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SCIENCE FICTION analog SCIENCE FACT

CHARLES SHEFFIELD
Between the Strokes of Night

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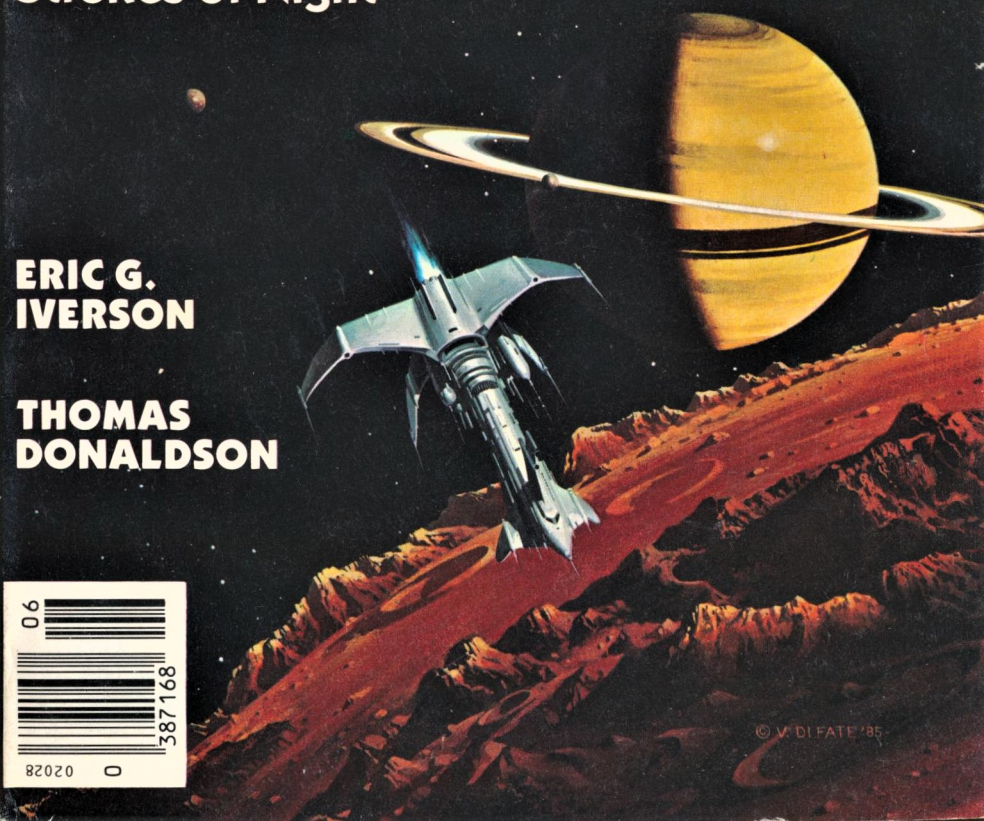

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Editorial

THE NEED TO BELIEVE

Stanley Schmidt

Back when I was working primarily as a physicist and freelancing stories and articles on the side, I found it annoying to hear editors and such riff-raff complaining that, "Scientists can't write." I thought I could, at least tolerably, and I'd found enough people who agreed with me to create something of a market for what I wrote. This seemed to me little more than the kind of literacy I could expect of any reasonably well educated adult, and it seemed to me that most of the scientists I knew were at least that. In fact, it seemed to me that most of them were a little more than that; they struck me, on the whole, as a pretty special group. I wanted to believe that, and I still do believe it, to some extent. But when I became an editor it gradually dawned on me that there was a good deal of truth in the old complaint: many scientists *can't* write very well (though there are some conspicuous exceptions, and some learn very quickly once they put their minds to it).

So my belief in scientists as a special group had to be readjusted a bit, to get a better fit to reality. It wasn't the first time it had happened, of course. When I was younger I had also wanted to be-

lieve that I could learn to use telepathy and telekinesis, that I might someday hobnob with a visitor from Epsilon Eridani, or that something like a Dean drive might someday take me to visit him. I understood, mind you, that *wanting* to believe does not entitle one to do so; so I wasn't prepared to believe that any of these things *was* possible without much more direct evidence than I'd seen. I knew they attracted lots of kooks and generated lots of nonsense—but I also knew many people had insisted space travel was nonsense just a very few years earlier, and now it was really happening. I had not seen anybody prove rigorously that those other things were *not* possible. My main hope that somebody might actually have a lead on any of them came from this magazine, which was the one place I saw them mentioned in a context of intelligent, critical thought. The magazine seldom, if ever, said flatly that So-and-So could do such-and-such, but it did on several occasions cite cases where it looked as if So-and-So *might* have something and couldn't get "Establishment scientists" to pay any attention. I wasn't quite sure how to reconcile this with my picture of scientists as objective, unprejudiced seekers after truth, for it seemed to me that if somebody *was* doing any of these things, that fact would be so important as to warrant prompt and thorough examination. I didn't want to believe scientists would be unwilling to consider something just because it was offbeat—but I would cheerfully have sacrificed a bit of my high regard for scientists-as-a-group in return for the ability to go to the stars.

Becoming editor has also given me a closer look at many of those would-be scientific revolutionaries, and I've become a lot more sympathetic to the "Establishment" scientists who hesitate to give them much time. I've read lots of letters and papers by unorthodox experimenters and theorists, and seen very little that could withstand much scrutiny. I have yet to see what I would consider solid proof that anybody can build a reactionless space drive or transmit information without using one of the known physical media—but neither have I seen solid proof that these things can *never* be done. Since there are people working in some of these areas who, though controversial, are serious and have earned at least some respect from some portion of the scientific community, I think it's reasonable to report on some of that work here, or to let the workers themselves do so.

I've done that a couple of times lately, and the resulting mail was both interesting and occasionally distressing. It included some quite vivid demonstrations that the people who buy supermarket tabloids are not the only ones who have become fixed in a particular belief and are not about to let any new facts interfere with it. That tendency afflicts people across the entire intellectual spectrum, and certain subjects seem especially likely to bring it out—at either end.

The more conspicuous examples from our recent pages are astrometeorology and parapsychology. To our readers' credit, I didn't hear from many who were prepared to accept uncritically

whatever they heard claimed for these fields. I did hear from many who applauded our willingness to give exposure to controversial work; I appreciate that because whether the claims made are tenable or not, I'd rather have them out in the open so we all remember not only what we think of them, but why. I also heard from some who attacked me for my gullibility in "believing in" these things, a charge which is (1) unfounded, (2) wrong, and (3) irrelevant. (My beliefs, as such, are of no consequence to anyone who doesn't have to put up with me every day. However, for the curious, I'll state now that I see a lot of room for improvement of methodology in these fields, but I haven't seen enough solid data to say flatly that the phenomena in question either do or don't exist. And now we can get back to business.) I got a *lot* of letters criticizing the methods and findings reported in those articles, and I welcome those just as I do the ones saying nice things about our printing the articles—but with one important qualification. A major *reason* for printing the articles is to open up the work reported to critical review from many quarters. Findings that are truly indefensible can be exposed as such and rejected for good cause. If others show potential but are questionable because of faulty methodology, such as experiments without proper controls or analyses that misuse statistics, criticism of the methods can lead to designing better experiments in the future. But *the fact that an experiment was not done as well as possible does* not *prove that its subject doesn't exist!*

A disturbing number of critical letters went far beyond what I can consider useful criticism. I saw letters claiming angrily that if there were really anything to parapsychology, it would have much more solid results to show because experiments have been going on for a hundred years or so. Well, a hundred years was not much in the development of, say, pre-Galilean physics; and if parapsychological phenomena exist at all, their study is at a stage much more comparable to that than, say, to modern electrodynamics. I saw letters ridiculing the use of statistics by parapsychological researchers—but many of the arguments hurled against them betrayed not only a misunderstanding of what the researchers had actually done, but a misunderstanding of statistics itself at least as serious as that being attributed to them. If you're going to attack somebody's methodology, it behooves you to make sure yours is at least as good as his. I saw letters saying, in essence, that since certain "respectable" scientists had found nothing conclusive in the results to date in these areas, there was no excuse for printing or reading anything new anyone else might have to say about them.

And *that* I find well nigh inexcusable, especially from a professional scientist. A good scientist needs to be both open-minded and critical—convinced by nothing less than solid evidence, but open to consideration of *all* evidence. It is one thing to demand rigor and responsibility of workers calling themselves scientists in any field, and to render frank, thoughtful criticism of

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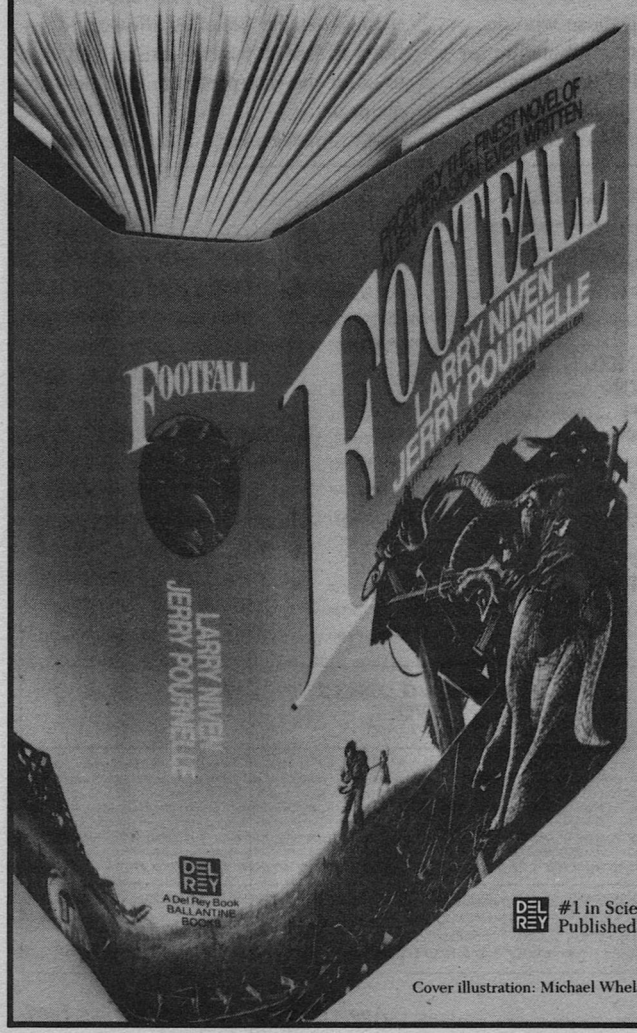

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their work. It is quite another to dismiss an entire field as *a priori* worthless, and incapable of generating data worthy of serious discussion. Any scientist has a right to decide that an area doesn't seem promising enough to spend his own research time on, but I'm far less convinced of the propriety of his ridiculing or casually dismissing those who do.

It seems that that combination of open-mindedness and critical judgment is a rarer commodity than I would like to believe, even among those for whom it is supposedly a cornerstone of their profession. So I must adjust my belief to observed facts—which is precisely what people at opposite poles of all these controversies seem to have trouble doing. It seems that in certain areas a great many people have a strong need to *believe* one way or another—so strong that the belief is allowed to solidify before all the facts are in, and then to color the interpretation of all subsequent data.

Astrometeorology and parapsychol-

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ogy are just two examples of such areas; there are plenty of others. The Fermi paradox, for example—available data are still pretty skimpy, but that hasn't prevented a lively discussion which often looks suspiciously like a running battle between scientists who are very determined to believe there *is* intelligent life on other planets and others no less determined to believe there *isn't*. For that matter, there's the question of intelligent life on *this* planet (other than the "obvious" example of ourselves). Critics accuse researchers trying to communicate with apes or dolphins of being so desperate to find nonhuman language ability that they'll see it whether it's there or not, while the critics themselves sometimes give the impression of feeling so threatened by the idea that they'll do anything to avoid admitting it as a possibility. A similar dichotomy often shows up in discussions of artificial intelligence. "Unidentified flying objects" have been a staple item of tabloid headlines for decades, selling papers, tantalizing the credulous, and amusing most scientists. The few scientists who have seriously studied the possibility that some UFO's may not have simple, mundane explanations have seldom been taken seriously by the bulk of the scientific community (even when they were working in more conventional fields). But does lack of general respect prove they are wrong, incompetent, or wasting their time?

I can only recall one UFO case (or group of related cases) of which I have any personal knowledge, and that one, like most (and quite possibly all) eventually turned out to have a fairly simple explanation. But it took a couple of years to establish that explanation, and what happened during those years was instructive to behold. Characteristic patterns of unusual lights were repeatedly watched for extended periods by hundreds of observers in a broad area north of New York City. Eventually it was established that they (or at least most of them) were a group of pranksters flying small Cessna airplanes in tight formation on calm nights—but that fact was not *known* until the planes were finally followed back to the rural airport from which they were operating and the pilots were identified and interviewed. Before that there were plenty of *conjectures*, but no definite information. Some of the conjectures were not terribly far from the truth (though no early ones that I recall were quite on it), but some were so ridiculous it was hard to believe persons in positions of authority would say them in print. "A single ultralight aircraft," for example, simply could not produce the effects seen, and whoever proposed that explanation could have checked its plausibility quite easily. (Yes, I saw the patterned lights, and as a pilot I have a fair amount of experience at estimating sizes, locations, and speeds of flying objects—and I have watched ultralights.) Yet many people cheerfully accepted that bit of glib nonsense who would never have considered the admittedly remote, but at that time more reasonable, possibility of an aircraft or spacecraft of unknown (and possibly quite foreign) design. The papers that amused themselves with cute re-

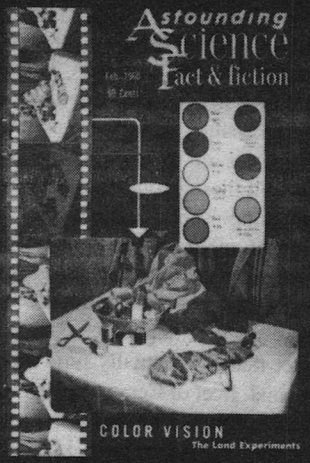
marks about "people who were oddly affected by the full moon" after a night of many sightings were nothing less than irresponsible. They were assuming, on the basis of no evidence whatsoever, that all these people had not really seen anything. Those who *saw*, and saw dozens of others seeing, knew perfectly well that they did see something — something every bit as solid and real as, say, a small fleet of Cessna 152s. The fact that it eventually turned out to *be* a small fleet of Cessna 152s is irrelevant to my point. What matters is that when nobody except the pilots knew that, people who *didn't* have any observational data were making smug (and wrong) judgments about those who *did*—and being taken more seriously. This is not good science, or even competent journalism.

I learned long ago that I must expect a certain segment of the population to be so eager to believe in things like telepathy and visiting spacefolk that they will do so, regardless of what evidence (if any) they confront. I find this a bit disturbing, of course, since these people help create the laws and social climate in which I must live; but I know there's not much I can do about it. I think I find it more disturbing that the compulsion to believe is so prevalent, even among scientists who are so appalled by such credulity that they react to it by going to the other extreme. *They* should know better. They have the training that should make them require full data *before* belief.

But perhaps I should not be too surprised. Under all their training most scientists are, after all, human. And while many humans find it easy to be either very open or very critical on a particular subject, it seems to take a very special outlook—and constant, conscious effort—to maintain a healthy balance between those two attitudes.

It isn't easy—but it is essential to real scientific progress. ■

MARCH 1933



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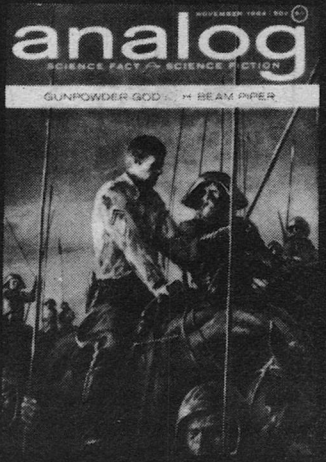

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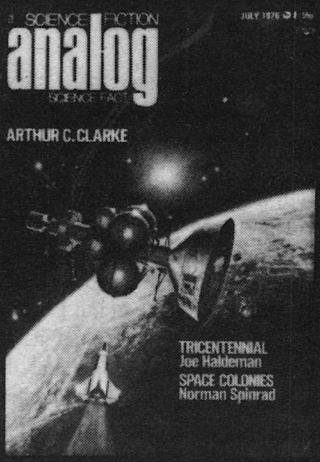

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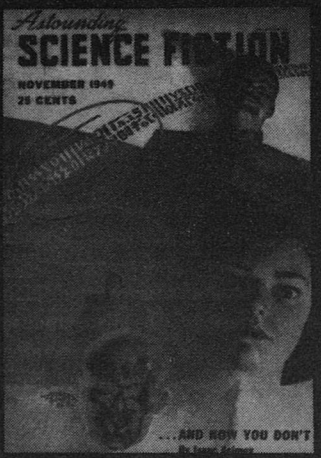

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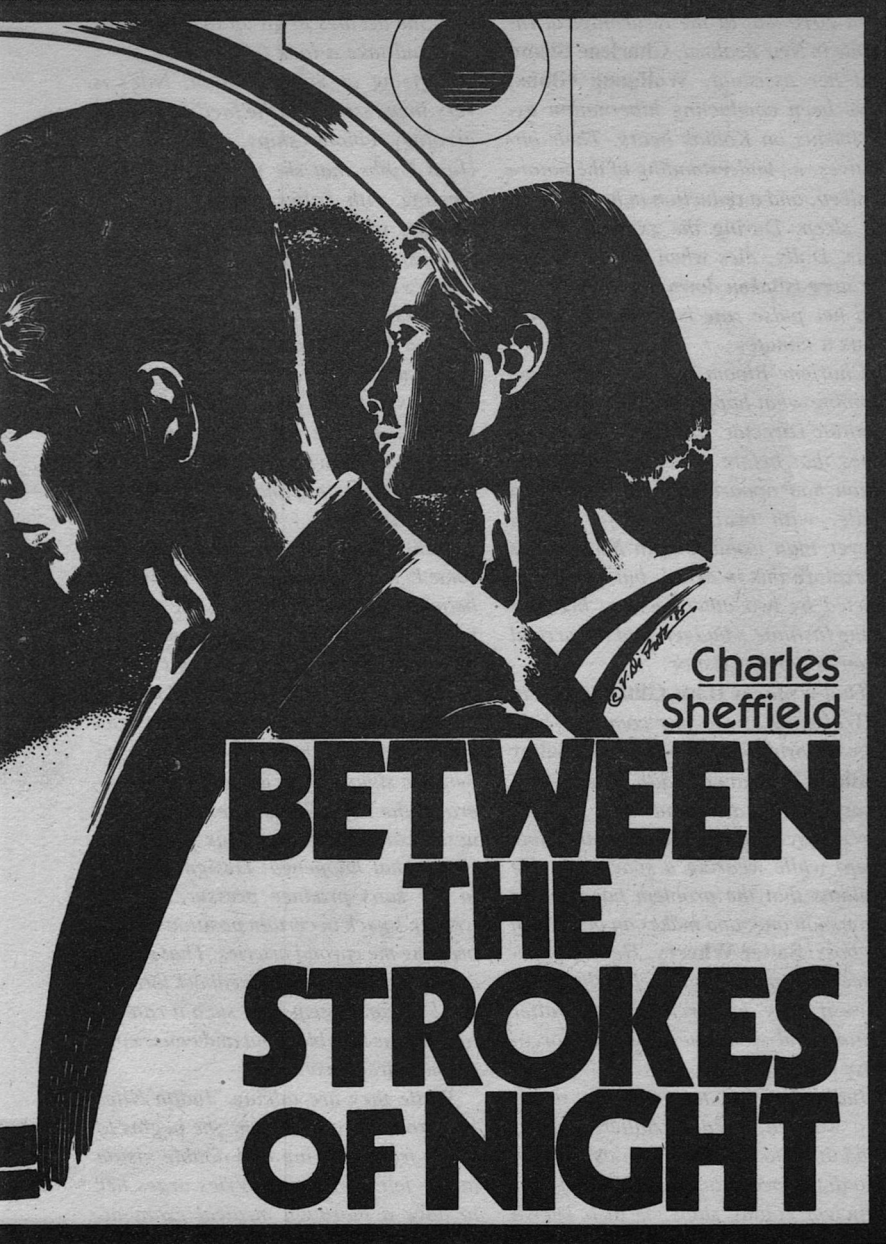

Charles Sheffield

BETWEEN THE STROKES OF NIGHT

SYNOPSIS

In 2010 A.D., at the Neurological Institute in New Zealand, **Charlene Bloom** *and her assistant,* **Wolfgang Gibbs,** *have been conducting hibernation experiments on Kodiak bears. Their objectives: an understanding of the nature of sleep, and a reduction in human need for sleep. During the experiment one bear, Dolly, dies when her body temperature is taken down near to freezing and her pulse rate is slowed to a few beats a minute.*

Charlene Bloom has the task of explaining what happened to Dolly to the Institute Director, **Judith Niles.** *Bloom notes that before Dolly died her condition had apparently stabilized for a while, with brain waves fifty times slower than usual. Judith Niles wants to explore this in detail, but she is distracted by two other factors: big cuts in the Institute's budget, and the arrival of an important visitor.*

That visitor is **Hans Gibbs** *(a cousin of Wolfgang), who has come for help from the orbital facility known as* **Salter Station.** *He shows Judith Niles a videotape of an astronaut who suffered narcolepsy (sudden and uncontrollable sleep) while wearing a space suit. He explains that the problem has become a common one, and makes an offer from his boss,* **Salter Wherry.** *He will guarantee increased funding for the Institute—if they will relocate to Salter Station and work there on the narcolepsy problem.*

Judith Niles is tempted. But she is also worried, because Salter Wherry, in addition to his reputation as the man who developed space industry and self-sufficient colony ships, is also known as a master manipulator of other people. She decides to go up to Salter Station and take a look for herself.

Arriving at Salter Station, Niles is very impressed with the facility and the arcology colony ships; but she tells Hans Gibbs that she wants a personal meeting with Salter Wherry. He is a recluse, who usually refuses meetings with strangers. However, to Hans Gibbs's surprise he agrees to meet with Judith Niles.

Wherry is old and frail, and has already survived several heart attacks. He explains to Judith Niles that he does not have much time left. The narcolepsy problem is slowing construction work on the arcologies, and he wants to see them finished.

Judith Niles suspects that Wherry has some hidden agenda of his own. But she believes that she already has the answer to the narcolepsy problem, and upon her return to Earth she performs an experiment to test her idea. With Wolfgang Gibbs as a volunteer in a spacesuit from Salter Station, they ask Wolfgang to perform simple tasks using the TV camera in the suit. Gibbs loses consciousness. Later, Niles explains to Jan de Vries what happened. Design changes in the suits produce pressure on the wearer's neck in certain positions, compressing the carotid arteries. That causes a momentary blackout. Feedback through the TV scan system is at such a rate as to continue that blackout and cause continued narcolepsy.

While they are talking, Judith Niles has problems of her own: she begins to suffer from blurring and double vision in her left eye. Jan de Vries urges her to have a thorough medical examina-

tion. After their discussion, Judith Niles makes the decision that the Institute should move up to Salter Station.

Meanwhile, Salter Wherry has been reviewing the international situation back on Earth. He sees new evidence of major upheavals, and he is alarmed enough to tell Hans Gibbs that operations must be speeded up. The Neurological Institute must move to space as soon as possible, and the arcology completion schedule must be advanced.

Wolfgang Gibbs is the first Institute staff member to move up to orbit. Once he is settled in he takes a Kodiak bear, Jinx, into a new hibernated condition. Again there is low temperature and slow pulse, but this time he manages to stabilize Jinx completely. The bear remains conscious even though its metabolic rate is down by a factor of eighty. Wolfgang is excited by the result of the experiment, but other factors reduce his pleasure: Judith Niles has had the medical tests that de Vries suggested, and they indicate a bad problem; and back on Earth, war now seems imminent.

Fast action is needed. Using every launch vehicle that Hans Gibbs can find, the staff of the Neurological Institute take off from Earth at the earliest opportunity. While they are actually on the way to Salter Station, the war that Salter Wherry had predicted and feared begins. The Station staff look on in horror as Earth-based missiles are launched in thousands toward their targets.

Salter Wherry comes to the control room to watch the holocaust down on Earth, but the strain of the event produces another heart attack. His doctor, **Olivia Ferranti,** *arrives to treat him, and realizes that he is dying. Salter Wherry knows it too. He tells Wolfgang Gibbs that Judith Niles must continue his work—the completion of the arcology colony ships. And he tells Wolfgang his real reason for wanting Judith Niles at the Station: he wants her to develop suspended animation methods for use on the arcologies.*

Meanwhile, Jan de Vries, on his way up from Earth, has more bad news. The medical tests showed that Judith Niles is suffering from a malignant brain tumor. Salter Station lacks the specialized facilities to treat her condition, and such facilities would take five years to develop there—but the tumor will kill Judith Niles in just a couple of months.

The only hope is to put Judith Niles into the same experimental hibernation state as Jinx. But even if that were to succeed, it seems to be a pointless effort. Earth is dying, from the thermonuclear war itself and its after-effects. There is no real future, for Judith Niles or for anyone else.

Year: 27698 A.D.

The year is 27698 A.D. On the planet Pentecost, in the Cassiopeia system, the Planetary Games have just concluded and the Planetfest winners are being announced. **Peron Turca** *stands with the other finalists, exhausted. They all know that the prize they are competing for is more than money or fame: the winners will proceed off-planet, where they may meet and work with the mysterious* **Immortals**—*beings who live in space, who can travel between the stars in days, and who return each generation to visit Pentecost.*

Peron is pleased (and amazed) to find that he placed third in the Games, be-

hind **Lum** *and* **Kallen.** *The fourth place winner,* **Elissa,** *grabs Peron and drags him away to celebrate their victory.*

The next day the Planetfest winners receive their first briefing for travel off the planet. They find that they are in for a tough time. The Fifty Worlds of the Cass System include some horrible places—desert worlds and jungle worlds. **Wilmer,** *a Planetfest winner who had been an oddity throughout the Games because of the ease with which he went through each trial, displays advance knowledge of some of the planets to be visited. And when Peron, Elissa, Lum, and Kallen meet and compare notes, they conclude that Wilmer is not a real contestant—he is a spy, there for some reason unknown to them. They wonder about other winners, too, particularly* **Sy Day,** *the fifth place winner, who has been a loner through the Games. But they conclude that Sy is a genuine competitor, though a strange and very talented one. The four agree that they will keep a close eye on all the other winners, to see if there are others like Wilmer.*

Leaving Pentecost, they have a brief view of The Ship, the great structure that supposedly carried their ancestors to Pentecost from Earth, many thousands of years ago. Then they travel on, to attempt a landing on the planet **Whirlygig.** *Peron lands first, and prepares things for the others who will join him—Kallen, Lum, Elissa, Sy, Rosanne, and Wilmer.*

Once all are on the surface, they proceed toward Whirlygig's polar region, to a habitable dome that they can use for a few hours rest. Peron and Elissa, traveling together, discuss the mysterious "S-space" that the Immortals use to move between the stars. Elissa tells the story she heard from a ship crew member, that the Immortals are actually machines from the legendary home planet, Earth, and that the Planetfest winners will somehow be used by them. She has also heard that the group on Whirlygig, except for Wilmer, was labeled as "troublemakers" by the Pentecost authorities.

Arriving at the pole, Peron and Elissa find that the others are struggling with a problem on the dome's airlock. They all work to operate it manually, and Rosanne prepares to enter. But Peron realizes there is still danger, and he moves to stop her. He pushes her safely out of the way, but is caught himself in an explosion of air from the defective lock. He is carried for many meters, bouncing across the rocky surface. When he regains his feet he is unharmed, but he finds that his suit's insulation is ruined. There is no spare suit and no way he can get back quickly to the ship. He is doomed to freeze to death.

At this point Wilmer takes charge. He tells Peron there is only one hope, and it is a long shot. Taking equipment from his carrying case, Wilmer gives Peron a series of injections. Peron loses consciousness.

When he wakes he is on a ship manned by Immortals. He meets Olivia Ferranti, who tells him that he is now an Immortal himself, and that they are in S-space. Peron feels very strange physically. He is astonished when Ferranti is able to make objects appear or disappear instantly, and to transport herself instantaneously from one place

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to another. He tries to do the same thing, with no success.

Peron seeks to explore the ship, but parts of it are barred to him. However, he is able to look out of a ship's port, and finds that the Universe outside is glowing and featureless, with no sign of stars, nebulae, or galaxies.

After a while he is summoned to see **Captain Rinker,** *who grumbles that the accident on Whirlygig has been a great inconvenience to the Immortals. Wilmer had taken an unauthorized action in saving Peron. Now, Peron and his companions are on the way to Sector Headquarters of the Immortals, for possible indoctrination. Rinker takes Peron to a Cold Sleep chamber and shows him his friends, all lying in sleep tanks, and says that they will stay that way until Headquarters is reached.*

Later, Peron has dinner with the crew, and they notice that there is a brief delay in the response to service commands—service is no longer instantaneous. This means that Rinker must proceed to N-space, to fix it, and Peron is sent back to his room while that is done.

However, he does not stay there. As quickly as possible he runs to Rinker's quarters, and arrives in time to see the captain go to the sleep chamber and enter a sleep tank. While Peron watches, Rinker instantly disappears. Peron goes to another tank, and finds that there are three control settings: C, N, and S. Peron believes that these must be Cold Sleep, S-space, and N-space, but he does not know what N-space might be. While he is looking at the tank, Rinker returns, looking exhausted, and Peron hides from him. Then he enters the tank himself and activates the N-space setting.

Peron wakes, still in the sleep tank —but now in free fall rather than in a gravitational field. He exits through a different door in the tank, and finds himself in a part of the ship he has never seen before. There are galleys and service facilities, where numerous small robots rumble along the corridors and disappear from sight through small hatches. Peron follows one of them—and finds himself back in the part of the ship he already knew. But now it feels very cold. All the crew members are there, and they are as motionless as statues.

Peron thinks he knows where he is, and what has been happening. He returns to the Cold Sleep tanks and revives his companions, bringing them to consciousness in N-space (which he has concluded is normal space). He explains to them that S-space is ordinary space, as perceived by someone whose sense of time has been tremendously slowed down. In S-space, human metabolism proceeds two thousand times as slowly. In a few S-space "days," humans can travel between the stars at sub-light speed. And it is the robots, living in N-space but obeying human voice commands from S-space, who provide the "instantaneous" service. As Peron points out, anyone living in S-space is vulnerable, because of the slowness of their reactions. Thus Peron and his companions can control the ship.

They force Olivia Ferranti to come to N-space for a negotiation with them. She explains the history of S-space development, which started with the space-based experiments in hibernation fol-

lowing the war that destroyed the civilizations of Earth. The big, slow colony ships had left before those experiments were complete, and over the centuries the outbound ships had lost contact. They had wandered through space, and finally established their own planetary colonies. Much later, exploring ships sent out from Earth, with their crew members in S-space, had found the colonies. However, direct contact had been a disaster. Therefore the S-space crews choose to approach the colonies as "Immortals," visiting infrequently and recruiting superior individuals from colony planets (such as Pentecost).

Olivia Ferranti returns to S-space, after proposing to Peron and the others that they should accept such indoctrination. When she has gone, they discuss that idea together. They decide that they have their own goals. Sy and Kallen want to gain scientific knowledge from the Immortals; Lum and Rosanne want to visit and explore other colonies; and Peron and Elissa want to go to Earth, which they believe must be the true headquarters of the Immortals.

They decide that they will negotiate again, and perhaps go to S-space—but only if they can do it on their own terms.

Chapter 23

Peron was drowsing when the alert sounded. For a couple of minutes he struggled against awakening, trying to merge the soft, blurred tones into the fabric of his dreams.

roomb . . . roomb . . . roomb . . . roomb . . .

He had been back on Pentecost, back when the idea of competition in the Planetfest had itself been like a dream. Twelve years old; the first tests, part of the State-wide evaluation of every adolescent. The blindfold maze was presented to them as no more than a game, something they could all enjoy. He had scrupulously obeyed the rules, mapping his path by ears alone, following the soft, purring will-o'-the-wisp tone of the muted bell.

It was seven more years before he understood the hidden purpose of the maze test. Sense of direction, yes. But more than that. Memory, courage, honesty, and a willingness to cooperate with other competitors when single talents could not provide a solution. It was *direct* preparation for Planetfest, though no one ever admitted it.

So how was Sy performing in the maze? That was a mystery. Sy was a loner. He didn't seek partners, even when the task looked impossible for a solo performer.

Peron, hauled back to full consciousness, realized that he had been confusing past and present. Sy was here, now, on the ship. When Peron took the maze test, he had never heard of Sy.

But it was still a good question. How *had* Sy found his way through the preliminaries for Planetfest? That was a puzzle to be filed away and addressed later. Meanwhile, that insistent tone was continuing, summoning Peron to action.

. . . roomb . . . roomb . . . roomb.

He sighed. So much for sleep. He had been trying to push the S-space sleep requirement down to its lower limit, to less than one hour in twenty-four. But he had been overdoing it. He stood up unsteadily, noticing that Elissa had already left their living quarters, and made his way to the central control chamber.

Olivia Ferranti was already there, gazing out of the port. Elissa and Sy were at her side, staring out into the formless sea of milky-white that sat outside the ship in S-space.

Except that it was no longer formless. Dark, complex shapes were there, drifting past the window. Peron saw a tracery of wispy rectangles, joined by braided lines of silver. Attendant on them, although not connected to them, were veined doublet wings like giant sycamore seeds.

Olivia Ferranti acknowledged Peron's arrival with no more than a brief nod.

"Remember what I told you when we were heading for Sector Headquarters?" she said. "I'm not sure you believed me. There's one of the reasons why Rinker didn't want you messing with his ship. Look at the power drain."

On the main console, every readout showed energy consumption up near the danger level. Peron glanced at the indicators for only a moment, then his attention was irresistibly drawn back to the shapes outside the port.

"What are they?" he said. "Are they taking our power?"

Olivia Ferranti was keying in a signal to the communications module. "They certainly are," she said. "That lattice shape is a Gossamere—one of the surprises of interstellar space. You'll never find one within a light year of a star. The strangest thing about them is that they're quite invisible in ordinary space, but so easy to see here in S-space." She indicated the screen to the left of the port where a frequency-shifted image was displayed, allowing them to see outside the ship at the wavelengths of normal visible radiation. It showed only the star field of deep space. Sol was the nearest star now, nearly three light years ahead and no more than a faint point of light.

"We don't know how the Gossamers do it," went on Ferranti. "But they maintain themselves at less than one degree absolute, well *below* cosmic background temperature, without emitting radiation at any frequency that we've been able to detect. And they suck up all the power that a ship can give out. If you didn't know that and were in charge of a ship, you could get into terrible trouble."

"But what *are* they?" repeated Peron. "I mean, are they intelligent?"

"We don't know," said Ferranti. "They certainly respond to stimuli. They seem to interpret signals we send them, and they stop the power drain on us as soon as they receive a suitable non-random message. Our best guess is that the Gossameres are not intelligent, they're no more than power collection and propulsion systems. But the Pipistrelles—those bat shapes that you can see alongside the Gossamere—they're another matter. They ride the galactic gravitational and magnetic fields, and they do it in complex ways. We've never managed a two-way exchange of information with them—they never emit—but they *act* smart. They really use the fields efficiently to make minimum time and energy movements. That could be some kind of advanced instinct, too, the way that a soaring bird will ride the thermals of an atmosphere. But watch them now. What does this mean? Are they saying goodbye? We've never been sure."

She had completed the signal sequence. After a brief delay, one of the Pipistrelles swooped in close toward the ship. There was a flutter of cambered wings, a dip to left and right, and a final surge of power drain on the meters. Then the panels and filaments of the Gossamere began to move farther off. The silver connecting lines shone brighter, while the whole assembly slowly faded. After a few minutes, the winged shapes of the Pipistrelles closed into a tighter formation and followed the Gossamere.

"We had ships drift helpless, with all power shut down for months, until we learned how to handle this," said Ferranti. "We even tried aggression, but nothing we did affected the Gossameres at all. Now we've learned how to live with them."

"Can you bring them back?" asked Sy.

"We've never found a way to do it. They appear at random. And we encounter them far less often now than when our ships first went out. We think that the 'power plant failure' on *Helena* when the arcologies first set out was probably an encounter with a Gossamere. When the colonists turned off the plant to repair it, they couldn't find anything wrong. That's typical of a Gossamere power drain. They certainly don't seem to *need* our energy, but they like it. The science group in the Jade sector headquarters argue that we're a treat for the Pipistrelles, a compact energy source when they are used to a very dilute one. We're like candy to them, and maybe they've learned that too much candy isn't a good thing."

She switched off the display screen and rose from her seat at the port. "Stay here if you like, and play with the com link. Maybe you can find a way to lure them back. That would certainly please our exobiologists and communications people. I wanted you all to see this, and absorb my message: you can't learn all about the Universe crouching in close by a star. You have to know what's going on out in deep space."

"What else *is* going on?" asked Elissa. She was still peering out into the milky depths of S-space, watching as the final traces of the Pipistrelles slowly faded from sight.

"Here?" said Ferranti. "Nothing much. On the other hand, we're not in deep space. Sol is less than three light years from here—we'll be there in less than a week. Now, if we were in *deep* space, with no star closer than ten light years . . ."

Olivia Ferranti stopped abruptly. She had seemed about to say more, but thought better of it. With a nod at the others, she turned and left the control room.

"So what do you make of *that?*" said Elissa.

Sy merely shook his head and offered no comment.

"She's telling us there are more surprises on the way," said Peron. "I like Olivia, and I think she's doing her best for us. She knows there are still things she's not supposed to reveal to us, so she gives us hints and lets us work on them for ourselves. That was another one—but I don't know how to interpret it. Damn it, though, I wish the others were here. I'd like Kallen's comments on the Gossameres. Do you think we

made a bad mistake, splitting up like that?''

Peron had been asking himself and the other two that question ever since they left Sector Headquarters. It had seemed like a small thing at the time. Given their experiences after they left Whirlygig, the briefings from the Immortals had been boring rather than thrilling. They had learned about S-space for themselves, the hard way, and what should have come as revelations came merely as confirmation of known facts. The personnel at Sector Headquarters were minimal, little more than a communications and administrative group, and almost all the information was provided through education robots and computer courses—neither of which had been programmed with interest as a dominant factor. As Rosanne had put it after a long and tedious series of humorless computer warnings about the physiological dangers of frequent movements to and from S-space: ''You mean they had to bring us a whole light year for *this?* Maybe when you're an Immortal you don't live longer—it just *seems* longer.''

One of their negotiated conditions with Captain Rinker for return of ship control to him had been a freedom to travel after their training and indoctrination. At first he had indignantly refused to consider such a thing. Unprecedented! He at last grudgingly agreed, after Kallen had sent several thousand service robots to Rinker's living quarters. They cluttered up every available square foot of space, moved randomly about, refused to obey any of Rinker's orders, and made eating, walking, or even sleeping impossible.

When the indoctrination was finally over, each of them was bored and restless. And when they learned that two ships would be arriving at Sector Headquarters within one S-space day of each other, one bound for Earth directly, and the other proceeding there via Paradise, they had split into two groups. Kallen wanted to visit the investigating group of Immortals orbiting Paradise, while Lum and Rosanne were curious to take a trip down to the surface of the planet itself. The computer had contained a brief description of events that led to the extinction of the colony on Paradise, but as Lum had pointed out, that stark recitation of facts was unsatisfying. A healthy, thriving population of over a million humans had died in a few days, with no written or natural record to show how or why. If it could happen so easily on Paradise, why couldn't it happen on Pentecost, or anywhere else?

Since the whole detour would amount to no more than a week of S-space travel, Elissa, Peron, and Sy had taken the ship directly to Sol. Kallen, Rosanne, and Lum went to Paradise. And as Lum had cheerfully pointed out as they were leaving, they would never be more than an S-day apart through radio communications. They could talk to each other any time. Except that their ship's equipment seemed to be in continuous higher-priority use. . . .

Now, Peron at least was regretting their decision to separate. And Sy was looking unusually thoughtful and withdrawn, even for him.

''Perhaps I have everything backwards,'' he said at last. ''When I said that I wanted to visit the galactic center, I assumed that it would be the place to

find new mysteries. Maybe not. Perhaps the true unknown is elsewhere. Should I be looking at nothing, at the regions *between* the galaxies?''

He stood up abruptly and followed Olivia Ferranti out of the control chamber, leaving Peron and Elissa looking at each other uncertainly.

''More questions,'' said Elissa.

''I know. And nobody willing to provide us with answers. I'll tell you the biggest mystery of all. The society of Immortals has a complicated structure. They have the network of ships linking all the inhabited worlds, they have an elaborate recruiting system to bring people like us into S-space, and they have definite rules for encounters with other societies—even human ones. Lord knows what they'd do if they met aliens who were obviously intelligent and lived close to stars. But with all that, we never seem to get any closer to the Immortals who are in charge of the whole organization.''

''Maybe their society doesn't operate like that—perhaps it's a true democracy.''

''I don't believe it.'' Peron leaned across and put his arm around Elissa's shoulders. ''Just think about it for a minute. *Somebody* has to develop rules and procedures. Somebody has to monitor them. Somebody has to arrange for food supplies, and energy, and travel, and construction. You have to have leaders. Without that you don't have democracy—you have anarchy, and complete chaos. Where is their *Government?*''

Elissa was absently rubbing the back of Peron's right hand as it lay across her shoulder. ''Didn't we conclude that it's on Earth, or at least in orbit somewhere in the Sol system?''

''We did. But I don't believe it any more. I told Olivia Ferranti that we want to meet the leaders of the Immortals. She won't talk about that, but she insists we'll really enjoy the visit to Earth. How could she possibly say that, if we might be heading for a confrontation there?''

Elissa shook her head. She did not speak, and after a couple of minutes moved out of Peron's embrace and quietly left the control cabin.

Peron was left alone, gloomily staring out into the pearly blankness of the S-space sky. It felt like only weeks since he was walking through the sticky marshes of Glug, or contemplating the dangers of a landing on Whirlygig. To him, and to Sy and Elissa, it *was* weeks.

But back on Pentecost, new generations of contestants had won and lost at Planetfest. By now, Peron's name, along with Kallen, Lum, and the others, was no more than a footnote in an ancient record book. And Wilmer, or some newly trained Immortal, would be down on the planet's surface, observing the new contestants and reporting back on their behavior.

And everyone they had known on Pentecost, except for Wilmer, was now long dead. Peron wondered about the great centuries-long project to reclaim the southern marshes of Turcanta Province. Was that finished now, with real-life agricultural developments replacing the artists' futuristic drawings that had illustrated a geography lesson when he was back in school? And what other planet-shaping projects had been developed since then?

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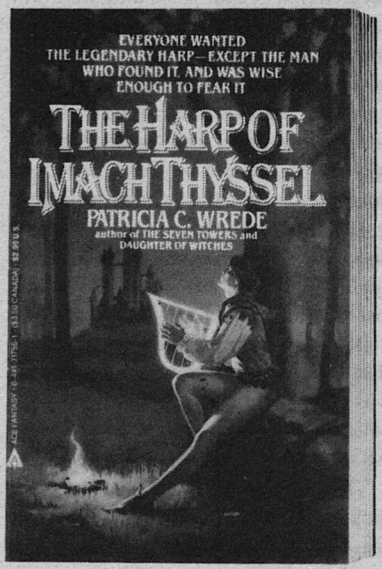

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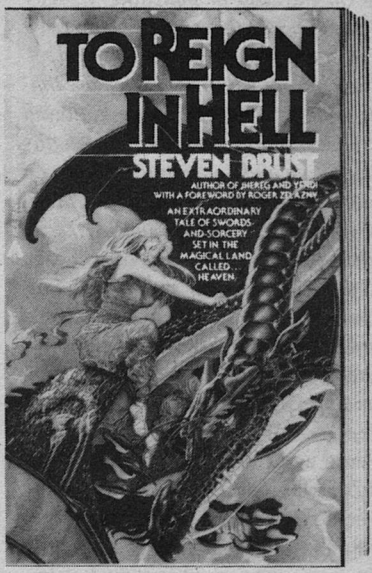


ACE FANTASY

He and Elissa had talked of their decision, and there were no regrets. With what they had learned, there could have been no turning back to a planet-bound "normal" life on Pentecost. The idea of visiting Earth had filled them all with energy and enthusiasm; and he and Elissa were ridiculously happy together. And yet . . .

Peron had a premonition of other travels and troubles ahead, before the true secret of the Immortals was revealed.

Chapter 24

Deceleration: procedures, Part I.

The deceleration phase of an interstellar journey is normally passed in cold sleep. While the human passengers are unconscious, on-board computers perform the task of matching velocity and position with the target. They awaken the sleepers only upon final arrival.

The alternatives to cold sleep are limited: a move to normal space, followed by full consciousness during lengthy deceleration and final maneuvers; or an immobilized and dizzying ride in S-space. Neither is recommended. . . .

Without discussion, Sy had chosen cold sleep during their approach to Sol. He was planning on using suspended animation techniques extensively in his future travels, and he was keen to gain more experience with it as soon as possible.

Peron and Elissa had far more difficulty making a decision. After dreaming for so long of a return to Sol and to Earth, the idea that they would close their eyes, then suddenly find themselves *there,* was not at all attractive. It missed the whole point of the trip. Earth was a legend, and every experience connected with it should be savored. They had studied the Solar System during the journey from Sector Headquarters, and now they wanted to witness the whole approach. But that meant over a month of subjective travel time during deceleration, or a nauseating hour of slowing and orbit adjustment, tightly strapped in and unable to move a muscle. . . .

They had discussed it over and over, and at last made their decision. Now they lay side by side, tightly cocooned in restraining nets. As a special favor, Olivia Ferranti had placed screen displays so that Peron and Elissa would have frequency-adjusted views both ahead of and behind the ship as it neared Sol. They had entered the nets before deceleration began, when they were still nearly fifty billion kilometers from Sol and the Sun was nothing more than an exceptionally bright star on the displays.

At first, they both felt all their studies would be wasted. The Sun had grown steadily bigger and more brilliant, gyrating across the sky as their trajectory responded to the System-wide navigation control system. But it looked disappointingly like any other star. In the last five minutes of travel, they caught a glimpse of Saturn, and had one snapshot look at the ring structure—but it was a long way off, and there was little detail to be seen of surface or satellites. All the other planets remained invisible.

They could not talk to each other, but they independently decided that the nausea and discomfort were definitely not worth it. Until, quite suddenly, Earth showed in the screen off to one side. The planet rapidly swung to loom di-

rectly ahead for the last stages of their approach.

And their sufferings were suddenly of no consequence.

They had been conditioned by the ship's stored viewing tapes to expect a blue-green clouded marble and attendant moon, hanging isolated in space. Instead, the whole sphere of Earth shone girdled by a necklace of bright points of light, whirling around the central orb like an electron cloud about the central nucleus. There were so many of them that they created the illusion of a bright, continuous cloud, a glittering halo about the planet's equator. As they watched, smaller units darted like fireflies between Earth and the orbiting structures.

Space stations. They were at all heights, some almost grazing the atmosphere, an entire dense ring at synchronous altitude, others wandering out beyond the Moon. And to be visible from this distance, many of them must be kilometers across. Peron and Elissa were looking at the result of twenty-five thousand years of continuous development of Earth orbit. The asteroid moving and mining operations that began at the dawn of Earth's space age had yielded a rich harvest.

Before Peron and Elissa had more than a minute or two to absorb the scene, they were homing in on one of the larger structures. It was in synchronous orbit, hovering above a great land mass shaped like a broad arrow head. A shining filament extended downward from the station toward Earth, finally to vanish from sight within the atmosphere.

Their final approach was compressed to a few S-seconds of blurred motion, twisting a way in through a moving labyrinth of other spacecraft and connecting cables and tunnels. All at once they were docked, and the ship motionless. They were trying to release themselves from the cocoons when a man materialized in the cabin and stood looking down at them.

He was short, pudgy, gray-haired, and precisely dressed, with elaborate jewelled rings on most of his fingers. He wore a flower in his lapel—the first blossom of any kind that they had seen since they left Pentecost. The stern look on his face was contradicted by a pattern of laughter lines around his button-bright eyes and small mouth.

"Well," he said briskly, after a thorough inspection of Peron and Elissa. "You look normal enough. I've been waiting for your arrival with some interest. Neither of you appears to be quite the degenerate monster that sector reports suggest, and Olivia Ferranti speaks well of you. So let us proceed on the basis of that assumption. *Command: Remove the cocoons.*"

The restraining nets vanished, and the little man calmly extended a hand to help Elissa to her feet.

"My name is Jan de Vries," he said. "It is my melancholy duty to approve—or veto—all trips to and from Earth by certain persons living in S-space. You *do* still wish to visit Earth, I suppose, as you had requested?"

"Of course we do," said Elissa. "Will you be going down there with us?"

De Vries looked pained. "Hardly. My dear young lady, my duties are various and sometimes odd, but they have not to date included the function of tour guide. I can, however, dispose of cer-

tain formalities for you that would normally be handled otherwise. When were you last in normal space?''

''Not since we were on the way to Sector Headquarters,'' said Peron. He was becoming increasingly uneasy. He had been preparing himself for a great clash with the secret rulers of the Immortals, and instead here he was chatting with some apparent bureaucrat.

''Very good,'' said de Vries. ''Then you can be prepared at once for your visit to Earth. By the way, you will find that the robot services ignore your commands until we have your voice patterns keyed into the station's computer. This is part of a larger data transfer. It will be complete upon your return here, and we will talk again then. But for the moment you will need my assistance. *Command: Prepare them for the standard Earth visit.*''

''But we don't—'' Peron stopped. De Vries had disappeared. Then the walls spun about Peron and he caught a glimpse of a long corridor. As the scene steadied again he felt a sharp pain in his thigh. Suddenly it was as though he were back on Whirlygig, experiencing that familiar and disquieting fall into blackness.

His last thought was an angry one. *It wouldn't happen again, he had sworn it—but it was happening now! Things were out of control. And he had no idea what came next.*

Peron and Elissa emerged from the suspense tanks together, into a room filled with a noisy, excited crowd. They knew at once that they were again in normal space—S-space couldn't offer the sharpness of vision or the bright colors. There was an exhilarating taste to the air, and a feeling of well-being running through their veins. They looked around them curiously.

A loud, metallic voice was booming out directions. ''Single file into the cars, please. Take your seats, and don't overload them—there will be another one along every ten minutes.''

The crowd took little notice, pushing and surging forward down a long broad hall toward a loading area.

''Peron!'' Elissa reached out and grabbed hold of his arm. ''Keep a grip. We don't want to be separated now.''

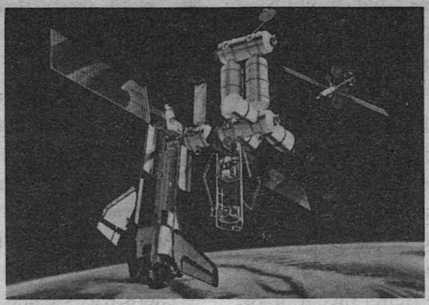
It was like being in a river and swept along by the current. With no effort on their part, they found themselves carried forward into a semi-circular chamber, and seated on soft benches covered with a warm velvety material. On either side people were grinning at them and staring out of the half-circle of the ports.

''Look down!'' said a woman next to Elissa. Her accent had peculiar vowel sounds to it but it was easy to understand. ''It'll give you the shivers. No wonder it's called Skydown.''

Elissa followed the other's gesture, and found that the floor beneath their feet was transparent. She was looking directly down toward Earth, following the line of a giant silvery cylinder. As she watched, the doors of the chamber closed and they began a smooth, accelerated descent, their car riding an invisible path along the side of the cylinder.

''Peron.'' Elissa leaned close to him so that he could hear her above the clamor. ''What's going on here? Look at them. They're like the mob at the end of Planetfest. And where are we going?''

Peron shook his head. ''It's our own



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fault. I realized it as soon as we came out of the tanks there—we should have known we're no different from anyone else. Don't you see? *Everybody* from the planet colonies and arcologies has been told about Earth since they were small children. They all want to visit. No wonder de Vries was amazed when you asked if he was coming with us—I bet people who live in the Sol system get tired of explaining things to the simple-minded visitors. Better face it, love, we're just part of the tourist crowd."

Elissa looked around her at the restless, exuberant travelers. "You're right—but they're all having fun. You know what? I feel wonderful. I'm going to postpone solving the mysteries of the universe until we get back into orbit." She grabbed Peron's arm and pulled him closer. "Come on, misery. Let's get into the spirit of it. Remember, a week down on Earth will only be five minutes in S-space—they won't even notice that we've gone."

They bent forward to look down through the floor. Although the cylinder was rushing past them as one continuous blur of motion, Earth was not perceptibly closer. It hung beneath them, a glittering white ball blocking out over fifteen degrees of the sky.

"I wonder how long the journey will be," said Elissa. She reached out to the miniature information outlet built into the arm of her seat, and switched it on. "Speed, please, and arrival time."

"Present speed, forty-four hundred kilometers an hour," said a cheerful voice. The vocal reply system had been chosen with as pleasant and soothing a tone as possible. "Arrival will be three hours and forty-one minutes from now. We are still in the acceleration phase. We have thirty-three thousand four hundred kilometers to go to touchdown."

"Where will we land?"

"Half a degree south of the equator, on one of the major continents."

Peron was still staring down at the globe beneath them. "This doesn't look the way I expected it to—it's too bright. Why so much cloud cover?"

There was silence for a split second, as the on-board computer called back up to the synchronous station above them for assistance with the answer. "There is less cloud cover than usual today. You are probably mistaking snow cover for cloud cover."

"But that would mean there's snow over two-thirds of the surface!"

"Correct." Again the machine hesitated. "That is not unusual."

"Earth was not snow-covered in the old days—is this a consequence of the old war?"

"Not at all. It is a result of reduced solar activity." The information system hesitated for a moment, then went on: "The amount of received radiation from the Sun has declined by half a percent over the past fifteen thousand years. The increased glaciation is apparent even from this distance. It is predicted that this Ice Age will persist for at least ten thousand more years, to be followed by an unusually warm period. Within fifteen thousand years there will be partial melting of the polar ice caps, and submergence of most coastal lands."

Elissa reached out and switched off the set. She looked at Peron. "You don't mind, do you? I had the feeling it was just getting into its stride. I hate

being burbled at—whoever programmed that sequence needs brevity lessons from Kallen."

Peron nodded his agreement. The view below was enough for their full attention. From the poles almost to the tropics, blue-white shining glaciers coated the land areas. The old outline of the larger land masses was unchanged. Soon Peron could see where the Skyhook was tethered. It met the surface on the west coast of the continent that had been known as Africa. They were descending rapidly toward that touchdown point, a couple of hundred kilometers from the place where the region's mightiest river flowed to the Atlantic Ocean.

"We ought to decide what we really want to see," said Elissa. "If we have a choice, I don't care to travel around in the middle of a mob of sight-seers."

"So let's see what the options are. Can you stand to have the information service on again for a couple of minutes?"

He touched the switch and spoke into the tiny microphone.

"Will we be free to move as we choose when we reach the surface?"

"Of course." The cheerful but impersonal voice answered at once. "There will be air and ground vehicles at your disposal, and personal information systems to go with you and answer any questions. Your account will automatically be charged for services."

Elissa looked at Peron. To their knowledge, they had no credit account of any kind. They might have to fight that one with Jan de Vries when they returned from Earth.

"Do you have a site selected?" went on the service computer. "If so, we can schedule something to be available at once upon touchdown."

"Wait a minute." Peron turned away from the microphone. "Elissa? Let's get away from everybody for a while. Maybe we'll take a look at one typical Earth city, then let's see some wild country."

At her nod, Peron relayed their request to the machine. There was the longest silence so far.

"I am sorry," said the voice at last. "We cannot grant your request."

"It is not permitted?" said Elissa.

"It would be permitted. But the environment you describe no longer exists."

Elissa showed her astonishment. "You mean—there is no natural country left, anywhere on Earth?"

"No," said the voice. Peron imagined he could hear an element of surprise in the overall joviality of the machine's tones. "There is natural country, plenty of it. But there are no towns or cities on Earth."

Chapter 25: Earth

The steady march of the glaciers had been more effective in the Northern Hemisphere. In Africa, Australia, and South America, the great oceans had moderated temperatures and checked the spread from polar regions. Occasional snow-free pockets could be found as far as forty degrees south of the equator. But in the North, the glaciers ruled everywhere past latitude thirty-five.

Even at Skydown the temperature was chilly. Peron and Elissa emerged from the cable car at the foot of the Beanstalk to bright sunshine and clear

skies, but they stood in a blustery east wind that encouraged warm clothing. While most of the visitors headed for a briefing on the sights of Earth, the two took an aircar and flew north.

They spent the first evening on the lush southern shore of the Mediterranean Sea near the ancient site of Tripoli. The information service computer informed them that they had reached the border for true forest land. Farther north, in what had once been Europe, only stunted stands of spruce and juniper persisted, clinging to south-facing slopes.

Night came quickly, sweeping in with a scented darkness across the white sandy beach. The aircar contained two bunks, but they were on opposite sides of the cabin. Peron and Elissa chose to sleep outside, protected by automatic sensors and the car's warning system. Holding each other close beneath a moonless sky, they watched the wheel of unfamiliar constellations. Against that slow-moving backdrop the space stations swept contantly overhead, one or more of them always visible. Sleep would not come easily. They whispered for a long time, of Pentecost, Planetfest, and Whirlygig, and of the accident to Peron that had plunged them across light years and centuries.

The night was full of unfamiliar sounds. There was wind rustling in tall trees, and the steady beat of waves on the seashore. Somewhere to the south a group of animals called to each other, their voices tantalizingly familiar, like humans sobbing and crying out in some foreign tongue. When Peron at last fell asleep, it was to unpleasant dreams. The voices called to him still through the night, but now he imagined he could understand their lamenting message.

Your visit to Earth is a delusion. You are hiding from the truth, trying to put off unpleasant actions. But they cannot be put aside. You must return to S-space . . . and go further yet.

The next morning they took to the air again and headed north and east into Asia. Two days' travel convinced Peron and Elissa of two things. Apart from the general location of the land masses, Earth bore no resemblance to the fabled planet described in the old records of Pentecost and the library records on the ship. And there was no chance that they would choose to live on Earth, even if it were to be colonized again in the near future. Pentecost was more beautiful in every way.

They left the information service on all the time. It described a link between the old, fertile Earth of legend and the present wilderness.

The post-nuclear winter had been the first cause of the trouble. It was far more influential as an agent of change than the Ice Age that now held Earth in a frozen grasp. Immediately after the thermonuclear explosions, temperatures below the thick clouds of radioactive dust dropped drastically. Plants and animals that fought for survival in the sunless gloom of the surface did so in a poisoned environment that forced rapid mutation or extinction.

In the air, the birds could not find enough food over the land. A few remaining species skimmed the surface of the tropical seas, competing with sea mammals for the diminished supply of fish. Their high energy need killed them. The last flying bird on Earth fell

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from the skies within two years of the thermonuclear blast that obliterated Washington. The penguins alone lived on, moving north from the Antarctic to inhabit the coastlines of South America and Africa. Small colonies of emperor penguins still clung to the shores of the Java Sea and Indonesia.

The larger surface animals—including all surviving members of *homo sapiens*—were early victims. Long life spans permitted the build-up of lethal doses of radiation in body tissues. The small burrowers, driven deep underground to live on deep-lying roots and tubers, fared much better.

One circumstance had assisted their survival. The hour of Armageddon came close to the winter solstice in the northern hemisphere, at a time when many animals were fat for the winter and preparing for hibernation. They had burrowed deeper and settled in for the hibernal sleep. The ones too far north had never awakened. Others, returning to consciousness in a cold, dark spring, foraged far and wide for food. The lucky ones moved steadily south, to the zone where a pale, sickly sunlight still permitted some plant growth. Of all Earth's land mammals, only a few small rodents—mice, hamsters, ground squirrels, marmots, and woodchucks—lived on to inherit the Earth.

The competition had been formidable. The invertebrates were fighting for their own survival. Insect life dwindled at first, then adapted, mutated, grew, and multiplied. They had always dominated the tropical regions of Earth; now the larger ants and spiders, aided by their formidable mandibles and stings, strove to become the lords of creation.

The mammals took the only paths left to them. The invertebrates were limited in maximum size because of passive breathing mechanisms and their lack of an internal skeleton; and they were cold-blooded. The rodents grew in size to improve their heat retention, developed thick coats and hairy paws, and moved away from the equator to regions where there was no insect competition. Some of them were totally vegetarian, browsing on the sparse, chlorotic plant life that still grew in the dust-filtered twilight. They developed thick layers of blubber, for food storage and insulation. The other survivors became super-efficient predators, preying on their herbivorous relatives.

As the nuclear winter slowly ended the insects moved north and south again, away from the tropics. But the mutated mice and woodchucks were ready for them. They had increased in size and ferocity, to become a match for any pre-civilization wolf; and now they wore thick coats of fur and protective fat that rendered impotent the fierce mandibles and poison stings. The insects were a new convenient source of protein. The carnivores followed them back into their tropic habitats, and on to the southern regions.

The changes to animal life on Earth were easiest to see; but the changes to the vegetation were in some ways more fundamental. The grasses were gone; in their place a dwarf form of eucalyptus covered millions of square kilometers with flat, bluish-green leaves. Waving fields of corn and wheat would never be seen again on Earth. Their nourishing seeds had been replaced by the red clusters of berries that hung from every eu-

calypt stem. After being assured that it was safe to do so, Elissa sampled a couple. They were filled with a fatty syrup, and at their center sat an oval, impenetrable seed. The seeds, berries, and roots of the eucalypts sustained a thriving animal community beneath the foothigh canopy of their leaves, where in the blue-green gloom devolved mice fought finger-long giant ants for the best food and living space.

As they traveled on across the natural face of an Earth where no vestige of human works remained, Peron became gradually more silent and withdrawn. Elissa assumed that it was a reaction to their surroundings. She was reluctant to interfere with his thoughts. But as they skirted the barren western seaboard of South America, where the continuous line of glaciers stretched down to the Pacific, Peron's need to discuss his worries became overwhelming.

They had landed in the Andean foothills to watch sunset over the Pacific. Neither spoke as the broad face of Sol, red in the evening twilight, sank steadily past a thin line of clouds far out over the western ocean. Even after the last of the light had faded, they could turn to the east and see the sun's rays still caught by the summits of high, snow-covered peaks.

"We can't stay here," said Peron at last. "Even if we liked it better here than on Pentecost, even if we thought Earth was perfect, we'd have to go back—to S-space."

Elissa remained silent. She knew Peron. He had to be allowed the time to work his way into a subject, without pressure and with minimal coaxing. That was the way that he had first managed to speak to her of their own relationship—and the way that she had finally learned of his continued doubts over leaving his family to take part in Planetfest.

The last of the light vanished, leaving them sitting side by side on the soft earth next to the aircar. Stars were appearing, one by one, twinkling brightly in the crisp night air.

"We've had a great time here," Peron went on at last. "But for the past two days I've had trouble getting a thought out of my head. Remember the colony of mouse-monkeys, the black ones with the fat tails?"

Elissa squeezed his hand without speaking.

"You asked me how the head of the colony could control the others so easily," he continued. "He didn't seem to fight them, or bully them, or try to dominate them at all. But they climbed the trees, and brought him food, and groomed him, and he didn't even have to move to live in comfort. Well, for some reason that reminded me of something my father said to me when I was only ten years old. He asked me, who controlled Pentecost? He said that was the third most important question to answer in a society, and the most important ones were, *how* did they control, and *why* did they control? If you knew all three, masters, mechanisms, and motives, you were in a position to make changes."

"Did he ever tell you the answers?"

"No. He never knew them. He spent his life looking. The answers were not on Pentecost—we know now that the true controllers of Pentecost are the Immortals, with the cooperation of a nerv-

ous planetary government. They control through superior knowledge, and they use the planet—so they say—as a source of new Immortals. Those ideas were beyond my father's imaginings. But he was right about the important questions."

Elissa stirred at his side. She was lightly dressed, and the air was cold on her bare arms, but she was reluctant to suggest a move.

"I finally tried to ask the important questions myself," said Peron at last. "Not about Pentecost—about the Immortals themselves. They have a well-developed society. But who runs it? How, and most of all *why?* At first I thought we had the answer to the first question: the Immortals were run from The Ship. As soon as I was in S-space, I found that wasn't true. Then I thought we would have the answer at Sector Headquarters. But we learned that was false—headquarters is nothing but an administrative center with a switching station and cargo pickup point for traveling starships. So what next? We decided control had to be back at Sol, and we came here. But we have no more answers. Who runs the show in the Sol system? Not Jan de Vries, I'll bet my life on it. He's a good follower, but he's not a leader. And even if we find out *who*, that still leaves how and why."

"So what do you want to do?"

"I don't know. Look harder, I suppose. Elissa, we've been on Earth for nearly five days now. How do you feel?"

"Physically? I feel absolutely wonderful. Don't you?"

"I do. Do you know why?"

"I've wondered. I think maybe part of the reason is our ancestry. We come from millions of years of adaptation to Earth as the natural environment —gravity, air pressure, sunlight. We *ought* to feel good here."

"I know all that. But Elissa, I think there's another reason. I think everything is relative, and we had spent over a month in S-space before we came here. I'll tell you my theory, and it's one that makes me uncomfortable. I think that S-space isn't right for humans, in ways that we haven't been told yet."

"Even though we will live many times as long there? I don't just mean long in S-time, I mean live *subjectively* longer. Doesn't that suggest S-space is good for our bodies?"

Peron sighed. Elissa didn't know it, but she was presenting arguments to him that he had wrestled with for days, and found no satisfactory answers.

"It looks that way. It seems so logical: we live longer there, so it must be good for us. But I don't believe it. Think of the way you *feel*. S-space didn't give you the same sense of vitality. Think of our love-making. Wasn't it wonderful on Pentecost, and hasn't it been even better in the last few days on Earth?"

Elissa reached out and ran her fingers gently up Peron's thigh. "You know the answer to that without asking. Be careful now, or you'll give me ideas."

He placed his hand gently over hers, but his voice remained thoughtful and unhappy. "So you agree, some things just don't feel right in S-space. We've known that, deep inside, but I assumed it was all part of the adjustment process. Now I feel just as sure that's not the case. And everybody who has lived in

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S-space for any length of time must know it, too."

Peron rose slowly to his feet. Elissa followed suit, and they both stood there for a few moments, shivering in the seaward nightwind sweeping off the snowy eastern peaks.

"Suppose you're right," said Elissa. "And you have me fairly well persuaded. What can we do about it?"

Peron hugged her close to him, sharing their warmth. But when he spoke his voice was as cold as the wind. "Love, I'm tired of being manipulated. I'm tired of blind guesswork. We must go back to orbit now. We must stop allowing ourselves to be fobbed off with sweet reasonableness and bland answers, from Olivia, or Jan de Vries, or anyone else. And we have to push as hard as we can for the *real* answers about S-space civilization: *who, how, and why.*"

Chapter 26

At Elissa's insistence, they set a meeting with Sy as their first priority on returning to orbit and to S-space. She agreed with Peron's ideas, but she wanted Sy's unique perspective on them.

Their journey back up the Beanstalk took place in a totally different atmosphere from the trip down. The cable car was as crowded as ever, but the travelers were subdued, the mood somber. After a few days on the surface, everyone had sensed at some deep level that Earth was now *alien*—a world so affected by Man's wars and changing climate that permanent return there was unthinkable. Humanity had left its original home. There would be no going back. The travelers looked down at the planet's glittering clouds and snow cover, and said their mental farewells.

Olivia Ferranti had mentioned that few people made more than one visit to Earth. Now Peron and Elissa knew why.

When they arrived at the set of stations that formed the upper debarkation point of the Beanstalk, Elissa queried the information system for Sy's location. While she did so, Peron prepared to transfer them back to S-space. It proved surprisingly easy. Since almost everyone returning from a visit to Earth moved at once back to S-space, the procedure had been streamlined to become completely routine. Peron gave their ID codes, and was quickly offered access to a pair of suspense tanks.

"Ready?" he said to Elissa.

She was still sitting at the information terminal. She shook her head and looked puzzled. "No. Not ready at all. Hold off on booking us into the tanks."

"What's the problem? Can't you find Sy."

"I found him—but he isn't in S-space any more. He moved to normal space even before we did."

"You mean he went down to Earth, too?"

"Not according to the information service. He's been here all the time we were on Earth. And he left S-space a quarter of an S-hour before we did—so that means he's been in normal space for over twenty days!"

"What's he been doing?"

Elissa shook her head again. "Lord knows. That information isn't in the computer bank. But he was last reported on one of the stations here in the synchronous complex. If we want to get

our heads together with his, there's no point in going to S-space yet."

Peron cancelled the suspense tank request. "Come on then. I don't know how to do it, but we have to discover some way to track him down."

That task proved far easier than Peron had imagined. Sy had made no attempt to conceal his whereabouts. He had lived in one room for the whole time, with an almost continuous link to the orbiting data banks and central computer network. He was sitting quietly at a terminal when Elissa and Peron slid open his door.

He took his eyes away from the screen for a second and nodded to them casually. "I've been expecting you for a few days now. Give me a moment to finish what I'm doing."

Elissa looked curiously around the small room. It was a one-fifth g chamber, with few material signs of Sy's presence. The service robots had cleared away all food and dishes, and there were no luxury or entertainment items. The bed looked unused, and the small desk top was completely empty. Sy was neatly groomed, clean-shaven and dressed in tight-fitting dark clothes.

"No hurry," she said. She sat herself down calmly on the bed.

"Got a message from Kallen," said Sy, without taking his eyes off the screen. "Lum and Rosanne are delayed, won't be here as soon as they thought. How was Earth?"

"Thought-provoking," said Peron. He seated himself next to Elissa, and waited until Sy had completed data storage, signed off, and swung to face them. "You ought to make a trip there, Sy. It's something you'd never forget."

"I thought of it," said Sy. "Then I decided I had higher priorities. Plenty of time for Earth later—it won't go away."

"But what are you doing here, in normal space?" asked Elissa. "According to the information service, you've been here forever."

"Twenty-six days." Sy grinned. "You know what's wrong with S-space? You can't get anything done there in a *hurry*. I had things I wanted to do, and things I wanted to know—fast—and I wasn't sure that our Immortal friends would give permission. So I came here. I've been here for only nineteen minutes of S-time. By the time they register the fact that I've gone, I'll be all finished."

"I had the same feeling," said Peron. "We're too slow in S-space. We have a lot less control over what happens to us there. But finished doing what?"

"Several things. First, I've been testing Kallen's Law—my name for it, not his. Remember what he said? 'Anything that can be put *into* a data bank by one person can be taken *out* of it by another, if you're smart enough and have enough time.' That's one problem with a computer-based society, and one reason why computers were so tightly controlled on Pentecost: it's almost impossible to prevent access to computer-stored information. I decided that if there were another headquarters for the Immortals, and one that they preferred not to talk about, there must be clues to its location somewhere in the data banks. Well hidden, sure, but they should be there. Is there a secret installation, and if so, where is it? Those were two questions I set out to answer. And I had another thing that worried me. When we met

the Gossameres and Pipistrelles, Ferranti said that the Immortals couldn't really communicate with them. But she *did* communicate with them, even if they didn't send a message back. And I couldn't be sure that was true, either. Suppose they did send a message?—we don't know what the ship was receiving. I'm afraid I don't have an answer yet to that one. I've been working here flat out, but it takes time."

"Do you mean you *have* answered the other questions?"

"Think so." Sy cradled his left elbow thoughtfully in his right hand. "Wasn't easy. There's a pretty strong cover-up going on. None of the data that's available for the usual starship libraries will tell you a thing. I had to get there by internal consistency checks. What do you make of these data base facts? First, the official flight manifests show one hundred and sixty-two outbound trips initiated from Sol in the past S-month. The *maximum* fuel capacity of any single ship is 4.4 billion tons. And the fuel taken out of supplies in the Sol System in the past S-month is eight hundred and seventy-one billion tons. See the problem? I'll save you the trouble of doing the arithmetic. There is *too much* fuel being used—enough for a minimum of twenty-six outbound flights that don't show on the manifests."

"Did you check other periods?" asked Peron.

Sy looked at him scornfully. "What do you think? Let's go on. This one is suggestive, but not conclusive. The navigation network around the Sol system is all computer-controlled, and it's continuously self-adapting to changing requirements. Generally speaking, the most-traveled approach routes to Sol are the ones with the most monitoring radars and navigation controls. The information on the placement of radars is available from the data banks, so you can use it to set up an inverse problem: Given the disposition of the equipment, what direction in space is the most-traveled approach route to and from Sol? I set up the problem, and let the computers grind out an answer. When I had it I was puzzled for days. The solution indicated a vector outward from Sol that seemed to lead *nowhere at all*—not to any star, or toward any significant object. It pointed at nothing. I was stuck.

"I put that to one side and chased another thought. Suppose there were a hidden Headquarters somewhere in space. It would communicate with the Sol system not just with the ships—they only travel at a tenth of lightspeed—but with radio signals, too. There are thousands of big antennae and phased arrays scattered all around the Sol system, and the computers keep track of their instantaneous pointings. So I accessed that pointing data base, and I asked the computer a question: Of all the places that the antennae and arrays point to, what direction was pointed to *most often?* Want to guess the answer?"

"The same one as you got from the navigation system solution," said Peron. "That's wild. But damn it, how does it help? You have the same mystery."

"Not quite." Sy looked unusually pleased with himself. For the first time, Peron realized that even Sy liked to have an appreciative audience for his deductions.

"You're right in one way," went on

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Sy. "I got the same answer as from the navigation system solution. I had a vector that pointed to nothing. But there's one other thing about the antennae. The computer points them all very accurately, but of course they're scattered all over the solar system, from inside the orbit of Mercury to out past Saturn. So if you want to beam a message to a precise *point* in space, rather than merely in a specified *direction*, each antenna would be aimed along a slightly different vector. In other words, the computer pointing must allow for *parallax* of the target. So I took the next step. I asked if there were parallax on the previous solution, for the most common antennae pointings, and if so, what was the convergence point? I got a surprising answer. There *is* parallax—it's small, only a total of a second of arc—and the convergence point is twenty-eight light years from Sol, in just the direction I'd determined before. But when you check the star charts and the positions of kernels and hot collapsed bodies, there's nothing there. *Nothing*. The antennae are aimed at the middle of nothing. I called that place Convergence Point, just for lack of a better name. But just what place is it?—that was the question. And that's where I stuck again, for a long time. Know what finally gave me the answer?"

Elissa was sitting on the bed, her expression dreamy. "Olivia Ferranti. Remember what she told us—'you can't learn all about the Universe crouching in close by a star.' And you, Sy, you said maybe you should be looking at *nothing* to find new mysteries, rather than at the center of the galaxy. Convergence Point is a nothing point."

Sy was looking at her in amazement. "Elissa, I was asking a rhetorical question. You're not *supposed* to give me the right answer. How the devil did you work it out?"

Elissa smiled. "I didn't. You gave it away yourself. You'll never be a good liar, Sy, even though your face doesn't give you away. It was your choice of words. Even before you knew the distance, the twenty-eight light years, you said several times that the antennae were pointing 'at nothing.' But you couldn't know there was no dark object there, if you went out far enough. And from your voice, it was the 'nothing' that was important, not the coordinates of the target point."

Sy looked at Peron. "She's a witch. If she reads you like that, you'll never keep any secrets from her. All right, Elissa, take it one step further. Can you tell me what's so special about that particular nothing?"

Elissa thought for a few moments, then shook her head. "No data."

"That's what I thought, too. How can nothing be special? But then I remembered what else Olivia Ferranti said: 'you have to know what's going on out in deep space.' So I asked myself, what *is* deep space? I went back to the star charts and the kernel coordinates, and I asked the computer another question: Give me the coordinates of the point of open space within one hundred light-years of Sol that is *farthest from every known material body*. Uncertainties in our knowledge of distances make the answer slightly ambiguous, but the computer gave back only two candidates. One is ninety-one light years away; half a year's trip, even in S-space.

The other is—no prizes for guessing—just twenty-eight light years from Sol, in the right direction. Convergence Point is a real nothing point. Communication time: five S-days."

Sy called a holographic starscape display on to the space in front of them. He moved the 3-D pointer to an empty location within the star field. "Would you like to visit the real power center of the Immortals? Then I say that's where you want to be. Nowhere Station. S-space travel time: less than two months."

Elissa looked puzzled. "But Sy, *why* would anyone build a Headquarters out there, in the middle of nowhere?"

Sy shook his head. "I can't answer that."

Peron was still staring at the display. "We may have to go there to find out. And it won't be easy. You can be sure that the Immortals don't want us there—they don't even want us to know the place exists. You've solved the 'where' puzzle, Sy, I feel sure of it. But that just leaves a bigger problem: how can we find a way to make the trip, when the whole system is set up to prevent it?"

Sy looked smug. "I told you I've been working hard. If we want to make an S-space trip out to Convergence Point, I've identified the major problems we'll have to solve. Solving them, now—that's another matter, and I'll need help."

He called out a numbered list onto the display. "First, we have to find the departure time and place of the next starship to Convergence Point. Second, we have to find a way to get ourselves onto that departing starship—preferably in a way no one else will notice. Third, we have to explain our absence, so that no one wonders where we have gone. Fourth, we'll have to do something with the ship's crew. Fifth, before we get there we'll need a plan of action for what we'll do when we reach Convergence Point. Where do you want to begin?"

"Can't we put the crew in cold sleep and take them with us?" asked Elissa.

"That's my thought. It won't do them any harm, and it's a lot better than leaving them somewhere in the Sol system. I'm confident that we can handle the mechanics of the ship—the service robots do almost everything, and we learned the rest on our trip from Cassay. The other problems are not so easy. I'd like your thoughts."

"The third one—explaining our absence," said Elissa. "All we need is enough time to get us well on our way to our real destination. Once we're gone, they'll never catch us."

"That's true. But we don't want them to know where we're going. If they find out they'll send a radio signal to warn Headquarters we're coming their way."

"Why should they learn where we're heading? Jan de Vries already implied that we're more of a nuisance to him than anything else. If we can show we've departed for a plausible place, I don't think he'll take much interest. Pentecost would be a natural—it was our home. The most I would expect him to do would be to warn them to watch for our arrival. Can you do a fake data bank entry, indicating that we are shipping out for Pentecost?"

Sy shrugged. "I can try. One nice thing about the information system, it

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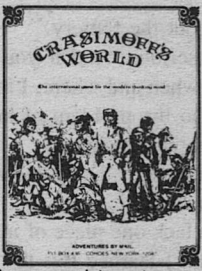

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doesn't *expect* the sort of changes we'll be making. The logic is protected against the usual screwups and programmer meddling, but not against systematic sabotage. I'll do it. I've learned the software pretty well in the past few weeks."

"Well enough to answer your first question?" asked Peron. "You said it, Sy—the information about starship departure has to be in the data banks somewhere. It's just a question of finding it. But if anybody can pull it out, you can."

Sy grimaced. "Not without a long, horrible grind."

"It would be for me or Elissa—but you'll come up with a smart approach to it."

"Cut out the flattery."

"I'm serious. And if you can do it, find out when and where, I think I have the key to the problem of how we get on board the starship."

Sy frowned. "Do you, now? What have I missed?"

"You lack one piece of information. Elissa and I learned this the hard way, and we can vouch for it: there is no way that the crew will stay in S-space for the acceleration phase of their journey. It's just too damned uncomfortable. They'll be in cold sleep when the journey begins. See what that means?" He pulled the terminal entry pad closer. "Let me sketch an approach. Then we can look at some timings."

"T MINUS 4 MINUTES, COUNTDOWN PROCEEDING," said a disembodied voice.

"—FUEL MASS CHECK IN PROCESS."

"—THRUST PROTOCOL COMPLETE."

"—CARGO CHECK PROCEEDING."

"—OUTBOUND TRAJECTORY CONFIRMED AND APPROVED."

The mechanical voices chimed in one after another. Ward Lunga, ship's pilot, lay quietly in the suspense tank. He was watching the displays, chatting to copilot Celia Deveny and listening with half an ear to the robotic checklist. Full attention was unnecessary. Anomalies would be separately flagged and reported to them.

"T MINUS 180 SECONDS, COUNTDOWN PROCEEDING," said the voice.

"—MECHANICAL SYSTEM CHECKS COMPLETE."

The starship *Manta* floated in stable orbit about Sol, hovering at a Saturnian Trojan Point. Final countdown for departure was nearly complete. The nav displays showed a thrust profile that would carry the *Manta* from the middle Solar System direct to Gulf City, twenty-eight light years away. The ship still floated in free fall, but in three S-minutes that would be changed to an accelerated outbound trajectory.

"ELECTRICAL AND ELECTRONIC SYSTEMS CHECK COMPLETE."

"—FUEL MASS CHECK COMPLETE."

The final few hundred million tons of fuel had now been transferred; the mobile tank was swinging away under robot control toward Sol.

"ANOMALY! CARGO PORT ANOMALY," said a voice suddenly. "CARGO PORT SEVEN OPEN."

Lunga grunted in surprise. "Damn. All that cargo should have been in and secured by now. *Command: display Port Seven.*"

Two views of Cargo Port Seven showed on the displays. Lunga looked at them closely. "Bloody thing looks shut to me. Everything else reports normal—see anything odd there, Celia?"

"Not a thing." She threw a pair of switches. *"Command: repeat status check, Cargo Port Seven."*

"CARGO PORT SEVEN CONDITION: CLOSED AND NORMAL. ALL CARGO DELIVERY PODS MOVING NOW TO SAFE RANGE. ALL CARGO SECURE AND BALANCED."

"—T MINUS 120 SECONDS, COUNTDOWN PROCEEDING."

"—TRANSITION TO COLD SLEEP BEGINS IN THIRTY SECONDS UNLESS ALTERNATE SIGNAL PROVIDED TO CENTRAL CONTROL."

Ward Lunga's finger hovered over the button. He hesitated. Unless he took action in the next half minute, the system would initiate the crew's descent from S-space to cold sleep. *"Command: repeat all checks and report any anomalies in condition."*

There was a fraction of a second's pause. "ALL CHECKS REPEATED. NO ANOMALIES OBSERVED, ALL SYSTEMS ARE READY FOR FLIGHT DEPARTURE."

"—T MINUS 100 SECONDS, COUNTDOWN PROCEEDING."

Lunga moved his hand away from the abort button. He took a last look at the displays, then lay back full-length in the suspense chamber. He started to sit up again, then changed his mind and allowed his body to relax in the tank. The gentle hissing of vapors that would initiate the first phase for cold sleep was already beginning. Time to let the computers and the robots take over, and wake again at Gulf City. . . .

Outside the tank, three figures flickered through the interior of *Manta*. Peron, Sy, and Elissa were moving cautiously, but to an observer in S-space they went too fast for the eye to follow—the six-hundred meter length of the ship from cargo hold to control room was traversed in less than an eighth of an S-second, in a flashing blur too rapid for comprehension. The biggest obstacle to even greater speed was the service robots, trundling haphazardly along in their assigned tasks at a slow walking speed.

Ninety-nine S-seconds before launch, they were standing outside the suspense chamber. As a first priority, there must be enough spare tanks to accommodate three extra travelers in cold sleep. If not, there was still time to recall a cargo pod and make their exit from the *Manta*.

"T MINUS NINETY SECONDS"—the three intruders were now familiar with all the main controls of the ship, had assured themselves of the ship's immediate destination, and confirmed the trip travel time to the fraction of a second.

"T MINUS EIGHTY SECONDS"—after a meal and a four-hour rest period, Sy, Elissa and Peron adjusted the cold sleep settings for the ship's crew, and prepared three unoccupied suspense tanks.

"T MINUS SEVENTY SECONDS"—Sy sent coded messages to Kallen, Lum and Rosanne, one to Earth and one to Paradise, explaining what was happening.

"How confident are you that they'll know there's a hidden signal?" asked Peron.

"If Kallen receives it, no question." Sy had smiled grimly. "Sometimes I think he's as smart as I am. If they can't find a way to follow us, I expect they'll send us a message. Want to bet on it with me?"

"Not today."

"T MINUS SIXTY SECONDS"—every contingency had been checked. Now it

was time to settle into their cold sleep chambers, next to the crew members.

"These tanks are set to wake us one S-minute before arrival at Gulf City," said Peron. "They'll still be asleep. Sy, are you sure you changed the deceleration profile so that we'll be in freefall when we wake?"

"Trust me."

Peron lay in his suspense tank; for the thousandth time his mind ran over the same event sequence. The three of them had reviewed it together until it was totally familiar to each of them.

Arrival time minus one S-minute: They would wake in normal space during the ship's final approach to Gulf City. One S-minute would give them a little more than one normal day for possible changes to final plans. The Immortals in Gulf City should be in S-space, and unable to formulate a timely response.

Arrival in Gulf City: next came control of the service robots. Control of Gulf City itself would follow. . . .

The cold sleep vapors were hissing about him, and he could feel the cool and unpleasant touch of catheters on his arms and chest. Nothing more to be done now; except to sleep, and wake at Gulf City.

Peron closed his eyes . . .

Chapter 27: Gulf City

. . . and opened his eyes, to the immediate knowledge that something had gone terribly wrong.

He should have been in normal space. He was not. The blurred outlines of the objects around him, and their muted colors, told him at once that he was in S-space. And he was no longer in the snug confines of the *Manta*'s suspense tanks.

He tried to sit up, but could not do it. He was secured by broad straps to the bed that supported him. Worse, he had no feeling or muscular control below the neck. He turned his head desperately from side to side and saw that Elissa lay on his right, with Sy just beyond her. Sy was already fully conscious, and looking about him thoughtfully. Elissa's eyes were just beginning to blink open.

Where in Heaven's name were they? He craned his head forward, and as he did so there was a soft whir of machinery. The bed he lay on was tilting to a semi-upright position, and he was gradually able to see more of his surroundings.

He was in a long, gray-walled room with no windows. Bare shelves lined the walls, and the only other furnishings were three hard-backed chairs, arranged to face the beds. The whole room had a seedy look, of an area poorly maintained. On the chairs, eyeing him curiously, sat three people: a short, powerfully-built man with hot, tawny eyes, and two women: one black-skinned, tall, and angular, but at the same time graceful; the other tiny, plump, and fair. Peron guessed that the women were in their thirties, the man a few years younger.

"Very good," said the shorter woman unexpectedly. "All present and correct. I think we may begin."

Peron caught his first glimpse of her eyes, and it was like a plunge into cold water. They were brown and wide-set, and in them was a disconcerting power and intensity. He felt as though she

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could see right through him. The forehead above the alert eyes showed a faint but extensive pattern of fine white scars, running up into the hairline.

"You are probably feeling quite surprised," the woman went on. She turned her attention to Sy, and stared at him closely. He gazed back, the usual expression of cynical abstraction on his face.

"Or maybe not," she said at last. "But maybe a little disoriented. So let me begin by telling you that you are exactly where you wanted to be. This is Gulf City—your 'Convergence Point,' which I rather like as a fitting name for this location. This is also our main Headquarters. You have arrived. No longer will you need to imagine other gates still to be passed through."

Peron looked at Sy, but the other remained silent. He would be performing his own evaluation, and until that was complete he was unlikely to speak.

"What happened?" said Peron at last. As usual in S-space, speech was a problem. And there was something in the woman's super-confident tones that was irksome. "How did we get here?"

"You found your own way here," said the woman. "Everything else is of lesser importance. Jan de Vries told us about the three of you, and said you had the potential; but we were all surprised—and delighted—at how quickly you came. Only one or two people finagle their way to Gulf City every Earth-year. Three at once is a bonanza."

"You mean you *wanted* us to come?"

"Anyone who can find his way to Gulf City is welcome. There is a natural selection process at work—if you lack the necessary qualities, you will never overcome the intellectual and physical barriers, and you will never reach this place."

"You were playing with us," said Peron bitterly. He was feeling sick with the sense of failure. "Watching all our moves. When we thought we were so clever sneaking aboard the *Manta*, you knew we were there all along."

"We did not." The woman's voice carried conviction. "The crew of the *Manta* is in cold sleep recovery—they still have no idea of your presence on board their ship. Your actual departure from the Sol System also went unobserved. And you made a team of technicians there work for many weeks, eliminating the data system weaknesses that you discovered and ingeniously exploited. You walked through the Sol checkpoints and safeguards. Jan de Vries was appalled at how inadequate you made them seem. You should certainly feel no shame. But we find it expedient to employ our own security system in Gulf City. As I'm sure you know, S-space inhabitants are highly vulnerable to actions in ordinary space. We inspect all approaching ships ourselves, during deceleration, long before they are allowed to dock here."

Peron realized that Elissa was now fully conscious next to him, and listening intently. "Just who are you?" he said. "And what do you mean, you want us here? *Why* do you want us?"

"One question at a time." The woman smiled, and it transformed her face. She no longer looked austere and unsympathetic. "Introductions first: you are Peron of Turcanta, Elissa Morimar, and Sy Day of Burgon." Her eyes went

again to Sy, and there was another long moment of locked gazes. "The Pentecost trouble-makers—but also the first people from your planet ever to reach Gulf City. My congratulations. As for us"—she touched the stocky man lightly on the shoulder—"this is Wolfgang Gibbs, Manager of Gulf City. This is Charlene Bloom, my special assistant. And I am Judith Niles." She smiled again. "I am Director General of Gulf City, and of all Immortal operations. Lie quiet for one moment longer."

She moved forward and looked at their faces. Then she studied the dials set into the head of the three beds for a second or two, and nodded. "I think we can return you to free mobility. The precautions were for your sakes as much as ours. *Command: release these three.*"

The straps around Peron at once went loose, and after a second he felt a painful tingling in his limbs and the return of full sensation there. He slid forward and stood, making sure of his balance.

"You are impatient for answers," went on Judith Niles. "As I would be. Very well, we will not disappoint you. Wolfgang, will you begin the explanations and tour? Please summon me at the appropriate time."

She touched a setting at her belt, and vanished. A moment later, and Charlene Bloom was gone also. Wolfgang Gibbs stood looking quizzically at Sy, Elissa, and Peron.

"Well. That's real nice." He sniffed. "Yeah. J.N. says you can go free, then she and Charlene go back to work—so I have to handle you on my own when you go homicidal. All right, then, I'll trust you. If you feel up to a little walk, we'll take the old guided tour."

Wolfgang Gibbs turned casually and ambled toward the door of the room. After a single look at each other, the other three followed.

"We could use the service robots to move us around," Gibbs said over his shoulder. "I'd normally do that. But if we did you'd get no feel for the Gulf City layout. Better to do it on your two feet, then you'll know where everything is for future reference. We'll begin with the outside."

"Where are you taking us?" said Elissa, falling into step at his side, while Peron and Sy trailed along behind.

He looked at her appreciatively. To Peron's annoyance he seemed to be making a close inspection of her face and figure. "Lookout Point. It's the place where the galactic observations are done—the whole galaxy and beyond. We do a lot of listening and looking in Gulf City. That's why we're here, light years from anywhere you'd ever choose to be. You'll notice a lot fewer service robots here than usual, and fewer mechanical gadgets. We put up with the mess. When you've come all this way to find a quiet place to listen, you don't want to clutter up the observational signals with your own electronic garbage."

He led the way along a radial corridor that ran for more than a kilometer outward. The size of Gulf City began to make an impression on the other three. By the time they reached Lookout Point they were moving in total silence, making mental notes of everything they saw. The whole of Gulf City was girded with antennae, telescopes, interferometers, and signal devices. Dozens of exterior ports showed the same blank white of

S-space, but screens on the interior walls performed frequency conversions and display. They could observe open interstellar space as it looked at every wavelength range, from hard X-ray to million kilometer radio waves.

Wolfgang Gibbs paused for a long time in front of one screen. "See that?" he said at last. He tapped the display, where a faint, crablike shape showed dark against a lighter background. "That dark, spirally blob? That's one of the main reasons we're here at Gulf City. We've been watching them for fifteen thousand Earth years. I've been studying them myself for half that time—I came here four S-years ago, with Charlene Bloom."

"What are they?" asked Sy. His taciturn manner was gone, and there was a febrile excitement in his voice. "That screen shows signals at ultra-long radio frequencies—I didn't know anything radiated there, except the Gossameres and Pipistrelles that we saw on the way to Earth."

Wolfgang lost his detached and casual manner. He looked hard at Sy. "Quite right, sport. We started with the same idea. But now we think half the Universe communicates on those long frequencies. Like our friend there. We call that a Kermel Object, but that's only a name. It's still a major mystery. We think it's a sort of big brother to the Gossameres. They all send signals to each other, multi-kilometer wavelengths."

The displays showed a full three hundred and sixty degree field of view. Sy moved quickly from one to another, checking for the dark, spidery shapes. "The screens show Kermel Objects in all directions," he said. "How far away are they?"

"Good question," said Wolfgang. "A long way—a damned long way. We estimate the nearest one at two thousand light years, and even that nearest one is out of the plane of our galaxy. They're not galactic objects, generally speaking—they're inter-galactic objects. Unless you get to a quiet place like this, you can't hope to detect them at all. Come on. You'll have plenty of opportunity to find out more about the Kermels, but for now I want you to get the ten-cent tour. I'll tell you one more thing, though: you're looking at possible intelligence there—and it's an intelligence that seems to be older than this galaxy."

He continued around the outside of Gulf City, making a circuit that was more than three miles long. Sy did not speak again. Elissa asked questions about everything, and Gibbs did his best to answer. Once inside Gulf City, any secrecy toward outside inquirers appeared to vanish.

They saw billions of cubic feet of power generation equipment, and massive drives sufficient to allow Gulf City to cruise where it chose in interstellar space. There were food production facilities enough to feed tens of thousands, lying near the center of the structure. Most of them stood idle. According to Wolfgang Gibbs, the current population of Gulf City approached seven hundred, though the original capacity was more than ten times that.

Finally, after showing them corridor after corridor of living accommodation, Gibbs stopped and shrugged his shoulders. "It will take you a month to see

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everything, but you should have enough for a first impression. Take a break, and make yourselves comfortable here. All these suites are fully equipped. The information system will tell you most things about the city that I haven't covered. I'll make sure the service robots will accept your voice commands—but don't expect instant response, we're always short of service. We have an appointment in J.N.'s office in three hours. I'll see you there."

"Where is that?" asked Elissa.

"Ask the info-system if you want to go there on foot. If you're feeling lazy, just give the command. If you want me, use the call system." Wolfgang Gibbs winked at Elissa, manipulated a control on his belt, and vanished.

"So. What do you think?" asked Peron.

Elissa looked up at the ceiling. They were alone at last. Sy had left them a few minutes after Wolfgang Gibbs, saying he needed time to think. Peron and Elissa had wandered for a while along the endless corridors, poking their heads into kitchens, entertainment areas, and exercise rooms. All were deserted. Finally they found a set of living quarters that appealed to them, and decided they might as well move in. Now they were lying side by side on a huge, cloud-soft floor area.

"Think we're being monitored?" she said at last.

"When in doubt, assume yes. But does it make any difference?"

"I guess not. But I think we're going to see sparks fly here at the next meeting. Did you notice the way that Sy and the Director General looked at each other?"

"Judith Niles? It was hard to miss it. She's probably used to a lot of respect here. You know old Sy, he'd be rude to the devil."

"I told him to go easy." Elissa laughed. "He said she was arrogant."

"Coming from Sy, that's a bit much. What does he think *he* is?"

"I told him that. He says that maybe he has 'the natural suspicion of youth for age' but that she has the 'intolerable arrogance of unquestioned authority.' According to Sy, she's surrounded by yes-men and yes-women, and she thinks she knows all the answers."

"When in fact, he does?" Peron was irritated. He was still slightly jealous of Sy—particularly when Elissa sounded admiring.

"No. He says he has a hundred unanswered questions, but he didn't want to go into them with Gibbs. He's waiting for a shot at Judith Niles."

"So am I. But there's really only one question to be asked. Why does Gulf City exist?"

"You heard what Wolfgang said; to study the Kermel Objects."

"Sure—but that's nonsense." Peron rolled over to face Elissa. "Look, I can imagine a group of pure scientists arguing that it was worth the enormous effort of setting up a research station out here in the gulf, to decide the nature of the Kermel Objects. But you've met Judith Niles. Can you see her swallowing that argument? She'd throw them out of her office in two minutes. I think Sy will ask her the main question—and rather him than me. But if he doesn't, you and I must do it."

Peron sounded unhappy but resolute. Elissa said no more, but she snuggled closer to him and took him in her arms.

Almost a mile away, in a secluded area on the other side of Gulf City, Wolfgang Gibbs was engaged in his own secret meeting with Charlene Bloom. They lay side by side in an empty room, in darkness and with all monitors turned off.

"You noticed the difference, didn't you?" he said softly. "I think we caught a new breed of fish this time. Sharks, maybe, instead of guppies."

"I agree. J.N. certainly thinks so, too. You could feel the tension between all four of them. Especially with the dark-haired kid, Sy—he didn't give her an inch. I'm not sure I want to be at the next meeting. She'll have her hands full."

"I sure as hell hope so." Wolfgang Gibbs smiled bitterly in the darkness. "You know the trouble with the two of us, Charlene? We're outgunned. J.N.'s the boss, and we know it, all three. We just can't argue with her, even when we're on the right side of the issue—she has too much firepower. I'm sick of this place, and I'm beginning to hate S-space life, but I still can't tell her I want out."

"You mean *leave?* Leave Gulf City and J.N. completely?" Charlene Bloom pulled away from him. "We couldn't do that. We've all been together since the beginning."

"Yeah. And that's too long. Over fifteen years, most of them in S-space. God, Charlene, don't you think we need a new look at things here? And I don't believe we can provide it. Maybe those three kids can. You and I should be off, out to pasture, running a planet contact group, or a Sector Headquarters. Maybe we should go to Pentecost, where they came from."

"Did you tell them about their three friends?"

Gibbs scowled and shook his head. "Not yet. I couldn't do it. They're expecting them to roll up here at Gulf City. I'm leaving it to J.N. to break the news. They'll hear it soon enough. That's going to be hard for them."

There was a long silence.

"Wolfgang?" said Charlene at last.

"Yeah."

"I'm sorry you feel the way you do." Her voice was unhappy and tentative. "I know it's frustrating here, sometimes. But I've been very happy, all these years. I know my limitations. I could never have done what Judith has done, pulling us together and holding us together. Nor could you. And you can say what you like about living in Gulf City, but we're working on humanity's biggest problem. If we don't find a solution, I think it's the end of the road for *homo sapiens*. And if you're making a sacrifice, J.N. is making one that's just as big."

"I know it. But she's calling the shots. Suppose we're off on the wrong tack? J.N. thinks we're making progress, but as far as I'm concerned we're in just the same position as when Gulf City was created—that's over fifteen thousand Earth-years ago. What have we accomplished in all that time? And how long do we have, before it's all over?"

Charlene did not reply. Wolfgang had sometimes spoken of breaking away from Gulf City, but never before in such

strong terms. If he went, what would she do? She could not bear to lose Wolfgang, but also she could not desert her work and Judith Niles.

She was glad of the darkness. And she was more than ever dreading the results of the coming meeting.

Chapter 28

Sy hesitated for maybe a minute after leaving Peron and Elissa. Then he moved fast. During their tour of Gulf City they had seen a dozen suspense chambers for movement to and from S-space. Now he headed for the nearest of them and unhesitatingly lowered himself inside one of the tanks. He performed a final check of the monitors to confirm that he was alone and unobserved, then lay back in the casket and initiated the process that would take him to normal space. His eyes closed . . .

. . . and opened—to find Judith Niles calmly peering in at him through the tank's transparent cover. She had an unreadable smile on her face, and when he was fully awake she opened the door and helped him out. He looked at her warily.

"Come on," she said. "You and I need to talk, just the two of us. I think my office will feel more comfortable than the chamber here." And without looking at him she turned and led the way.

She took him toward the main labs of Gulf City, in the very center of the station. Sy soon found himself in a well-appointed set of rooms, with pictures on the walls, shelves of genuine books, and serried ranks of monitors. She waved at them.

"First lesson. I'll be throwing a lot of lessons at you. Don't *ever* assume that you are unobserved in Gulf City. I learned the art of monitoring from a master—the only master I've ever known. From here you can watch everything." She initiated a suite-spin to give an effective gravity about half that of Earth, then sank into an armchair and tucked her feet in under her. She gestured Sy to take a seat opposite. There was a long silence, during which they performed a close inspection of each other.

"Want me to do the talking?" she said at last.

Sy shook his head. "You first, me second. You know I have questions."

"Of course you do." J.N. leaned back and sighed. "I wouldn't be interested in you if you didn't. And I think I have some answers. But it has to be a two-way street."

"What do you want from me?"

"Everything. Cooperation, understanding, brain-power, new ideas — maybe partnership." She was staring at him with peculiar intensity, eyes wide and unblinking beneath the scarred forehead. "It's something I haven't had in all the years since we left Earth. I think you can be a full partner. God knows, we need it. We're dying for lack of fresh thoughts here. Every time a new arrival finds a way to Gulf City, I've waited and hoped." Her expression had changed, became almost beseeching. "I think you're different. We can read each other, you and I. That's rarer than you know. I want you to help me recruit your companions, because I'm not sure I can do that. They're a stubborn pair. But you think in the same way as I do.

The most eye-opening day of your life

The day was so long ago, it may be blurred by the years.

Was it a day as gray as the clouds or was it a day as gold as the sun? And exactly how long ago was it?

It's difficult to say. You were, after all, only a child at the time. And yet, you experienced a moment like no other moment in your life.

Suddenly, it was as if the world were in your hands. But there was no clap of thunder. There was only silence, for you were alone with nothing more than a printed page when you made an awesome discovery: *you could read.*

The words and sentences were simple enough, and even though they came slowly at first, the wonders of storybook friends such as Alice, Dorothy and Christopher Robin were just around the corner.

So, as time went on, were countless writings to move your mind, tug your heart and capture your imagination, for the power of the printed word had become forever yours that day nearly a lifetime ago. And the more you have made it yours through the years, the more it has changed the way you have lived and learned and hungered for more.

Americans by the tens of millions share the same insatiable hunger for new information, new ideas and new ways to understand the ageless mysteries around them and the uncharted depths within them.

The more innovative their lives become and the more sophisticated their technologies become, the more they seek out ideas on every conceivable subject from arts to sciences and from politics to economics.

Does it surprise you that they depend on magazines more than they depend on any other sources of information for those precious breaths of fresh air we call ideas? It doesn't surprise the magazines of America. Today, they are more successful than they have ever been, because they are more challenged and more rewarded by their readers than ever before.

There are more than 10,000 magazines across America today, and while no two of them are quite alike, all of them have one thing in common.

They know that the essence of a magazine is to go deeper than the clamor and clutter of daily events, to strike a unique chord with its readers, and to touch them, one by one, with insights and inspirations that will open their eyes again and again.

Nothing opens your eyes like a magazine.

This message is one in a series from America's magazines.

I suspected you would come here, to normal space, because it's exactly what I do myself when I need quiet time, time to think. You heard that it's bad to go from normal space to S-space and back too often?''

Sy nodded. ''That's what Olivia Ferranti told us. She believes it, but I'm not sure I do. I've seen no evidence of it.''

''I don't think you will. If there are bad effects, they are very subtle.'' Judith Niles smiled again, an open smile that lit up her face. ''But a system in which people pop into normal space to think too much is hard to control. You don't take other people's word for much, do you?''

''Should I?'' Sy's face was expressionless. ''Look, if this is to be more than a waste of time, let's get to specifics. You're right, I came here to think before we met with you again. I needed time. Gulf City seemed like a big charade—a place without a plausible purpose. If you want my cooperation, and the cooperation of Peron and Elissa, begin by telling me what's really going on here. *Tell me why Gulf City exists.*''

''I'll do better than that.'' Judith Niles stood up. ''I'll show you. You can see for yourself. I don't often have a chance to brag about the work we've done here, but that doesn't mean I'm not proud of it. Put this suit on—we'll be visiting some cold places.''

She led the way down a long corridor. The first room contained half a dozen people, all frozen in postures of concentration around two beds occupied by recumbent forms.

''Standard S-space lab.'' Judith Niles shrugged. ''No big mysteries here, and no justification for Gulf City. We still conduct sleep experiments in S-space, but there's no reason except my personal interests why this has to be here. This is my own lab. I started out in sleep research, back on Earth—it led us to discover S-space. The main center for sleep research is still back in the Sol System, under Jan de Vries. The best protocol we know reduces sleep to about one hour in thirty. Our end objective is still the same: zero sleep.''

She closed the door. Another corridor, another lab, this one entered through a double insulating door. Before they went inside, they sealed their suits.

''Temperature here is well below freezing.'' Niles spoke over the suit radio. ''This one should be more interesting. We discovered it about seven thousand Earth-years ago. Wolfgang Gibbs stumbled across the condition when we were exploring the long-term physiological effects of cold sleep. He calls it T-state.''

The room had four people in it, each sitting in a chair and supported at head, wrists, waist, and thighs. They wore headsets covering eyes and ears, and they did not move.

Sy moved forward and looked at each of them closely. He touched a frozen fingertip, and lifted the front of a headset to peer into an open eye. ''They can't be in S-space,'' he said at last. ''This room is too cold for it. Are they conscious?''

''Completely. These four are volunteers. They have been in T-state for almost one thousand Earth-years, but they feel as though they entered it less than five hours ago. Their subjective rate of experience is about one two-millionth

of normal, roughly one thousandth of the usual S-space rate."

Sy was silent, but for the first time he looked surprised.

"Mind-boggled?" She nodded. "We all felt the same when Wolfgang showed us. But the real significance of T-state won't be obvious to you for a little while yet. It's hard to grasp just how slowly time passes here. Let me tell you how Charlene Bloom put it when she and I had our first one-minute experience of T-state: in the time it takes a T-state clock to strike the hour of midnight, Earth would pass through two whole seasons, from winter to spring to summer. A full life on Earth would flash by in half a T-hour. We have no idea of the human life expectancy for someone who remains in T-state, but we assume it's millions of Earth-years."

"Why the headsets?"

"Sensory perception. Humans in T-state are blind, deaf, and dumb without computer assistance. Our sense organs are not designed for light and sound waves of such long wavelengths. The headsets do the frequency adjustment. Want to try T-state?"

"Definitely."

"I'll put you on the roster to spend a few minutes there. That's enough. Remember the time rate difference—one T-minute costs most of a day in S-space, and nearly four Earth-years." Again Judith Niles turned to leave the room. Sy, after a final glance at the four cowled and motionless figures, followed her outside and along another long and dimly-lit corridor. He noted approvingly that her energy and concentration remained undiminished.

They finally approached a massive metal door, protected against entry by locks that called for fingerprint, vocal, and retinal matching. When Sy was at last cleared by the system and had stepped inside, he looked around him in surprise. He had expected something new and exotic, perhaps another frozen lab, full of strange experiments in time-slowing or suspension of consciousness; but this room appeared to be no more than a standard communications complex. And a dusty, poorly maintained one, at that.

"Don't judge by appearances." Judith Niles had seen his expression. "This is the most important room in Gulf City. If there are any secrets, they're here. And don't think that human nature changes when people move to S-space. It doesn't, and most individuals never question *why* things are done the way they are in our system. If they do question, they are shown what you are about to see. If not, we don't force the information on them. This is the place where the oldest records are accessed."

She sat down at the console and performed a lengthy coded entry procedure. "You should try cracking this, if you think you're a hot shot at finding holes in system software. It has six levels of entry protection. Let's feel our way into the data base gradually. This is a good place to begin."

She entered another sequence. The screen lit with the soft, uniform white glow characteristic of S-space. After a few moments there appeared on it a dark network of polyhedral patterns, panels joined by silvery filaments. "You've seen one of these yourself, I gather. Gossameres and Pipistrelles—probably

the first alien intelligence that humans discovered. We ran into them twenty thousand Earth-years ago, as soon as deep space probes began with S-space crews; but we're still not sure if we're meeting intelligence. Maybe it depends on our definition of intelligence. Interesting?''

Sy shrugged in a non-committal way.

''But not that interesting?'' Judith Niles touched the control console again. ''I agree. Abstractly interesting, but no more than that unless humans learn to set up a real dialog with them. Well, we tried. We located their preferred output frequencies, and we found that simple signal sequences would drive them away and discourage them from draining our power supplies. But that's not much of a message, and we never got beyond it. The Gossameres and Pipistrelles proved to be a kind of dead end. But they served one enormously important function. They alerted us to a particular wavelength region. We began to listen on those frequencies any time we were in deep space and thought there might be a Gossamere around. And that's when we began to intercept other signals on the same wavelengths—regular coded pulses of low-frequency radiation, with a pattern like this.''

On the screen appeared a series of rising and falling curves, an interlocking sequence of complex sinusoids, broken by regularly spaced even pulses.

''We became convinced they were signals, not just natural emissions. But they were faint and intermittent, and we couldn't locate their sources. Sometimes, a ship on an interstellar transit would pick up a signal on the receiver, long enough for the crew to lock an imaging antenna onto the signal source direction. They might receive a faint source image for a while, then they would lose it as the ship moved on. It was tantalizing, but over the years we built up a library of partial, blurred images. Finally we had enough to plug everything into a computer and look for a pattern. We found one. The 'sightings' took place only near the midpoints of the trips, and only when the ships were far from all material bodies and signal sources. The signals were received only when we were in deep space—the deeper, the better.

''By then we knew we were seeing something different from Gossameres and Pipistrelles. The new sources were very faint and distant, and the reconstructed image outlines showed a hint of a spiral structure, nothing like those paneled polyhedra. But we were still too short of information. It seemed a fascinating scientific mystery, but not much more. That was when Otto Kermel proposed a series of missions for a long-term search and study of the objects.

''I don't deserve any credit at all for what happened next. I thought his idea would go nowhere, and gave him minimal resources and support. He did all the pioneer work on his own. We gave him the use of a one-man ship, and he went away to a quiet location about seven light years from Sol. He argued that the absence of electromagnetic and gravitational fields was essential to studying the objects. Although his first objective was communication with them, he found that a round-trip message to even the nearest of them took two S-years. That limited him, but during his studies he discovered lots of other things.

"First, he found many Kermel Objects, all around the Galaxy. The signals we intercept are not intended for us. We were eavesdroppers on transmissions between the Kermels, and those signals between them are numerous. Based on the length of those transmissions, Otto concluded that the Kermel Objects are immensely old, with a natural life-rate so slow that S-space is inadequate to study them—in thousands of Earth-years, he was receiving only partial signals. Otto claimed that he could partially decode their messages, and he believed that they have been in existence since the formation of the Universe—since *before* the Big Bang, according to one of his wilder reports. He also suggested that they propagate not by exchange of genetic material, but by radio exchange of genetic information. We have not been able to verify any of those conjectures, and Otto could not provide enough data for convincing proof. What he needed was the T-state, and a chance for more extended study periods on a time scale appropriate to the Kermel Objects. But by an accident of timing, he departed for a second expedition just before the T-state was discovered. And he has never returned.

"By the time he left, though, we had changed our ideas about the practical importance of studying the Kermel Objects. We decided that it is central to the future of the human species. We have continued his work, but without much of his data base. Take a look at this."

Judith Niles projected another scene onto the display. "Does it seem familiar?"

Sy studied it for a second or two, then shrugged. "It's a picture of a spiral galaxy, looking down on the disk. I've no idea which one."

"Correct. There's no way you'd recognize it, but it's this galaxy, seen from outside. That signal was recorded by Otto Kermel, from one of the Objects sitting way up above the galactic plane. And as part of the same signal, this image came with it." At her keyed command, another picture appeared split-screen, side by side with the first one. It was the same galaxy, but now the star patterns were shown in different colors. "Keep watching closely. I'm going to zoom."

The star fields expanded steadily as the field of view moved in to focus on one of the spiral arms. Soon individual stars could be distinguished on the screen.

Judith Niles halted the zoom. "Once you look at individual stars, you can see what's going on. The stars in the right hand image have been color-coded according to spectral type. And by looking at the stars in our own stellar neighborhood, it was easy for us to read the code. For instance, Sol is a G-2 V star, and G-types show in pale green. Red giants are magenta, O-type supergiants are purple, red dwarfs are orange-yellow. There was another important piece of information in the image. By looking at the distribution of stars in some of the main stellar clusters, we could determine the date. All the evidence was consistent, and told us that the image represented the situation seventy thousand Earth-years ago. When Otto Kermel received another signal of the same type, he thought at first that it was just a copy. But it wasn't. Here it is."

She brought another image on the

screen, over-writing the first one. "For one thing, the stellar distribution indicates a different date. This image shows our arm of the galaxy as it *will be* in about forty thousand Earth years. Take a good look at it—it's the most important picture in human history."

Sy stared at the screen in silence for a couple of minutes. "Can you display the color key for spectral type?" he said at last.

Without speaking, Judith Niles flashed a color code onto the screen header. Sy was silent again for an even longer period.

"Where's Sol?" he finally asked.

Judith Niles smiled grimly, and moved the screen cursor to indicate one star in the field. "That's Sol, forty thousand years in the future. Now you see why we're here in Gulf City."

"Red dwarf. Wrong spectral type. The whole spiral arm is *full* of red-dwarfs—far too high a proportion of them." Sy turned his attention again to the first image. "This is impossible. It wasn't that way seventy thousand years ago, according to the image. And there's no way that stellar types could change so much, and in such a short time. You must be misinterpreting the data."

"That's what we thought—at first. Then we began to compare recent star catalogs with ones made in the earliest days of stellar astronomy. There's no mistake. The main sequence stars centered on this region of the spiral arm"—she moved the cursor to a place about three thousand light years closer to the galactic center "—have been changing. What used to be spectral classes G and K are becoming class M."

"No way!" Sy shook his head vigorously. "Not unless all the astrophysics we knew back on Pentecost was nonsense. It takes hundreds of millions of years *at least* to move from one spectral class to another, unless there's a cataclysmic change like a nova."

"You know the same astrophysics as we do. And we can only think of one mechanism for change. Class G and class K stars have surface temperatures between about four and six thousand degrees. Class M are more like two to three thousand. You *could* get those changes in stellar type—if somehow you could artificially damp the fusion reaction in the stars. Lower the internal energy production, and you would lower the overall temperature."

Sy looked frustrated. "Maybe—but can you suggest any process that could possibly do that? I know of none."

"Nor do we. No *natural* process. That keeps leading me back to one unpleasant conclusion. The information we've received from the Kermel Objects is true—we've done other checks on changes in stellar types. And there's no natural way for these changes to happen. So: either the Kermel Objects *induce* the changes; or some other entity, living in our spiral arm of the galaxy, prefers stars of lower temperature and luminosity."

"You mean something or someone is inducing reduced fusion reactions through the spiral arm—intentionally."

"I mean exactly that." Judith Niles's forehead filled with frown lines, and she suddenly looked a dozen years older. "It's a frightening conclusion, but it's the only one. I don't think the Kermel Objects are doing this, even though they seem to know a lot about it. We have

some evidence that suggests they understand the whole process, and they certainly seem able to predict the rate of change in the spiral arm. But I believe the action doesn't originate with them. What we're seeing is the work of another species, one more like ourselves—one that has no use for the deep space preferred by Gossameres or Kermel Objects. These other creatures want to live near a star. A red, low-luminosity star." She cleared the display, leaned back, and closed her eyes. "A long time ago humans talked of terraforming Mars and Venus, but we never did it. Just too busy blowing ourselves up, I guess, ever to get round to it. Now maybe we've met someone more rational and more ambitious than we were. What we are seeing is *stellaforming*. And if it goes on, and if we don't understand it and find out how to stop it, in another hundred thousand years this whole spiral arm will have no G-type stars. And that will be the end of human planetary colonies. Finis."

Judith Niles paused. She switched off all the displays.

"And we think the Kermel Objects hold the key," she said softly. "Now do you see why we're living out here in the middle of nowhere, and why S-space and T-state are so important? In normal space, a hundred thousand years used to seem like forever. But I expect to be alive a thousand Earth-centuries from now."

Sy wore an expression that Peron and Elissa would have found unfamiliar. He seemed uneasy, and lacking in confidence. "I read it wrong. I thought the only reason for being here in Gulf City was safety from outside interference, and control of S-space. The whole advantage of being an 'Immortal' was presented to us as increased subjective life span—but now I wonder about that."

"You are right to do so. We have life-extension methods available—ones that came out of S-space research—that can allow increased life span in normal space. And probably let the subject enjoy life more keenly, too. But you can't solve the problem thrown at us by the Kermel Objects unless you can work on it for a long time. That means Gulf City, and it means S-space." She stood up. "Will you work with me on this? And will you help me to persuade your friends to do the same?"

"I'll try." Sy hesitated. "But I still need to think. I've not had the thinking time that I wanted when I headed for the tanks."

Judith Niles nodded. "I know. But I wanted you to do your thinking with a full knowledge of what's going on here. You have that. I'll head back now. This chamber is self-locking when you leave. And as soon as you're ready to do it, let's meet again with your friends." Now she hesitated, and her expression matched Sy's for uneasiness. "There's something else to be discussed, but it's on another subject. And I want to do it when all of you are together."

She gave him a worried smile and headed for the door. For the first time, Sy could see her as a lonely and vulnerable figure. The power and intensity of personality were still there, unmistakable, but they were muted, overlaid with an awareness of a monstrous unsolved problem. He thought of the splendid confidence with which the Planetfest winners had lifted off from Pen-

tecost. They had the shining conviction that any problem in the galaxy would fall to their combined attack. And now? Sy felt older, and felt a great need for time to think. Judith Niles had been carrying a killing load of responsibility for a long time. She needed help, but could he provide it? Could anyone? He wanted to try. For the first time in his life, he had met someone whose intellect walked the same paths as his own, someone in whose presence he felt totally at ease.

Sy leaned back in his chair. It would be ironic if that satisfaction of mind-meeting came at the same time as a problem too big for both of them.

An hour later Sy was still sitting in the same position. In spite of every effort, his mind had driven back relentlessly to a single focus: the Kermel Objects. He began to see the Universe as they must see it, from that unique vantage point of the longest perspective of evolutionary time. With the T-state available, humans had a chance to experience that other world-view.

Here was a cosmos that exploded from an initial singular point of incomprehensible heat and light, in which great galaxies formed, tightened into spirals, and whirled about their central axes like giant pinwheels. They clustered together in loose galactic families, threw off supercharged jets of gas and radiation, collided and passed through each other, and spawned within themselves vast gaseous nebulae.

Suns coalesced quickly from dark clouds of dust and gas, blooming from faintest red to fiery blue-white. As he watched in his mind's eye, they brightened, expanded, exploded, dimmed, threw off trains of planets, or spun dizzily around each other. A myriad planetary fragments cooled, cracked, and breathed off their protective sheaths of gases. They caught the spark of life within their oceans of water and air, fanned it, nurtured it, and finally hurled it aloft into surrounding space. Then there was a seething jitter of life around the stars, a Brownian dance of ceaseless human activity against the changing stellar background. The space close to the stars filled with the humming-bird beat and shimmer of intelligent organic life. The whole universe lay open before it.

And now the T-state became essential. Planet-based humans, less than mayflies, flickered through their brief existence in a tiny fraction of a cosmic day. The whole of human history had run its course in a single T-week, while mankind moved out from the dervish whirl of the planets into the space surrounding Sol. Then S-space had given the nearer stars; but the whole galaxy and the open vastness of inter-galactic space still beckoned. And in that space, in T-state, humans could be free to thrive forever.

Sy sat back in the chair, drunk with his new vision. He could see a bright path that led from mankind's earliest beginnings, stretching out unbroken into the farthest future. It was the road to forever. And it was a road he wanted to take, whatever the consequences.

Chapter 29

Elissa was the last to arrive at the meeting. As she hurried into the long conference room to take her seat she glanced around the table, and was struck

at once by the odd seating arrangement. Judith Niles sat alone at the head of the table, head bowed forward and her eyes on the control console built into the table in front of her. Sy sat to her immediate right, and Peron next to him, with an empty chair between them. Peron looked a little uncomfortable, while Sy was obviously a million miles away, absorbed by some private concern. Wolfgang Gibbs and Charlene Bloom occupied seats on the opposite side of the table. They were sitting very close together, but well away from the rest. Wolfgang was scowling, and chewing moodily at a fingernail, while Charlene Bloom glanced from one person to another with rapidly blinking eyes. Elissa looked at her closely. Extreme nervousness? It certainly appeared that way, but for no obvious reason. And the whole room was unnaturally quiet, without the normal casual chit-chat that preceded even a serious meeting. The overall atmosphere was glacial and tense.

Elissa paused, still standing. She had a choice. Sit opposite Sy, and thus be between Wolfgang and the Director? Or next to Sy and Peron; or at the other end of the table, facing Judith Niles. She headed to sit next to Sy, then on some obscure impulse changed her mind and went to the end chair directly opposite the Director. Judith Niles raised her head. Elissa underwent a brief scrutiny from those intense eyes, then the Director nodded briefly in greeting. She seemed as remote and preoccupied as Sy.

"To business," Judith Niles said at last. "I gather that Sy briefed both of you on our meeting and conversation?"

Peron and Elissa looked at each other. "In detail," said Elissa. She waited for Peron, but he did not speak. "However, we still have questions," she went on.

Judith Niles nodded. "I am sure you do. Perhaps it is best if you first listen to what I propose. That may answer many of your questions for you. If not, we will consider them later."

Her words were couched as a suggestion, but her tone of voice showed she expected no argument. No one replied. Wolfgang ducked his head and seemed to be studying the granular plastic table top, rendered a soft continuous blur by the oddities of S-space optics. Charlene looked expectantly around the table at the others, then back to the Director.

"It is interesting that the arrival here of the three of you should coincide with a decision point in my own thinking," went on Judith Niles. "Although I could argue that your presence in Gulf City precipitated that point. By now you know something of our history here. For fifteen thousand Earth years, research work here has continued without a break: monitoring messages from the Kermel Objects; developing new techniques for slowing of consciousness, designed to make us better able to match the Kermel transmission rates; and making many attempts at direct communication with them. Failed attempts, I should add. But we have had some successes. We are assured now of the extreme age of the Kermels; we have learned how to present signals received from them reliably, as one, two, or three dimensional arrays; we have confirmed by independent methods that the changes in stellar types in this spiral arm of our

galaxy are real; and finally, we are beginning to see hints of methods to slow subjective experience rates even further, beyond those of T-state.

"These are all major advances. Yet you do not need me to point out that they will all be of no value unless we can learn how to inhibit the stellaforming of G type stars. We face the possibility of greatly extended life spans, with no place to live except far from our home stars. If that happens, we will also face the extinction of all our planetary colonies. And that is an intolerable thought, even if we forget recruitment needs from normal space to S-space.

"Before you arrived, the senior staff of Gulf City, and in particular Wolfgang, Charlene, and I, had worried long and hard about the slowness of our progress. I decided some time ago that the pace of our efforts had to be picked up—by whatever methods. This is an absolute necessity. And to accomplish it, I have resolved to take an unprecedented step. You, the three of you, are uniquely central to that step."

Elissa and Peron looked at each other in surprise, then both turned to Sy. He was unmoved, his usual cool self.

"Hear me out," went on Judith Niles. "Why you? Because you have not yet become locked into our existing ways of thinking about the problem. We must find totally new avenues, create new thought patterns, and explore different options; but we cannot do that—we are too wedded to our existing exploration, and too fixed in the pattern of past analyses. Stay here for a few months, and you will have the same problem. That is why I propose a change at once, before you harden into our ways and ideas.

"What I am suggesting is revolutionary. I expect to establish a completely new facility, similar to Gulf City but in a separate location. It will have independent management, and independent research staff. The location that I have as first choice is eighteen light years from here, and almost twelve light years from Sol. It does not have quite the same degree of isolation from interference as this site, but signals received here from Kermel Objects will naturally be available to the new facility. There will be cooperation, but strictly limited interchange of information. We cannot afford to inhibit each other's research.

"And now, here is my specific proposal: you three are invited to go to that facility, with the best support that we can offer from anywhere in our network of colonies and stations. You will not merely be *participants* in the facility's research; you will in practice direct it, setting directions and allocating resources." She smiled. "I am sure you feel suspicious. Why would I, without taking leave of my senses, entrust a huge new undertaking to three near-strangers? I will tell you. Your performance to date has been highly impressive, but my real reason is far more compelling: we are becoming desperate here. *Something* must be done, and something new has to be tried."

She looked along the table. "You are silent. I am not surprised. I would be silent also. But when you have questions, I will do my best to answer all of them."

Sy did not move. He had been nodding his head a tiny fraction as she

spoke, but now he was motionless. Wolfgang and Charlene were looking at Peron and Elissa, and avoiding Judith Niles's eye. Charlene looked tenser than ever.

"Why us?" said Peron at last. "Why didn't you do it with the last group of people to find their way to Gulf City?"

"For two simple reasons. First, I did not feel they could do it—I feel that you can. And second, I had not yet reached my own flashpoint. Now I feel a great need for action. Our present approach is too slow, and we must have at least two facilities working in parallel."

Peron looked at each participant in turn, taking his time, then finally turned back to Judith Niles. "When do you propose this would begin?"

She smiled with her mouth, but her eyes remained tense. "I am now about to fail one test of a good manipulator. Take it, if you will, as evidence of the depth of my concern on this issue. The process for creating the second facility has already begun. A station from Sol is now on the way to form the facility's nucleus, and other equipment is in shipment from three Sector Headquarters. It will be ready for operation as soon as you arrive there. If you agree, I hope that you will begin your journey at once. You can become familiar with details of equipment on the way there."

Peron nodded. "And what experiments would we do?"

"You will tell me that—remember, too much direction from here and the second facility becomes useless." She smiled again, and this time there was real humor there. "Talk to Wolfgang and Charlene, if you want to know how much it costs me to remove myself from the direction of the new effort. All my working life I have insisted on hands-on knowledge of any experiments under my control. Now I am promising to turn my back on you."

Judith Niles touched the controls on the table top, and the room began to darken. Behind her, panels in front of the big display slid open, and a flickering pattern showed on the screen.

"You will need time to make a decision. I expect that, but I also urge you to minimize that time. The most important job in human civilization is waiting for you. And for that reason, I do not hesitate to use unfair tactics of persuasion. I have one more argument to present to you. If you are the people that I believe you to be, it cannot fail to sway your opinions.

"A few days ago we received at Gulf City a video message from one of our Sector Headquarters, out near the planet of Paradise. It was sent via Earth, and addressed to you. It appears to be in clear form—though I know your penchant for hiding coded messages in with clear ones. The clear message is quite enough. Watch closely."

The screen behind Judith Niles now showed the image of a man. He was a stranger to Elissa, gray-bearded and balding, with a prominent nose, pale gray eyes, and a craggy, lined face. A faint scar ran across his forehead, diagonally from the upper right to his left eyebrow. He grinned, looked directly into the camera, and raised his hand in greeting.

"Hello again. Greetings from Paradise—or near it."

Elissa heard Peron gasp, at the same moment as she felt her own rush of rec-

ognition. There could be no mistaking that strained, husky voice and precise diction. "It's Kallen!" said Peron. "My God, Sy, that's Kallen."

"Yes, quite right," said the face on the screen, exactly as though he could somehow hear the comments in the conference room. He grinned again. "This is Kallen, the one and only. Long time no see. But now get ready for a bigger shock."

The camera field of view slowly panned across from him to a large photograph, then zoomed in to take a close-up of a group of eight people. In the foreground, sitting cross-legged on cushions, were two teenage girls. Behind them, on a bench, were two men and two women in early middle age, and an elderly couple stood at the back in the center of the picture. The old man was white-haired and stooped, with heavy shoulders and a substantial paunch. The woman, also white-haired, was thin and wiry. Everyone was smiling.

"More greetings," said Kallen's thin voice. "And also a farewell. From Lum and Rosanne, their children, and their oldest grandchildren. There are four little ones, not in the picture. They are all still living on Paradise at the time I send you this message. When you receive it, they expect to be long dead." He shrugged. "Sorry, friends, I know we told you that we'd follow you to Earth in a few S-days. As you can see, it didn't quite work out that way.

"I expect that this will take a while to reach you. I know you're not on Earth, even though this message will be routed that way. But I've heard more than you might think about what you've been doing. Sy will tell you that nothing in the universe can travel faster than light, but let me tell *him* that doesn't apply to rumors. There are great rumors about you three, and what you did to Sol's data bases and computer network—I wish I'd been there to help cheat the system. Don't give up on me, though. I expect that I'll see the three of you eventually.

"Rosanne and Lum asked me to give you their love, and to tell you not to grieve on their behalf. I pass that message, and agree with the sentiment." Kallen smiled. "I suspect that you are feeling horrified with the way that Lum and Rosanne look in this picture, and probably horrified also with the way that I look. But don't make the mistake of feeling sorry for them, or for me. Their lives have been the most rewarding of anyone I know. They lived happy, and they're happy now. And if you think of us as old people, remember that we think of you as children. Smart children, sure, and we love you like our own sons and daughters; but still children. Don't confuse calendar time and experience. When two or three hundred Pentecost years flash by in a month of S-space, you don't get the knowledge of life that comes with thirty years of living. You all have a lot of real living to do.

"I promised Lum and Rosanne that I would tell you what happened here. I'm back in S-space, in orbit around Paradise. I've been here for twenty-five Earth years. But I couldn't persuade them to join me. Sy, do you remember the arguments we had, after Planetfest was over, on the strongest force in the universe? Well, I can tell you now, it's not gravitation, or the force governing hadronic interactions. It's a force unique

to living organisms. When Lum and Rosanne went down to Paradise, it was a frightening world, where all the humans had died. They wanted to stay there long enough to study the problem thoroughly. And after a few months, Rosanne became pregnant. They wanted the baby, but they knew they couldn't raise a child in S-space. And the idea of leaving their children was unthinkable to them. They stayed, to raise the family. *That's* the strongest force. After a while I joined them, down on the surface. I was there when each of the children was born.

"We were trying to find out what had killed off the previous colony on Paradise, and we had the best possible incentive. Unless we found an answer, we could go the same way, along with the children.

"I won't bore you with details. It took nearly thirty years, and we felt like giving up a dozen times. But we found the answer. Paradise has a benign protozoan parasitic life form, part of the intestinal flora and fauna that help the animals there to digest cellulose. It usually stays in the alimentary canal, but a few organisms make their way into the blood stream. No problem. The animals remain healthy, and don't even know the bugs are there. The colonists found that the organisms were inside them soon after they arrived, but all the tests showed that they were just as harmless to humans as they were to the native animals. Paradise has a wonderful climate, and fertile soils. The human colony was doing fine, thriving and growing. Until they decided it would be less effort to import food synthesizers, and make most of their food rather than growing it.

"And since humans can't digest cellulose, the synthetic foods didn't contain it. An alternative indigestible material was used to provide food bulk. Most inhabitants of Paradise, including everyone in the cities, turned to use of the synthetics. Still everything seemed to be going well, and they were all in good health. But the internal parasites were suddenly deprived of food, and when that happened many of them migrated out of the alimentary canal and into the bloodstream. They starved and died there. Those deaths seemed to produce no ill effects on the human hosts—they weren't even aware of it. But one of the decomposition by-products of the parasites has a structure very similar to a human neuro-transmitter. So far as we can tell, human intelligence all over Paradise suddenly dropped, fifty to a hundred points, from normal range to sub-moron. And it happened quickly. The city dwellers became ferocious animals, not smart enough to operate their own signalling system and call for advice and assistance. And they turned on the few people outside the towns, and killed them as they found them. By the time the next ship touched down on Paradise, it could find no survivors. And since the cause of the problem was still unknown, the ship did not stay long.

"Well, I've said enough to make my point. Paradise is a safe, habitable planet again. I helped a little, but it was really Lum and Rosanne who cracked the problem, and pointed out the simple solution: adequate cellulose in the diet. And that's related to the message that they want to send to you. Back on Pentecost, and later when we were looking

at the Fifty Worlds, we had long debates on the usefulness of our lives. Lum and Rosanne feel they found the answer. They wouldn't put it this way, but they saved a world. Don't waste your life on small problems, they say. Find the biggest challenge that you can, the hardest one, the most frustrating one, and hit it with everything you've got."

Kallen paused. "See, I've changed, too. Thirty years ago, the speech I've just given was a month's supply of words. But I'm finished. I told you not to grieve for Rosanne and Lum. I meant it. If you ever have the satisfaction of finding a problem as big as the one they found, and solving it, you'll have answered our old question about the meaning of our lives."

Kallen's face went solemn, and he looked into the screen for a long time without speaking. "I'd like to see you all again," he said at last. "But the odd thing is, I know exactly what you look like. You haven't changed a bit since we said goodbye at the Cass system Sector Headquarters. Whereas I . . ." He shrugged, and ran his hand across his balding head. "Goodbye, old friends, and good luck. And seek the highest, whatever you do."

The picture on the screen dissolved to a formless flicker of white, then that too faded to leave the room in darkness.

"Bless them," said Judith Niles softly. "I never knew Lum and Rosanne, but I grieve with you to know that they are dead. They were just the minds and spirits that we need for our problems here. Seek the highest, the hardest, the most frustrating. If you wanted a one-line description of the Kermel Objects and stellaforming, those all apply. I wish we had Rosanne and Lum with us, but there will be others. Kallen may find his way here. He said as much, and from what I have heard of him from Paradise Station, he'll be hard to stop once he makes up his mind to get here."

"Impossible to stop," said Peron softly. "I just wish he were here with us now."

"But he is not." The lights in the conference room slowly came back to normal intensity, and Judith Niles gave her full attention to Elissa and Peron. She looked from one to the other, meeting their eyes. "You heard your friends. I don't see how you can resist that message. They saved a world. You have a chance to save every planet that can support human life. Don't you feel as though they could have been speaking to you about the exact problem we have here, and telling you to undertake it?"

Elissa looked around her. Sy was nodding. She realized that his decision had been made before he heard the message from Kallen—perhaps before this meeting began. She turned to Peron. He was wavering, half-persuaded but still uncomfortable. Elissa was on her own.

"NO!" The word seemed to burst from her, surprising her with its force and intensity. "No, that's not the answer. You're missing the point."

There was a ghastly silence. Everyone looked at her in astonishment—even Peron, and she had hoped that he would understand at once. "Can't you see it?" she went on. "You've missed the real significance of their message."

"I very much doubt it," said Judith Niles curtly. Her face was calm, but the scars were prominent on her forehead. "It was clear enough. Work on major

problems, and do not let yourselves be distracted with trivia.''

''Yes, certainly—tackle big subjects, there's no question about that. But look behind the message, at the facts. The problem on Paradise had been known for *five thousand* Earth years, and no one had come near a solution. Until our friends came along, people were studying it *from S-space*, and that gave only a couple of S-years of effort. Now look at our situation. We have fifty thousand Earth years to learn how to control the changes in stellar types—maybe a hundred thousand years if we are lucky. With that much time available, the human race should be able to solve anything, any problem you care to mention. *But not if you work it in S-space.* That moves at a snail's-pace—and we need fast action.''

''But the messages from the Kermel Objects are absolutely vital.'' Judith Niles was leaning back, a perplexed look on her face. ''They're quite inaccessible from normal space.''

''Of course they are—and somebody must be in S-space or T-state to receive them. But the analysis of those messages must go as fast as possible. That means we must be in normal space. You have to change your system, change it completely. Tell the planet-dwellers the problem, and make them the key to its solution. *That's* the rest of the message from Kallen and the others, the part you've been ignoring.''

Elissa leaned forward across the table, her full attention on Judith Niles. ''You want us to work on the central problem? I'd love to, there's nothing in the universe that I'd like better. But *in normal space*. I know I may never see the solution if we do it this way. But I'll take my chances, because I feel sure that my descendants will find the answer, maybe a thousand Earth years after I'm dead. That's enough to make it all worth it for me.'' She looked at Peron, and drew encouragement from his expression. He was nodding vigorously, his earlier uncertainty gone.

''I agree completely with Elissa,'' he said. ''Though I didn't see it until she pointed it out to us. Let's go ahead just as you suggest, and set up your second facility. But in *normal* space. You'll feed us the best information you can collect in Gulf City, as you get it. We'll be turning that to new theories, two thousand times as fast as you could ever do it in S-space.''

Judith Niles had listened closely, but now she was frowning and shaking her head. ''It sounds good. But it would never work. Both of you, listen to what else your friend Kallen said: 'You lack experience.' It will take many years to acquire it. You need the interaction with us, here in Gulf City—and you could never gain the benefit of our experience if you were in normal space and we stayed in S-space. The information exchange problems are enormous. I said I would leave you free to undertake experiments in the second facility, but you would still have access to us, to talk to and exchange ideas. No.'' She shook her head. ''It sounds good, but it wouldn't work.''

''I agree with Elissa,'' said Wolfgang Gibbs suddenly from the other side of the table. He stopped, as though amazed at his own outburst. When he continued he addressed his words to Judith Niles, but he kept his eyes on Elissa and Peron,

as though drawing support from them. "She's right. We'll be able to progress thousands of times as fast in normal space as in S-space—not to mention T-state, and you know that's my own special baby. I've worried the problem for months and years, wondering how to make better progress. But I never thought of two facilities, one in S-space and one in normal space. To us, used to the way things are here, normal space is almost the unthinkable thought. Shorter life span, planet-grubbing, probably never seeing a solution. But I bet it will work."

He paused, hesitated, looked at Charlene and Elissa, then at Judith Niles. His face was pale, but there was only conviction in his voice. "Your point about experience is a valid one. There is no substitute for years of practical experience of your work here. But I have that. If you go ahead and set up a second facility, in normal space, then I am volunteering to go to that facility."

"Wolfgang!" said Charlene Bloom. The word came from her unbidden. She bit her lip, and looked down. They were revealing too much—too much new hope in his voice, and too much raw pain in her own.

Judith Niles was sitting bolt upright in her chair. Elissa's support had come from the place she least expected it. "And you, Charlene?" she said calmly. "Since we all appear to have formed our opinions by now."

Peron looked at the Director and marveled. Like Sy, she appeared able to move instantly from one position to another, and be ready at once for the next stage of discussion. It was as though her analysis of Elissa's and Peron's remarks had been performed automatically, subconsciously, needing no time for assimilation and full reflection.

"I'll stay here," said Charlene after a few seconds. She turned to look at Wolfgang, and her voice was despairing. "My work is here, in Gulf City. I couldn't do it in another facility. But Wolfgang, if you go—who could do your work on T-state?"

Judith Niles looked at Sy, who gave a fractional nod of his head. "We have a volunteer for that," she said. "Sy is keen to explore T-state—and beyond. So now . . ."

She leaned back in her chair and closed her eyes again. "Now comes the difficult question. You are proposing a radically different approach. Am I persuaded that it will work?"

"Wrong question," said Peron.

She opened her eyes and smiled at him. "True. I stand corrected. We cannot know in advance what will work, and what will fail. The right question, then: do I think a second facility in normal space has a better chance to succeed than one in S-space? The answer: maybe. Just maybe. I thought of many options, but I never seriously considered the Mayfly solution."

"You can't afford *not* to try it," said Peron. "Even if you reject it, we'll attempt it."

"I know. Bad position for a boss, right?" She smiled, then turned to Wolfgang. "And do you know what you are volunteering for? We can give you an extended life-span in normal space, but you will still be dead in much less than one S-year."

"Give me credit for something, J.N." Wolfgang's moment of defiance had

brought him a new confidence. "I know exactly what I'm offering to do. I'll go to normal space, and I expect that I'll die there. So what? I saw that message from Paradise, too. And now I think about it, I never really wanted to live forever. I just want to live *well*. Sy can do my work here at least as well as I can, probably a damned sight better. Let's get on with it, I say."

He did not wait for an answer from Judith Niles. Instead he turned to Charlene and took her hand in his. The room went silent, with everyone watching closely. Charlene's mind flashed across the centuries, to the time back on Earth when Wolfgang had horrified her by secretly stroking her thigh in J.N.'s presence. But this time she did not flinch when Wolfgang touched her gently on the shoulder. Her vision was clouded with tears. She moved to meet him when he leaned forward to kiss her, and put her arms around his neck. The final words had not been spoken, but she knew that the decision was already made.

The departure for a second facility could not happen immediately. She and Wolfgang would see each other many times before there was another parting, formal and final.

But this moment was unique. This was their first goodbye.

EPILOGUE

Five minutes. Five minutes remain. And after that? If I were sure of the answer, a forty-billion-year journey could have been avoided.

Five minutes . . . to the moment of the monobloc.

The Kermel Objects are all around me, crowding in as the universe dwindles. They are finally silent; even the low frequency transmission has subsided to nothing. And the Kermels have changed in appearance during the past two hours. There is a pulsation now at their centers, like a slow, strengthening heartbeat; and the outer tendrils have been steadily contracting, to tighten about the darker center. I feel as though I am witnessing a parody of galactic evolution, atramental spiral arms drawing close, knotting into the cores. The innermost regions are totally black. They look like holes in the universe.

Beyond them, everything grows brighter and brighter. I see it only as it is filtered through the protective layers of the Kermels, but every few moments there is a flare of blue, then a scintillation so fierce I cannot look at it. It is a beauty that the Universe perhaps sees once only. . . .

Four minutes. We are approaching the final singularity. The total radius of the Universe is now less than eighty million kilometers. Another two hundred seconds, and the point of infinite compression will arrive.

Five seconds before that, the diameter of the Universe will be less than the size of a Kermel Object. And then?

The end of the journey; faster and faster.

If there is to be a singularity, the moment of final annihilation must occupy zero time.

And my mind wanders. It insistently pokes a fact forward, an element of mathematics learned long ago and thought long-forgotten. *In the neighborhood of an essential singularity, a complex variable assumes all possible*

values. If that has relevance here, approaching the ultimate singularity of our Universe, then three minutes from now anything will be possible. As chaos grows out of order, nothing is forbidden.

My three companions are silent, overwhelmed by the sights around us. They are content to watch the displays, while I record this final message—to whom?

There is another change. The stars went long ago, vanished into the glowing bubble around me. Now there should be no residual structure to space. But the Kermel Objects persist. They take on darker and darker shades, standing solid against the golden-blue dazzle of cosmic collapse.

Witness the anomaly. The brightness grows, the Universe shrinks toward its final point; but the Kermel darkness is undiminished.

The black spirals surrounding me draw tighter, tearing open sharp-edged holes of shadow, quenching the inferno, gobbling up energy. They provide my shield from an intolerable glare. Without their protection I would long since be burned alive; instead, the temperature in the ship remains constant. The temperature of the Universe—if temperature still has any meaning—is trillions of degrees.

I know what science and logic tell me to expect. At the final mini-microsecond, in the terminal instant of un-creation, everything disintegrates. Nothing can survive infinite temperature, infinite pressure, infinite density. All will be gone, all consumed. . . .

. . . unless, perhaps, consciousness can transcend the limitations of physics?

I do not know. Less than one minute from the end, the nature of reality still eludes me.

The sky is infinite contrast now, swelling black and impossible radiance. Twenty seconds to the monobloc. There is no time left for time. *Fifteen seconds.*

This is Sy Day, once of Pentecost and now of everywhere. In the final moments of infinite light, I proclaim my faith:

I have made no error. I have interpreted the message of the Kermel Objects correctly.

The end is the beginning. There will be tomorrow. ■

Thomas Donaldson

HOW TO GO FASTER THAN LIGHT

"Every freshman knows it can't be done"—but then, they don't tell freshmen everything. . . .

"Absurdity: a belief in which one has not had the misfortune to be instructed." —Ambrose Bierce

"If relativity theory allows the existence of tachyons then if they exist it is good to study them and if they do not exist we learn that something is wrong with our understanding of relativity theory" —H.C. Corben

This is an article about heterodox interpretations of relativity, that is, *absurdities*. It's almost all theory, without experimental basis. Even worse, none of it coincides with the King James Version of Relativity. To understand it, you'll need little mathematics but a lot of willingness to look on physics from angles different than usual. I shall take as fundamental not even experiment, but the *working engineering device*. We must always *interpret* experiments; but a regular freight service to Arcturus would be unanswerable. What we want to do here is to ask: "What kinds of devices are possible?" Hardly any of the theorists and experimenters whose work I'll discuss have names as Authorities on relativity; but their theories

have equal *logical* status as attempts to make sense of the universe. Perhaps some of these ideas will even lead somewhere. After 80 years of questioning, the King James version of relativity has a lot of obscurities.

The FTL Drive

As readers of *Analog*, of course, the first question we'll want to answer is whether or not a "faster-than-light drive" is possible. The *classical FTL drive* has several properties:

1. The drive transports a spaceship, which may travel in any direction.

2. The spaceship can travel to any point of the universe.

3. The spaceship can travel at speeds very much greater than that of light.

Unfortunately not only do these requirements raise *physical* problems, they also make severe difficulties of a kind *Analog* readers will understand immediately. If such a drive were possible, then we would expect that any intelligent species, *anywhere in the universe*, could quickly spread to our Galaxy. This would considerably exacerbate any problems we might have with the Fermi Paradox.

I actually believe that the Fermi Paradox is *the* major difficulty with an FTL drive. But there are also more traditional *physical* difficulities: an FTL drive should also allow a form of time travel! If so, our problem is *worse*, since not only might we be colonized by extraterrestrials from distant galaxies, but also by ourselves from our own future! However we'll see very soon that neither our ideas of Causality, nor of Time, are so clear and well-defined as to produce any arguments stronger than the Fermi Paradox.

So I'll suppose that any device with all three of the properties listed is impossible. Naturally, then, we want to know whether transport that has only two of these properties might still be interesting. If the FTL drive allows transport only in some *fixed directions* or *special locations* it could still be very useful. Here are some examples:

1. Imagine a device that allows travel or communication in one direction, but not the opposite direction, at velocities faster than c. *Round* trips could therefore take *half* the time expected. One theorist, A. Antippa, presents a theoretical study of a kind of message transmission with just this one-directional property (*Nuovo Cimento* 10A [3] [1972] 389). He postulates a special particle, which can only travel in one *space* direction, in much the same way as normal particles can only proceed in one *time* direction.

Antippa shows that particles that could travel in only one direction would avoid any paradoxes with backward time-travel. He supposed that *all of space* had a preferred direction. We do not have to do this; we can imagine a special "hyperlight field" allowing hyperlight motion in one direction only. To avoid causality problems, all we need is to have it prevent the construction of a similar "hyperlight field" pointing in the opposite direction, at any point closer than its diameter (see Figure 1). We therefore could not use this field to make a *return* journey at faster than c.

The Antippa field allows hyperlight passage *in one direction only*. In the diagram, passage is always from N (North) to S (South).
In order that we never violate causality, N and S poles of two different Antippa fields can never be so close to one another that passage around the square takes less time than light takes in going from N to S and back again directly, without the field. In the diagram the Antippa fields are symbolized by heavy lines; the light lines are the straight line distances between the poles. The sum of Sides 2 and 4 must always exceed each of Side 1 and Side 3.

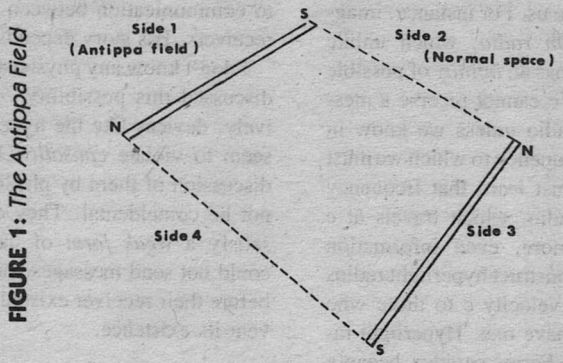
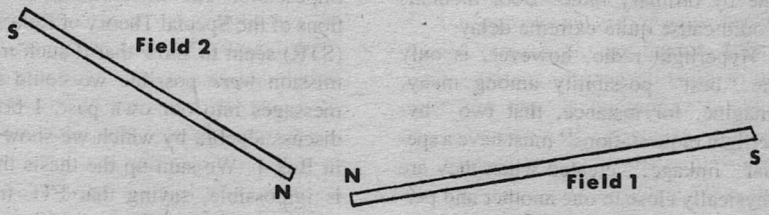


FIGURE 1: *The Antippa Field*

However two North poles, or two South poles, can be close to one another.



However, we might still make useful engineering devices that are not means of back and forth transport. Suppose we are miners sent to a far planet. We want to send the products of our mines to Earth quickly. We could use the hyperlight field to construct a *hyperlight runway* transferring ore back to Earth faster than c, just the thing needed!

2. The means of transport might not allow travel to any arbitrary point of the universe. This alternative opens many

possibilities. We'll come back to it often. I mention it here because it provides the best possibility for a kind of FTL travel free of difficulties with the Fermi paradox.

How could such an effect be possible? Imagine, this time, that the location to which we travel must be somehow *prepared* to receive us. For instance, imagine a *hyperlight radio*, which unlike ordinary radio has an *infinity* of possible frequencies. We cannot receive a message on this radio unless we know in advance the frequency to which we must tune it. We must learn that frequency by *ordinary* radio, which travels at c only. Furthermore, even information about how to construct hyperlight radios must travel at velocity c to those who don't already have one. Hyperlight radio avoids the Fermi paradox because ETIs living in some far galaxy must first either bring their FTL radio here (by slow means), or else tell us how to build one by ordinary radio. Both methods would cause quite extreme delay.

Hyperlight radio, however, is only the "best" possibility among many. Imagine, for instance, that two "hyperlight radio stations" must have a special "linkage," created when they are physically close to one another and persisting no matter how far apart they become. If so, the only way to use these stations for communication or transport between two galaxies would be to *physically transport* one of them to each galaxy, A and B. It might not even be possible to transport a "station" by using another station.

Even though these devices don't resemble spaceships, they *would* allow rapid communication and transport in a human-inhabited galaxy *once it had been colonized by slow means*. Poul Anderson has used an idea very similar to this in his novel *The Enemy Stars*, but his means work very much like radio. In particular, there were no barriers to communication between unprepared receivers. His story depends upon that.

I don't know any physicists who have discussed this possibility. At least naively, devices like the hyperlight radio seem to violate *causality*; lack of any discussion of them by physicists would not be coincidental. They do however satisfy a *weak form* of causality: we could not send messages back to a time before their receiver existed and so prevent its existence.

Causality and Time

Many people thought for a long time that FTL transmission of messages was impossible. The transformation equations of the Special Theory of Relativity (STR) seem to show that if such transmission *were* possible we could send messages into our own past. I briefly discuss algebra by which we show this in Box 1. We sum up the thesis that it is impossible, saying that FTL transmission would violate causality. But wait a minute. "Causality"? "Messages"? "Past"? Operationally, just what is a "message" or "causality"? It seems that the whole of relativity rests on some quite unclear ideas.

Furthermore, our problems with causality worsen when we remember that *general* relativity actually allows

solutions that clearly violate causality. Gödel produced the first such solution (*Rev Mod Phys* 1 [1949] 447–50). U.K. De and F. Tipler present others. All such solutions allow particles to travel to their own past.

In fact, one physics conference (AIP Conference Proceedings No. 16, 1973, *Causality and Physical Theories*) took up the problems of working out how these ideas fit together, if indeed they do.

The main reason why most people (not just physicists!) would be unhappy about sending messages into their own past is that doing so creates an anomaly with their own history and memories. That is, they could become millionaires by telling themselves how to win the Sweepstakes. Observing that (unfortunately) they are not now millionaires, a problem is created.

We might of course suppose special physical processes that somehow *force* consistency upon us. Apparently random events might *always* conspire to prevent any successful attempt to influence the past. However that does not seem an economical way of forming a physical theory.

It's nevertheless very hard to use causality to show that FTL transmission is impossible. Transmission might be feasible by some mechanism currently unimagined which avoids all of these doubts. We certainly don't have a well-formed idea of why backward communication is *impossible* (rather than just something that makes us feel uneasy).

Furthermore, when one atom emits a photon and another atom receives it, the two are *not* "sending messages." They simply interact. Why not interaction backward in time? As for causality, some interactions may simply not be possible, and causal paradoxes begin to seem a good deal less paradoxical. This fact lies behind one of the most fundamental explorations of FTL particles, the theoretical studies of *tachyons*. As most readers know, tachyons are (HYPOTHETICAL!) particles which travel faster than light and have imaginary mass. Bilaniuk, Sudarshan, and Deshpande (*Am Jour Physics* 30 [1962] 718) first proposed their possibility, and Recami and Mignani have done a good deal of work on them.

Soon after these theorists proposed tachyons, some physicists devised apparent causal paradoxes. These paradoxes involved chains of observers, A, B, C, D emitting tachyons in response to receipt or nonreceipt of a tachyon (see Box 2). These paradoxes, however, assume that *all* observers must give the same account of who *sends* and who *receives* a tachyonic signal. Because the order of these events differs for different observers, they should *not* all name the same people as senders and receivers. We have to make several other attributions too for everything to make sense; in 1970 Trefil and Root showed that *if* we use the right interpretation rules, *every* observer sees a consistent causal sequence of events (JS Trefil, RG Root *Lett Nuovo Cimento* 3 [1970] 412).

These events still look very strange, however. For instance, what observer C sees as receipt of a tachyon followed

by its emission the observer D will see as the emission of a tachyon and an antitachyon. Observer B will receive a fortuitous tachyon from infinity at just the time expected if observer A refuses to send a tachyon to B. If we consider these events as happening to subatomic particles, they are consistent and reasonable. But the idea of *macroscopic messages arriving from infinity just in time to replace messages which otherwise would not have arrived* still seems quite unreasonable.

Unreasonable, however, is not obviously the same as impossible. The real difficulty is that we are attempting to base a hard physical conclusion, the impossibility of FTL messages, upon an extremely vague idea, the notion of causality.

Several physicists have made a determined attempt somehow to define the problem with *macroscopic* FTL signals in terms of *entropy* and thermodynamic arguments. Terletskii (*Paradoxes in the Theory of Relativity*) attempts to argue that FTL transmission of messages would violate *thermodynamic principles*, by carrying negentropy backwards in time. That is, he claims that devices for FTL transmission would violate the Second Law of Thermodynamics.

I believe Terletskii is wrong. What he really shows is that (unlike ordinary radio) hyperlight radio messages will cost energy to *receive*. NET entropy, of course, would then increase for both sender and receiver. The problem with thermodynamic arguments is that neither sender nor receiver is a closed system. Receivers of tachyonic signals could pay for their reception by drawing energy from elsewhere.

However, Terletskii does show us useful facts about our hyperlight radio: both sending and receiving must increase net entropy. Furthermore, transmission can't carry energy without violating thermodynamic principles.

So thermodynamic arguments might restrict the possible kinds of FTL transmission, or even let us conclude that it either is or isn't possible. A second author, Richard Schlegel (*Found Physics* 3[2] [1973] 169), takes quite a different tack. He points out that there are *two* different ways to measure the passage of time, and asks whether the famous Lorentz time dilation might not apply to only *one* of these rather than both.

Schlegel's first measure of time is the familiar one of electronic cycles. His second measure is *entropic*. For instance, a mixture of gases will reach equilibrium at a certain rate; we can use this rate to measure time. As background, we recall that thermodynamic processes are *macroscopic* and don't depend on *microscopic* processes, which are entirely reversible. There's no reason in *microscopic* physics why mixtures of gases can't spontaneously separate into two pure samples. It's therefore not obvious that corresponding time measures will always coincide.

We all take for granted that "time" is, well, TIME, that there is one unitary flow. If we can measure time more than one way, however, we have to consider the *possibility* that these measurements could become seriously out of kilter. That is, events happening one hour ago

by one clock happen two days in the future by another! Coincidence of these two clocks is an *experimental* question. Of course, if even time's *direction* depends on our clock, then our notion of time itself must be very unclear.

Imagine two spaceships moving relative to one another. Aboard each ship are *entropic* clocks, which give time measurements independent of any interaction between the two ships and *also* independent of any electronic measurements. No one has yet produced either theory or experiment proving that such entropic clocks must show time dilation.

If the entropic clocks *were* unaffected by relative motion, we could then have an absolute measure of time and hence of causality too. With this measure, we could specify just how and what kind of FTL messages did not violate thermodynamic constraints. In particular, FTL messages might go backward in time according to electronic measurements but forward by entropic measurements.

BOX 1: *For those who want to see the ALGEBRA (Part 1):*
Here is a short account of why FTL signaling implies signaling into the past. The Lorentz transformation for time is:

$$T' = \frac{T - (v/c^2)\cdot X}{\sqrt{1 - (v^2/c^2)}}$$

where T' is the time for a clock moving with velocity v and T the time for a clock at rest. If a signal moves from a point where $X = 0$ to X with velocity U (as measured by the clock at rest) then the time taken by the signal as measured by the moving clock is:

$$T' = \frac{T\cdot(1 - U\cdot v/c^2)}{\sqrt{1 - (v^2/c^2)}}$$

Now suppose that the velocity U is greater than c. If v is large enough, the term

$$\frac{U\cdot v}{c^2}$$

is *greater* than 1. Suppose that A is stationary, B is moving with a high velocity v, and A sends a signal to B. THE SIGNAL THEN ARRIVES AT B BEFORE IT LEFT A.

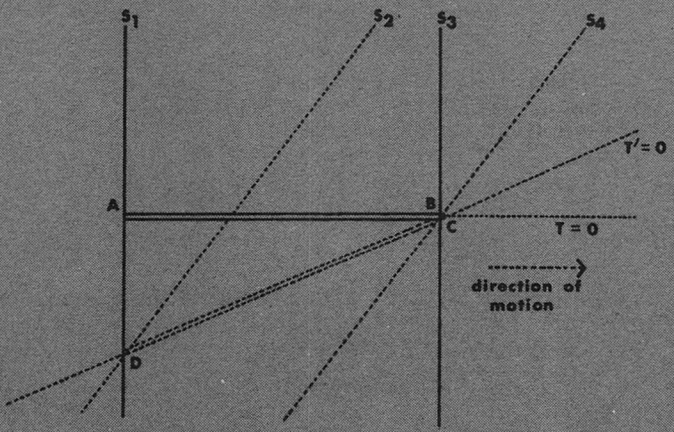
Most discussions of FTL effects assume they are carried by *particles*. Other effects can happen. Imagine, for instance, an FTL influence that causes collection of a gas mixture into two pure samples. We could not even *detect* such an influence on a subatomic level.

Schlegel points out that the famous

experiment by Hafele and Keating, using atomic clocks flying around the world, may prove that entropic and electronic clocks coincide. These clocks, however, were moving *circularly*, hence were *accelerated*; the Hafele-Keating experiment might only test coincidence of *gravitational* and entropic time.

I'm not sure that Schlegel's distinction between entropic and electronic clocks really exists, but he is trying to confront a problem, the problem of *thermodynamics and relativity*. This is a key problem, involving both time and caus-

BOX 2: *How to win the Sweepstakes by telling yourself yesterday who won today:*
You will need robots which will send the signals you tell them to send. In the diagram, the vertical axis is time. You are at A. You have a robot at B (who is stationary relative to you) and two robots at C and D who are moving at a high velocity in the direction of the arrow. A,B,C,D all contain *hyperlight radios.*



Because C is *moving*, C will see the events along the dotted line T' = 0 as all happening at the same time. You will see the different events along the line T = 0 as all happening at the same time. NOTICE THAT EVENTS AT TIME T' = 0 HAPPEN IN *YOUR* PAST!
For simplicity, I'll suppose that hyperlight radio is instantaneous as measured by an observer who is its SOURCE. You are at A. As soon as you know who won the Sweepstakes, send a hyperlight radio signal to B. B then sends his signal to C, who sends it to D. At the instant C's signal reaches D, D is moving past you at high velocity. D tells you what he has just learned from C, and you place your bets immediately.
In the diagram, S1,S2,S3,S4 are the paths followed by A,B,C,D.

ality. Even the definition of thermodynamic quantities isn't clear in relativity: for instance, several definitions of temperature exist (H. Arzelies, *Compt Rendu* 80[22] [1975] 1563).

One basic thermodynamic idea is the *closed system*, isolated from the rest of the universe. P. Havas, a third physicist (AIP Conference NO 16, *Causality and Physical Theories*, p. 23) uses closed systems to make one of the most interesting comments about causality. Havas points out that we don't sense any conflict with our ideas of causation if FTL processes go on within closed systems. Because closed systems are isolated, we see no *messages* transmitted, we just see bodies interacting. If some bodies happen to interact backward in time, we merely observe the results, which will inevitably be self-consistent. Causality problems arise when we imagine actually *taking part* in these interactions.

What does this mean for *engineering devices*? Here is another possible device, the *tachyonic computer*. A tachyonic computer operates much faster than ordinary computers because its parts interact through *tachyons* or some other FTL means. The calculations it carries out are the unfolding of a totally deterministic process, predictable in theory solely from the initial data. Because this process is totally deterministic, we don't even have any entropy decrease during calculation, nor do we even have transmission of information.

Yet tachyonic computers would have lots of use. The design of the Cray I, for instance, is controlled by the need to make all data paths as short as possible, for the highest transmission velocity.

Tachyonic computers would work because they were closed systems. That is, once they started we could not affect messages received by its parts until the answer came. How could this happen? The tachyons might only *exist* within a special field or medium, and transmission of tachyons might only be possible between stationary objects within that medium. For instance, at least one theorist, R.E. Cutkosky (*Phys Rev D* [8] [1970] 1386) has studied superlight transmission of sound waves in *nuclear matter*, which might simply not transmit any other impulses. An external, moving observer might *see* messages going backward in time within the tachyonic computer, but he couldn't actually alter the content of these messages because he would be moving. Tachyonic computers wouldn't violate causality, even though they work by sending impulses backward in time.

Tachyonic computers are particularly interesting because they tell us how FTL effects might prove extremely useful and important even if they *don't* make possible interstellar flight.

Independent of thermodynamics, do our ideas of causality alone require that energy or matter cannot be transmitted faster than light?

Commonly, of course, the answer is yes. However, detection or emission of undifferentiated *energy* doesn't necessarily let us send messages. Unless we can control the destination of the energy we send, we couldn't use it for messages.

The speed of heat conduction in a medium of ordinary matter is limited by c/3 (the factor of ⅓rd arises for complex reasons not germane to this discussion). Let's suppose that the universe is filled with a (currently undetected!) tachyon gas, which conducts heat away to any location in the future or past with temperature less than the temperature at our location. Since this gas conducts to both the future and the past, we could not modulate it and therefore could not use it for messages. It would simply act like a heat pipe with infinite conduction velocity.

This might prove very useful indeed. We could build a *tachyon radiator*. What the tachyon radiator does is to transfer heat to this tachyon gas, providing a sink for energy in any location. The tachyon gas would carry heat away to *any* ordinary matter, no matter how far away, so long as its temperature was less than that of our radiator. We could generate energy in the center of the Sun. In fact, we could generate energy wherever the temperature was higher than the average temperature of matter in the universe. Furthermore, the size of radiators needed for waste heat constitutes a major problem in all power generation. Power sources with tachyonic radiators could use the *entire universe* as radiator, radiating its waste heat through the tachyon gas.

To generate energy at all, we need a temperature difference. Looking at tachyonic radiators in another way, they allow us to draw energy instantaneously from the far galaxies. Our radiator could generate power by sucking heat through to infinity.

One might ask why heat hasn't *already* radiated away through this tachyon gas. It could be that conductivity between this gas and ordinary matter is normally very low; special devices, however, might raise it. Any matter absorbing our radiated heat wouldn't need high conductivity, since there is so much matter in the universe to absorb that heat.

Whether tachyonic radiators violate the laws of thermodynamics becomes partly a question of definition. They could take formerly isolated systems and turn them into systems which are not. Energy rejected by the tachyonic radiator, however, can arrive *before* it is sent out. This gives an observed *temporary* decrease in entropy, even though the effect isn't controllable enough to send messages. We would radiate not just to the light cone, but to the future and the past. Tachyonic radiators would force a revision in our ideas of thermodynamics; still, they aren't obviously contradictory, nor do they cause problems with causality.

Since Bilaniuk, Sudarshan, and Deshpande, many theorists have considered tachyons for the problems they might solve and the properties they might have. Their work makes clear that if tachyons did exist they would differ wildly from normal "particles." Theorists disagree: some consider that tachyons must be charged. Others conclude that they must be neutral. They may also be magnetic monopoles. Some conclude that tachyons with a given (superlight) velocity could only be absorbed by par-

ticles moving at a fixed velocity v (which depends on the velocity of the tachyon). Tachyons may have *no location at all* but rather be only conceivable as a wave disturbance acting instantly throughout all space (A. Peres *Lett Nuovo Cimento* 1[16] [1969] 837). The Reinterpretation Principle (by which some observers see the sender of a tachyon as receiving it: see Box 2) suggested these thoughts about tachyonic radiators to me. Although FTL transmission may be *possible*, it certainly can't take place by any means resembling normal particles.

Nor have I exhausted possible uses of tachyons. Tachyons may have arcane properties, only possible because they are not normal matter. One theorist, P.C. Vaidya, for instance, concludes that tachyons *repel* normal matter (*Current Sci* 40[24] [1971] 651). Even if we cannot transmit signals with tachyons, the fact that they travel FTL might imply other highly visible (and useful!) properties.

Of course, we still haven't settled any difficulties with causality arising from hyperlight radio.

The Special Principle of Relativity is Wrong

Einstein himself used one fundamental assumption to derive his theory, the Principle of Relativity. It states: "A frame in uniform translatory motion with respect to an inertial frame cannot be distinguished from that frame by any physical experiment whatever."

This means that all physical laws appear the same to all observers traveling at different constant velocities. We can use this principle either as a *definition* or as an empirical statement about the world. If we use it as a definition (i.e. inertial frames are frames with the above property) we solve nothing, because we must still show that inertial frames can *exist*. If we use it as empirical statement, unbiased observers in 1984 must have severe doubts about its truth.

First, what about the 3K background radiation? Using this radiation as a standard of rest, we can measure motion of the Earth with respect to it. Shouldn't we consider such measurements "physical experiments" in the sense of the Principle? If not, why not? Since the 3K background is common throughout the universe, it must somehow affect the entire universe, including local properties for any observer.

At least one theorist, E.G. Prokhurovnik, has grappled with this problem (*Nature* 25 [1970] 359). He recovers a theory very like the ordinary special theory of relativity. His theory differs in that distant, redshifted galaxies have the *same* average velocities in the cosmic reference system as our own galaxy. His theory says little about possible FTL, nor does it introduce forms of transmission other than (known) particles and light. Nevertheless, a "cosmic reference frame" makes *conceivable* the idea that some process *other than light* might behave differently, depending on the velocity of the observer with respect to cosmic rest.

Furthermore, preferred frames of reference can exist in *general* relativity even without any cosmic background

radiation. We can have "cosmic reference frames" defined by the geometry of the universe alone (C.H. Brans *Phys Rev* D 8[6] [1973] 1662).

Cosmic reference frames give us a *lot* of possibilities for FTL effects. Let's suppose that propagation is instantaneous in the cosmic reference frame. Such a form of "hyperlight radio" would have some quite peculiar properties. Its measured velocity would depend on the velocity of the observer with respect to cosmic rest: a stationary observer, and a moving observer *in the same position at the time the signal is received* would receive it at different times by their different clocks, sometimes before the signal is sent. Because its velocity depends in this special way on cosmic rest, the hyperlight radio signal doesn't even have a "velocity" in the ordinary sense. (The transformation equations are "wrong.")

Of course, this scheme can only work if we *have* a cosmic rest frame.

If tachyons are instantly spread throughout all of space (as Peres suggests in his paper *Lett Nuovo Cimento* 1[16] [1979] 837 cited above) then their behavior *ought* to depend on the cosmic rest frame, which we've seen does exist experimentally. Given a cosmic rest frame, such an effect could cause no causality problems. Hence our *hyperlight radio* can propagate without causality problems. Furthermore, this form of hyperlight radio could even transfer energy from sender to receiver.

Cosmic standards of rest allow FTL propagation in other ways too. Two theorists, R Sigal and A Shamaly, have proposed a different propagation depending on general relativity *(Phys Rev* D 10[8] [1972] 2358). They assume the possibility of a cosmic rest frame. In their theory, the disturbance is a special (hypothetical) field propagating at a velocity *depending on the age of the universe*. At some times and in some cosmologies, it fails to propagate; at other times, it propagates at a fraction of c. It can also propagate at more than c. If we are lucky enough to live in a priveleged time, we could use such a disturbance for a hyperlight radio.

Is Einstein's Relativity *Correct?*

Up to now we've been supposing that the basic transformation equations of the Special Theory of Relativity (STR) are *correct*. We don't have to do this. Several authors have suggested alternative theories and even experiments which they claim disprove relativity. Of course no reasonable man can believe that STR tells us the last word on time, space, and motion. Someday, somehow, we must expect a broader theory which reduces in the limit to STR.

Now the Special Theory of Relativity depends fundamentally upon Maxwell's equations for an electromagnetic field. If STR is somehow wrong, Maxwell's equations are also wrong. Discovery that Maxwell's equations were wrong would reduce virtually all of contemporary physics to rubble. Almost all physicists have a vested interest in Maxwell's equations; the Universe, however, has no vested interest in physicists.

Let's consider some theoretical and experimental work raised against Maxwell's equations.

At least two theorists, Blokhintsev and Pavlopoulos, have considered alternative sets of equations, reducing in the limit to Maxwell's equations, but NOT the same as his. Pavlopoulos has a very simple theory; to compare Maxwell's equations and those of Pavlopoulos, consult Box 3. Pavlopoulos provides no experimental evidence for his equations; however, he does provide *theoretical* arguments. These come down to the fact that Maxwell's equations lead to infinities and divergencies, which must somehow disappear.

If the factor L in Equation 2 is small enough, Pavlopoulos's theory coincides both with STR and with Maxwell's equations for all normal energies. It diverges, however, for ultrahigh energies. Light waves of ultrahigh frequencies would travel with a velocity increasing with their frequency, and could greatly exceed c. L has dimensions of length. Pavlopoulos considers it as a fundamental length. No one has found any experimental dependence of light speed upon frequency; of course, this could merely mean L is very small. Since we no longer deal with Maxwell's equations, the Lorentz transformations are no longer correct. Therefore no causality violations can happen because of signal transmission by ultrahigh frequencies.

BOX 3: *For those who want to see the ALGEBRA (Part 2):*
Here are Maxwell's equations and Pavlopoulos's equation for propagation of light waves. The quantity A is the *vector potential*, from which the magnetic and electric field strengths follow according to equation (0) below. This equation is the only one of Maxwell's equations which Pavlopoulos proposes to alter. L is a small constant with dimensions of length. Pavlopoulos's equation is essentially the equation for wave propagation in an *oriented* medium (cf. C. Truesdell, W Noll HANDBUCH DER PHYSIK III/3 (1965) 389).

(0) $$\mathbf{E} = -(1/c)(\partial \mathbf{A}/\partial t)\ H = \text{curl } A$$

(1) $$\nabla^2 \mathbf{A} - 1/c^2 \cdot \partial^2 \mathbf{A}/\partial t^2 = 0$$

(2) $$-L^2 \cdot \nabla^4 \mathbf{A} + \nabla^2 \mathbf{A} - 1/c^2 \cdot \partial^2 \mathbf{A}/\partial t^2 = 0$$

The equations of Maxwell (1) and of Pavlopoulos (2) for wave propagation.

Pavlopoulos's theory might actually permit the classical FTL drive. The answer to traveling faster than c might turn out to be: just keep on accelerating! The energies required, however, could be enormous, so enormous that FTL transport this way could be out of the question. Also, studies of interstellar flight have actually shown that *friction with the interstellar medium* becomes significant at only .1c and a very serious problem above .5c. Accelerating a macroscopic body to the energies required, and keeping it there long enough to travel a significant distance, may turn

out an impossible engineering problem.

This shouldn't disturb us. It means that if we want to travel FTL we should seek some way of *going around* the interstellar medium rather than *through* it, by "hyperspace" or otherwise. If the Lorentz transformations are no longer correct, we wouldn't get causality problems when we did so.

Would such a "hyperspace" be possible? *General* relativity has a concept of a "wormhole" in space. In ordinary general relativity, passage through a wormhole might only happen at less than c, but if we imagine a "general relativity" based on Pavlopoulos's equations, FTL wormhole transport might happen easily. Wormhole transport, of course, might require a receiving station, just like hyperlight radio.

Incidentally, "hyperspace transport" could prove useful even at less than c. We might avoid friction from the interstellar medium to travel much closer to c than otherwise possible.

There are still other proposals for alternatives to STR. In fact, there are at least three different theorists who have proposed *different* alternative explanations for the Michelson-Morley experiment on which relativity was (at least historically) based. One early transformation was proposed by the mathematician Voigt in 1887 and involves a *greater* decrease in the rate of passage of time for a moving frame. Instead of a contraction in the direction of motion we get an expansion in all the other directions. Voigt's transformation, however, leaves the MASS of a moving body invariant. Another theorist, Palacios, proposed a combination of contractions in both the direction of motion and the other directions, and *no* time dilation. A third theorist, Alway, has proposed a general transformation which reduces to the Lorentz transformation for the proper values of a parameter. These alternatives, however, don't coincide with experiment.

It is not even true that *no* experimenter has claimed to perform experiments contradicting STR. When we discuss the possibility that STR is wrong, we should note that some physicists actually claim experimental evidence for its falsity. One review paper by G. Horedt and H Ruck (*Spectrosc Lett* 5[12] [1972] 455) summarizes spectroscopic evidence, and evidence from interplanetary laser tests, that the velocity of light depends on the velocity of its source (!) Other workers claim that experiments over interplanetary distances give results counter to STR. Another experimenter, S. Marinov, has published descriptions of an experiment he calls the "coupled-mirror" experiment, giving a result different from that predicted by STR (*Int Jour Theor Physics* 13 [1975] 189). Marinov particularly has been as active as possible in putting his viewpoint; however, the physics community at large has ignored Marinov, his experiment, and all those other occasional studies claiming experimental contradictions. Experiments, as I said when I began, need *interpretation*: for what it's worth, the consensus of physicists is that these experimenters have mistakenly interpreted their results.

Possibility, Impossibility, and Physics

Einstein's original derivation of STR depended upon two "postulates." Since that time many other theorists have claimed to "derive" the special theory on logical grounds, and on the same logical grounds to show the impossibility of any transmission faster than light. All such "derivations" of course rely upon unexpressed assumptions concerning the nature of the transmission and the nonexistence of processes other than restricted kinds. When he proposed it, Einstein's "derivation" was thought to be an important idea. I believe that it led to an entirely unjustified feeling that questions such as FTL were settled once and for all. On balance, I believe that it has retarded our understanding of mass, time, energy, and motion. By now, many theorists have raised questions about points of the theory. I have reviewed here only a small proportion of the papers which raise questions about STR; I can only plead lack of space as an excuse for not discussing all of this other work. STR still has no clear superior, but its fundamental ideas are no longer so *obviously* true or clear, nor are their *implications* so clear.

None of these theories has attained any common acceptance. But unlike other fields such as mathematics, biology, or medicine, which are totally sunk in dogmatism, physicists have actually allowed these theorists to publish their results and argue out their ideas. Of course there are many dogmatic physicists; however, the physics community deserves a lot of credit for allowing so many alternative ideas to flourish. This questing may not lead to FTL in the form of the classic FTL drive, but it may well someday lead to devices at least as useful and important, and equally impossible according to current conceptions of possibility. ■

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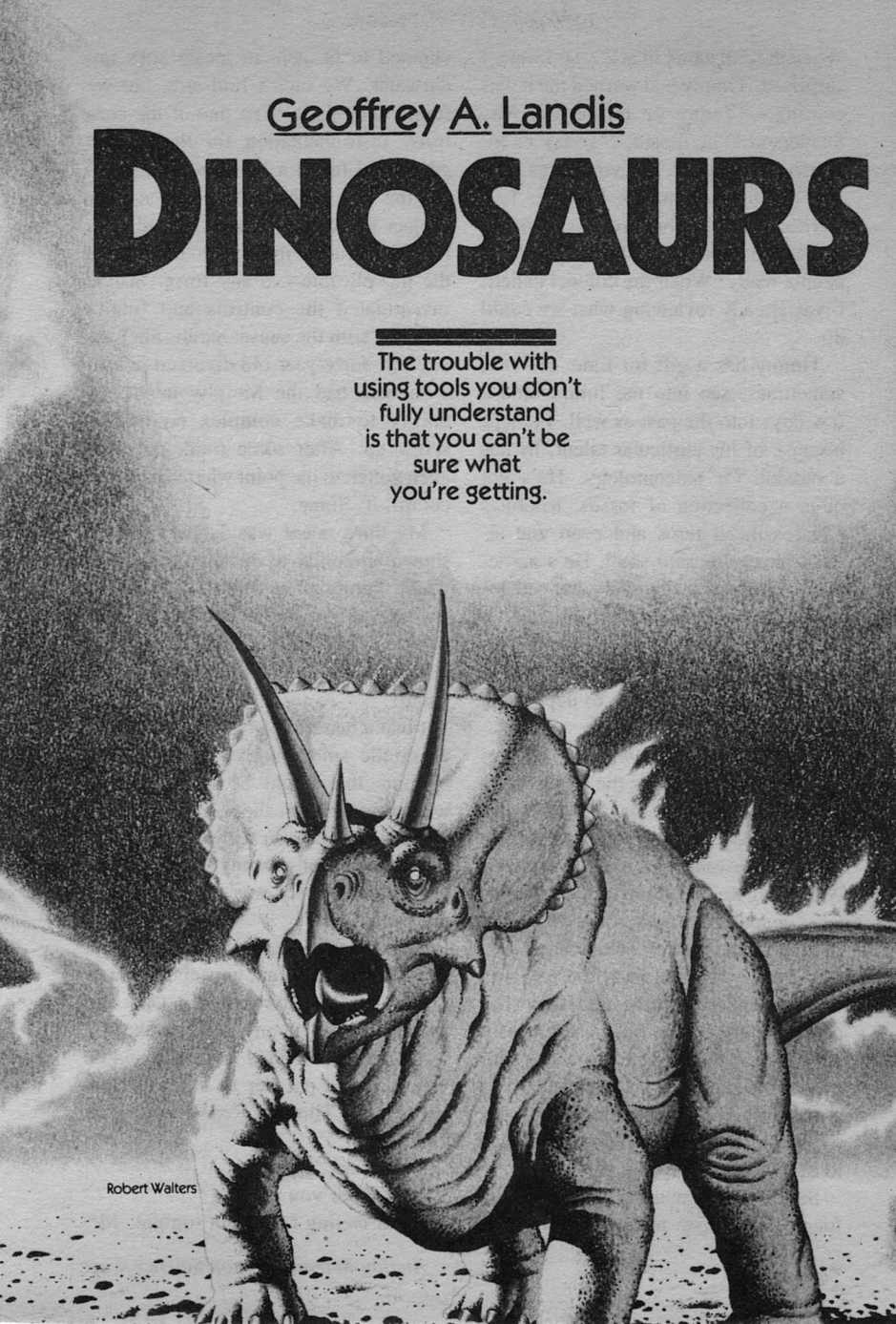
● It's what you learn after you think you know it all that counts.

Earl Weaver

Geoffrey A. Landis

DINOSAURS

The trouble with using tools you don't fully understand is that you can't be sure what you're getting.



Robert Walters

When the call came in at 2 A.M. I wasn't surprised. Timmy had warned me it was coming. "Today or tomorrow, Mr. Sanderson," he'd said. "Today or tomorrow for sure." His voice was serious, far too serious for his age. I've learned to accept his prognostications, at least when he was sure, so I had my people ready. When the colonel called, I was already reviewing what we could do.

Timmy has a gift for time. He can, sometimes, see into the future, and a few days into the past as well. Perhaps because of his particular talent, he has a passion for paleontology. He's got quite a collection of fossils: trilobites and fossilized ferns and even one almost-intact dinosaur skull. He's particularly interested in dinosaurs, but perhaps that's not so unusual. After all, Timmy was only eleven.

He has one other talent as well. I hoped we wouldn't have to depend on it.

I found Timmy in his room. He was already awake, passing the time sorting his collections of fossils. *We'll be joining them soon enough,* I thought. *Maybe in a million years the next species will be digging up our bones and wondering what made* us *extinct.* We walked in silence to the conference room. Sarah and January were already there. Sarah was still in her bathrobe and fuzzy slippers, sipping coffee from a Styrofoam cup. Jan had managed to throw on a pair of rather tight jeans and a faded Coors T-shirt. A moment later, Jason, our hypnotist, arrived. There was no need to brief them. They already knew.

Sarah was my number two talent. We found her while testing people who claimed to be able to locate subs underwater. We didn't find any, but we found her. She'd been one of the controls. Instrumentation for the control group had failed a lot more often than for the test subjects. Perhaps another project team might have ignored this, but I'd instructed my team to investigate the inexplicable—in any form. So we investigated the controls and finally came up with the cause: Sarah. She was a feisty, forty-year-old divorced housewife who had the Murphy talent, an ability to make complex equipment screw up. After some training, she'd even gotten to the point where she could control it. Some.

My third talent was January. She'd shown an ability to enhance the rate at which things burn. With a little more training, she might be the most dangerous one of all. Now, though, she was just a college student with an untrained talent.

I had a handful of other people, with an erratic smattering of other talents. Nothing that might be useful against what was coming, though.

"Sarah, how you feeling?"

"Burned out, Danny boy, feeling burned out. Never was good for much after midnight."

"That's not so good. Let's see, you work best awake. Jan, how about you?"

"I think I'd better go under, Dan. I'm too nervous to do any good awake."

"Right." I nodded to Jason, and he went over to put her to sleep. "How about you, Timmy? Ready to go under?"

"Yes, sir."

"How are you feelilng?"

"I'm feeling really hot tonight, Mr.

Sanderson." He grinned at me. "Real good."

If so, he was the only one.

Once I'd thought that being assigned to Project Popgun was the last stop in a one-way journey to obscurity, a dead-end directorship of a make-work project. But even if I was relegated to a dead-end project, I resolved to make it the best-run dead-end project in the government.

Maybe I should explain what Project Popgun is. Popgun is a tiny government agency set up to study what the military euphemistically call "long shot" projects. What they mean is "crackpot." Psychic assassins, voodoo priests, astrologers, tea leaf readers, people who claimed to be able to contact UFOs. Nobody really thought any of these would pan out, but they were each carefully investigated, just in case. Dogs who could foretell the future, children who could bend spoons, gamblers who could influence the fall of dice. There were always new crackpots to investigate as fast as the old ones were dismissed. After all, with the defense budget numbering hundreds of billions, a few million to check out crackpots is considered a bargain.

The psychics, the palm readers and fortune tellers, none of them turned out to be worth the investigation. But here and there, in odd nooks and by-ways across the nation, I'd found a few genuine talents. I'd begged, bribed, coerced, and flat-out hired them to come work for me here in Alexandria, where we could study them, train them to use their talents, and maybe even figure out what they were good for.

Strangely enough, as long as I had reported negative results, I was commended for rigorous work and carefully controlled test procedures. Once I started to report something worthwhile, though, we were accused of sloppy research and even downright falsification. The investigating committee, although not going so far as to actually endorse our results, finally suggested that our findings "might have legitimate defense applications," and recommended that I be given limited scope to implement near-term applications. So I'd asked for—and received—a hardwire link to the threat evaluation center at NORAD, the North American Air Defense command. Voice plus video images of the main NORAD radar screen, carried on EMP-proof fiber-optic cables.

Now we waited, listening to what was coming down across that link.

"*Surveillence satellites report covers are now coming off the silos.*"

The President must be on the hot line by now, trying to avert the impending catastrophe. ICBMs were being readied in their silos for a retaliatory strike, waiting for the word.

Across the U.S., fighter squadrons were being scrambled and ancient anti-aircraft missile batteries armed to intercept incoming bombers. Those couldn't shoot down ICBMs, though. The last defense of the U.S. would not be fought from the ultra-hard command post under some mountain in Colorado, but right here, in an ugly, nondescript cinder-block building in the suburbs of Alexandria, all but ignored by the military high command. A housewife, a college girl, and an eleven-year-old boy.

Sarah's talent, if she could make it work, would work best on missiles in

the boost phase, January's during coast, and Timmy's any time.

"Launches. Early warning satellites report launches from Eastern sector. Satellites report launches from Southern sector. Satellites report launches from Northern sector." A pause. *"Launches from submarines in polar sea. Launches from Baltic Sea. Launches from Black Sea. Launches from North Pacific. Total launches confirmed, 1419. Probables, 214. Failures on boost, 151."*

Not a so-called "surgical strike" like you sometimes read about in the papers, the strike at military bases and missile silos. This was a full scale attack, nothing held in reserve. Don't ask me why. I've never claimed to understand superpower politics.

"Okay, Sarah, here it comes. Go for it!"

"I'll see what I can do. I'm not making any promises, though." She closed her eyes and leaned back. I looked over to the TV screen. Still too early to see anything, I decided to pray. I'm an atheist, but maybe there was time to convert.

Sarah opened her eyes. "Well?"

We both looked at the monitor.

"BMEWS confirms 1589 launches. 3 boosters failed second stage ignition. 26 minutes to first arrivals."

"Damn," she said. "Some days you got it, some days you don't. Looks like today I don't." She leaned back to try again. Beneath her apparent calm I saw she was trembling slightly.

"Confirmation from PARC radars. Confirmation from PAVE-PAWS." The first dots were beginning to appear on the screen. *"Launch of second wave. Launches from North Atlantic. Launches from North Sea. 820 launches confirmed, 19 probable, 22 failures."* The voice on the hardwire link was cool and professional. How could he remain so calm?

Time to try January. She was fully relaxed, breathing deeply and evenly.

"You are very calm. You're floating, higher, higher. You're above the clouds. You can see a metal cylinder moving through the air. It's coming toward you. You can imagine the explosive inside the cylinder. You can reach out and touch it. It's getting hot. It's getting very, very hot. Make it explode."

The screen was filled with tiny dots, like ants crawling across the screen. Vicious angry ants, heading for us. *"Burnout on all boosters. 18 minutes to first impacts."*

"You can feel the missile next to you. Reach out and touch it, January. Touch the explosive inside. You can feel it! Make it explode!"

A fire started burning merrily in a wastebasket across the room. On the video screen, though, none of the little dots disappeared. Time to try Timmy.

"Surveillance satellites report first wave warheads have separated from the bus."

Timmy had one more talent, in addition to being able to see a little through time. He could also make things disappear. Where they went, nobody knew. None of them ever came back.

"Timmy, can you hear me?"

"Yes."

"Way, way up over us there are a whole lot of missiles flying through the sky. I want you to focus your attention on them. They're whizzing toward us at hundreds and hundreds of miles an hour. Can you picture them?"

"Yes."

"Lots and lots of them, Timmy. All around, coming at us. Now, when I count to three, I want you to concentrate real hard, and make them all go away. Ready?

"One . . .

"Two . . .

"Three!"

No sound, nothing seemed to happen at all. The dots on the display screen just vanished. *"They vanished."* For the first time, the voice on the hardwire link lost his cool. *"They vanished. I don't believe it."* He started to giggle. *"The whole Russian attack just disappeared."*

Jason looked stunned. Sarah jumped up and hugged me. "Dan, we did it! Timmy did it!" I hugged her back. She was laughing, laughing and crying at the same time.

It wasn't quite over. We had to use Timmy's talent twice more, on the second wave and again on stragglers. After about an hour, we heard the announcement that the bombers were returning to base. Then we knew it was all over.

Maybe we could have counterattacked with our own missiles, or maybe we should have announced that we had a secret weapon and asked for unconditional surrender. Maybe we could have done any number of things. It was pretty clear, though, that one thing we couldn't do was announce what really happened. Not unless we knew we could repeat it.

So the U.S. government just ignored the attack. Pretended it never happened. I think that this unnerved them worse than anything else we could have done. They never knew what had happened. It would be a long, long time before they'd try another first strike.

They kept secrecy here, as well. After all, it had all come and gone at two in the morning, and there had been no general alarm. Naturally, there were a lot of rumors that something had happened that night, but who could have guessed that a full scale attack had been launched? And who would believe it?

We did all get to meet the President. In secrecy, naturally. I wasn't surprised, but then, I hadn't voted for him either. Timmy was pretty excited about it.

Some days later, things were back to what passed for normal. Timmy sat at his desk, flipping through a book, *The End of the Dinosaurs*.

"Gee, Mr. Sanderson," he said, "I wonder what really did happen to dinosaurs?"

I thought about the iridium casings on nuclear warheads, about clouds of soot and ash rising from atomic explosions, setting off a long nuclear winter. I thought about Timmy's two strange talents, one dealing with time, one completely different. A talent to make things go away. And where do they reappear? I've often wondered. But I think I know now.

I could almost picture the warheads, six thousand of them, raining down on the forests of the Mesozoic. Poor dinosaurs, they never had a chance. And in sixty-five million years, even the last faint traces of radioactivity would have decayed to nothing.

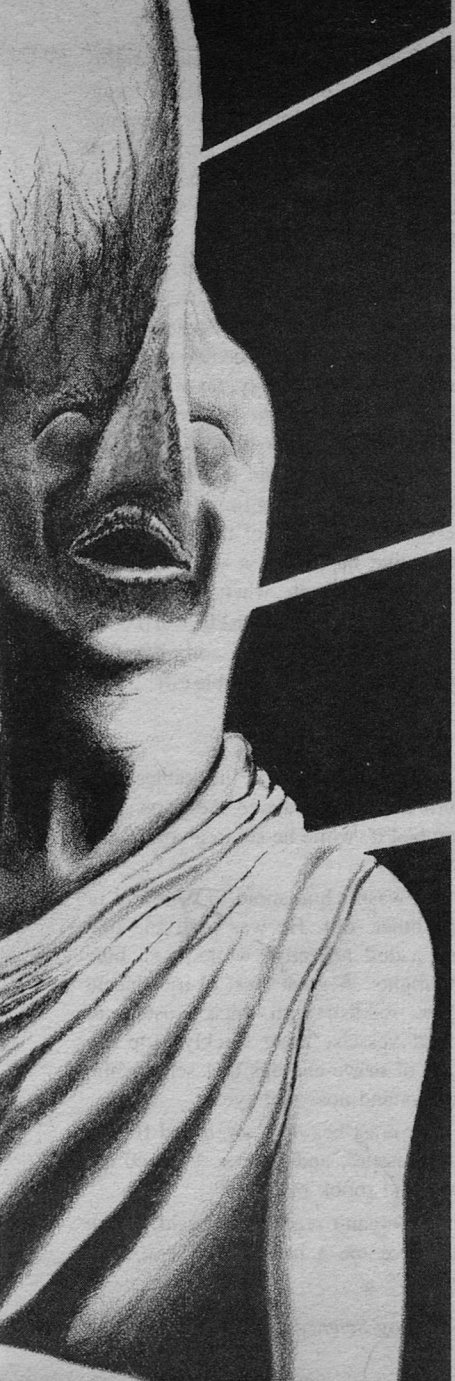
Yes, I think I know who killed the dinosaurs. But I didn't say it.

"I don't know, Timmy," I said. "I doubt if anybody will ever know for sure." ■

To judge other beings,
you must get to know them.
But if you do that too well,
your judgments may not be as
simple as you thought. . . .

RESPECT

Bill Johnson



"He's here to observe. He's a combination of judge and jury. We *have* to let him stay."

"Why?"

I finished my drink and poured more wine. It was tart, barely aged, and it seemed to clean my throat like the scraping of a knife.

"They found us just outside the Oort cloud. We never had a chance," I said. "They took our ship. Easily. Some kind of mind weapon that stunned everyone aboard, even the computers."

"Except you."

"Except me," I agreed. "And two others. They couldn't touch us, but we couldn't run the ship by ourselves. Scared the hell out of the aliens, though, when they came aboard. I got the impression the weapon had never failed before. So they're here to add us to their study, just to make sure that we don't throw off their data."

"What kind of study?"

I finished the wine, reached for the jug, thought better of it.

"Whether to burn Earth. Or give us a *real* star drive. Faster than light version."

My sister Minerva leaned back in her chair. Her head was turned in half-silhouette as she stared out over the Rio Grande Valley.

She was years older, more fragile, each time I came home from a six month trip. The gap grew with every trip I made to the stars, pushing a ramship just short of c. Her hair was gray now, and thin, but Full Medical kept her going. Old age was a disease she had beaten for two centuries, but she hadn't won all the battles.

I poured her a glass of wine, then

shrugged and filled my glass again. The sun burned a scar across the sky down into Mexico, and we watched the sunset.

"Where are the other two taking their observers?" she asked.

"Brian went to England. They'll tour the museums, the galleries, the plays. He's going to try to impress his observer with mankind's culture. Emilia's going to try Rome, and Mecca, and show how far we've come and how fast. That mankind has a better side. That we're trying."

"And you?" she asked. I shook my head.

"Brian and Emilia have both made a dozen trips Out. I've only made four. They can't even speak the language on Earth anymore. I still have someone to come home to," I said.

"You want to show him our tranquil family life?" she asked sarcastically.

"No," I said, and smiled. "They must have been watching us for centuries. I get the impression this sending of observers is a formality, a final check. I don't think there's anything we could do to change their opinion."

"And you don't think that opinion is favorable," she said.

"All they've seen is what we show each other. News. Drama. All our troubles and problems transmitted endlessly into space. No, I don't think they have a good opinion of us," I said. I finished my glass.

"Treat him like any other guest," I said. "No better, no worse.

"I want him to work with us, in the fields. Eat food he helped grow. Take his turn cleaning after the animals," I said. "I want one of them to know our real lives just a little. Art and morality are good, but how do you feel the struggle behind a sermon, or a painting? Before they burn us out, I want one of them to know what life here was really like. I want to be remembered with respect."

My sister bowed her head. She was older than I, fifteen when I was a baby. She carried me across the Rio when our parents died. She was the real matriarch and power in the family, no matter how much she deferred to me in public as the eldest male. She nodded.

"I like it," she said. "With respect. We've worked a long time for that. No need to tell the rest of the family. Let them live happy for a while. They'll learn soon enough, when he's gone.

"Now," she said briskly. "To business. Maria just had a son, her first child, and we need a suitable gift. . . ."

The boy got a pony.

Dagoth found me in the stables, just before dawn. I watered the horse, and combed it, while he sat in a corner and watched.

He wasn't humanoid or reptiloid or any other -oid. He was long and thin and a dull reflective white, with blue highlights. A great crest of translucent flesh, reddish with thick clusters of blood vessels, hung slackly atop the sack of nerve-endings that served him as ears and nose and eyes.

The crest began to swell and firm. I felt pressure, and a fever. I closed my eyes and shook my head.

"You can't read me," I said. "You *can* give me a headache if you keep trying."

"I apologize," Dagoth said. "But my job is to observe."

The pressure, and my fever, went down as his crest relaxed. Like everything else, telepathy, and resisting it, was work. And work produced heat. The crest carried the heat away and kept Dagoth from cooking his own brains. Human telepaths were weak in comparison, because evolution had not provided an efficient way to remove the waste heat from their brains.

"What do you want to do today?" I asked.

"This is your home, not mine. What would you like me to do?" Dagoth asked.

"Do you know what 'war' is?" I asked.

There was a long silence. Dagoth watched the false dawn transform into the real thing. South Texas sun, like the first breath in a sauna, caught my lungs. I exhaled/inhaled and swept the cool night air out, replaced it with the searing taste of daylight. It felt good. On board ship the temperature and humidity varied, according to some obscure psychological formula, to stimulate the crew. But there was never dust, never the taste of home in your teeth.

"Yes. We understand war," Dagoth said.

"I doubt that, somehow," I said. "But since the War with Mexico, the border is closed. We can't get migrant field hands anymore. This is a working farm, and some work can't be done by robots."

"I understand," Dagoth said. I smiled.

"You're a vegetarian, aren't you?" I asked.

"I ate meals with you on your ship. I ate meat," Dagoth said. He seemed defensive.

"Ersatz," I snorted. "Soy and algae and a hell of a lot of taste additives. Here we raise hogs, for the luxury trade. Real meat."

"The sausuge. At breakfast. I—"

I watched his discomfort for a moment, the twitching of his crest, then slapped him on the back. He seemed dazed. I laughed.

"Ersatz, Dagoth. Ersatz. I said the hogs are for the luxury trade. We don't eat real sausage. But we take care of it, on the hoof. And you'd be amazed at how much waste they leave behind in their confinement. Here's a shovel. Now, the idea is to move the crap from here to there, just like paperwork on a starship. . . ."

Shovel down, scoop, lift, and drop the load in the truck.

Four feet to go, and it was noon.

Dagoth was strong, for all his frail appearance. We stood ankle-deep, soil and waste all mixed together like some tasteless goulash. Flies circled us like a living halo. Dust rose, overwhelming with the smell of ammonia.

I rested for a moment, my shovel next to me. I reached outside the fence for a handful of dirt and absently poured it from one hand to the other. Dagoth sat beside me. He nodded at the dirt.

"The soil here is very poor?" Dagoth said. I nodded.

"Clay, mostly. All the good soil eroded away a long time ago," I said.

"Then why stay? Life would be easier in the city," he said.

"This is our *land*," I said. He looked puzzled.

"Why don't you leave your ship? Life would be safer on a planet," I said.

"Leave the *ship?*" Dagoth said, aghast.

I smiled at that, then laughed. Dagoth began to hum, a show tune already old when I was born. By the time Angela brought us lunch we were deep into an argument about the relative merits of the Beatles and Count Basie.

Angela was my great great grandniece. I remembered changing her diapers and the milky smell of her breath on my cheek. Now she was a tall woman, my age biologically, and a veteran of the Combat Game.

"I lost my eyes in the Game, Mr. Dagoth," Angela said. "We were fighting the South Asian Combine. They used a blinder, a low-powered laser that ruptured all the blood vessels in my eyeballs when I glanced out of my trench. But I get along just fine, now."

"I—" Dagoth said.

"Telepath, Dagoth. Human version. First in the family," I said proudly. Angela smiled at me, the faceted metal spheres in her sockets flashing a hundred distorted images of the sun as she moved. But I seemed to remember a different time, and her eyes were brown, not metal. . . .

"I didn't know humans could read my kind," Dagoth said.

"Only a little, Mr. Dagoth. Most people are very curious about my eyes. The thought jumps out at me," Angela said.

Across the Valley, like thunder around a distant mountain, a muffled *crump*.

"Down!" I shouted. I grabbed Dagoth around the waist and threw us both to the ground. Angela stood, half-turned,

her strange eyes tracking the shell as it rose, then fell. The echo of the explosion startled the birds.

"Mortar," Angela said. She turned toward a distant grove of orange trees and bowed her head. "None of our people hurt, Juan. Just a warning shot."

She shook her head and swayed, off-balance. I stood and helped her sit, made her drink some water. Her forehead was hot with fever, but as I touched her it subsided, the heat of telepathy dissipated.

"I don't understand," Dagoth said. He sat in the confinement, robe stained and smeared. His crest stood erect and full, his head turned toward the other side of the Valley. "They fire, but they don't want to kill anyone. Now they're gone, back to their village for lunch. They're even worried they might have killed someone. But then why fire the weapon? I don't understand."

"War isn't always sensible," I said. "Everyone in the Valley is a part-time soldier. The War is over in the capitals, but this is the frontier. They fire at us, deliberately aiming away from anyone, to warn us not to fire on them. Then they go home to have lunch because a man has to eat and it's good to see the kids and wife during the day. And they hope no one was hurt because then we'll have blood for blood and there are enough funerals already."

Another *crump*, closer. From our side of the Valley.

"And now we fire back," Angela said. The shell exploded and she closed her eyes again. I steadied her until she was finished. Dagoth never relaxed his crest.

"No one hurt," Angela said. She opened her eyes and smiled. "Honor is satisfied. And now we can have our own lunch."

"My daughters have never approved of me, Mr. Dagoth," Minerva said. Down the long table the daughters, granddaughters and great-granddaughters began to protest. Minerva waved them silent. Andrew, my great-grandson, sat next to Angela. He looked at me and smiled.

"The rich are always conservative," Minerva said. "They are very proper. They set the standards for everyone. But my daughters do not approve of my standards, of how we started. Now we must live by different standards. Because *we* are now the rich."

Dagoth sat in his place of honor, dressed in a dark blue robe. It seemed to *shift* somehow, so that it both drew attention and was hard to bring into focus. Minerva poured herself another glass of wine.

"Can you read my mind, alien?" she asked. The table fell silent.

"Yes," Dagoth said.

"Then I'm going to tell you our story, and I want you to read my mind, so you'll know what I say is true."

"Minerva, perhaps you've had enough to drink," I said.

"Quiet! You don't remember when we crossed the Rio Grande. This is my story." She spoke in field-worker Mexican, not her usual upper-caste Castilian. I noticed that Dagoth's crest was fully erect. "We came across the Rio Grande north of Del Rio, at night. The border wasn't guarded so well then, and we melted into the illegal community.

"We had our own towns then, and

churches, and law. All well hidden, everyone afraid of the Immigration police. I was young, frightened, and I had you. My baby brother. All the family I had left.

"Twice other illegals asked me to marry them. And what could they offer me? Respectability? Not here. They were as poor as we were. They had no papers, no land, no future. I didn't need that kind of respectability.

"Instead I flirted with the biggest landowner in the county. And one day he offered me the tarpaper shack that grew into this house. And I begged him for land. I could work as hard as any man, but I needed land. He gave me land. And I gave him comfort, and children, until he died.

"I never went to church in town, because his wife might be there. I never went to town during daylight, because she might see me. And I never went to his funeral."

"You loved him," I said.

"Of course," she said impatiently. "You young ones don't understand love. You fall in love with the excitement of falling in love, with the anticipation, the stolen moments. You let your glands rule your heart. Yes, love is excitement, but it is also work. And duty. And struggle. And that makes the love better.

"I never showed myself to his world while he was alive. He wanted it that way. Why should I do it then, when he was dead? Didn't he deserve the same respect? So, I never went to his funeral.

"That is how we started."

She sat, straight-backed and dry-eyed. Dagoth relaxed his crest, and looked puzzled.

After dinner, after a dessert of flan, and coffee, I lit a cigar and stepped onto the porch. The Valley was a darkling plain, light shuttered indoors to avoid giving the enemy a target. The stars were cold and cruel and seemed to go on forever.

Dagoth stood next to me, upwind from the cigar smoke. He sipped grapefruit juice, a new favorite, and waited.

"How did you like her story?" I asked.

"I didn't understand it . . . all," he said.

"You read her mind?" I asked.

"I read her. But information is not the same thing as knowledge. Data are cold things, hard and unfeeling. Knowledge is putting the data together, to make sense out of them. I can't do that with your people. The more data I get, the more confused it leaves me. Things were simpler on the ship."

I knocked the ash from my cigar and shielded the glow with my hand. I didn't need a sniper bolt in my back.

"You frighten her. All her life she's built the Family. Everything you see is Minerva. Every building, every animal. Every person. And then you come along," I said.

"She fears that I will destroy all her work," he said.

"No!" I said. I threw the cigar to the ground and stepped on it.

"You don't understand us. Her story tonight wasn't about love, it was about respect. We can be destroyed any of a dozen ways. War. Raids. Anything. But if we go, we go with our respect. We go as a family that struggled, and built, and never surrendered. Others know

what we've done. Even if they destroy us, they know what we did.

"Then you come along. If you burn us out, it's over. No one will ever know what we did, or care. You treat us like objects, not people. You dehumanize us. You take away our respect."

Dagoth was silent. The air was cold. After a little while I went inside.

The farm was too big for me to be with Dagoth every moment. He wanted to be outside, in the fields, the barns, the stables. After the first day I had enough of the fields. Besides, there were papers to shuffle and sign, and hands to shake, in the Big House. Everyone wanted to meet the eldest male. The farm was a business and now that I was home Minerva had plenty for me to do inside.

Andrew kept Dagoth busy, but I usually saw him with Angela. They used mindspeech, then broke off laughing. Andrew just shook his head.

Dagoth claimed talk was the greatest human pleasure, even more than sex. Angela teased him, but I think he had a point.

We prepared for Cinco de Mayo, Mexican independence day. The mortar attacks grew more frequent, then seemed to taper off.

I smelled ozone, and the hairs on my neck rose.

Angela screamed.

She scratched at her eyes, her hands twisted like claws. Andrew slapped her hands aside and pushed her to the floor. I fell, and rolled, and punched the master light control so the dining room plunged into darkness.

"Down! Now!" I shouted.

Like a laser, every 10th bullet a red tracer, the gun swept across the room.

Wood splinters screamed through the air like shrapnel as the bullets tore the room open. The roof disintegrated. The stone facade of the lower walls vanished like snow in a blowtorch flame, but the armor plating held.

Silence rang out, loud and clear.

Angela began to sob, softly, in the corner. I realized at least one person had lost sphincter control and hoped it wasn't me.

"Andrew?" I called out.

"Living," he answered.

"Dagoth?"

"Here."

I hesitated then, and licked my lips. Some things are always there. And hurt the most when they're gone.

"Minerva?"

"About time you asked." I closed my eyes and smiled.

"Juan? What happened?" Dagoth asked.

"It's a raid, from across the Rio. Angela's eyes use low-powered microwaves. They must have set off a microwave bomb to blind our radar. Angela's eyes focused the radiation right into her circuitry."

"Overload," Dagoth said.

"Blind, I'm blind again. Oh, God, not again. Oh, God, not again—"

"Yeah, overload," I said. "That's one way to put it."

Outside, the crackle of small-arms fire began to compete with the snap of burning wood. I had to appreciate the timing, the sheer professionalism of the attack. We always expected them to hold Cinco de Mayo sacred, like we did.

Stupid. Half our manpower was in Del Rio, or San Antonio. We were in trouble.

"No!" Angela screamed. "No!"

She jumped to her feet and ran. Andrew stood and Minerva grabbed his boot and tripped him. A sniper burned the air just where his head would have been.

"Her, they want. You, they want dead," Minerva said. "You stand up again and they'll take your head. Where does that leave *her?*"

"But—" Andrew said.

"Shut up! If you want to help her, get a rifle and join the fight. She's gone now, lost out there somewhere. You can't find her until we push the enemy back," Minerva said.

"Damn you. Damn you for a cold, unfeeling old bitch. Damn you," Andrew said. He began to crawl farther into the ruins of the house, toward the gun case.

"I will guard Ms. Uresti," Dagoth said. He crawled next to her and draped his cloak over them both. In the dim moonlight they looked like just another piece of rubble. But I still hesitated.

"Go on," Minerva said. "Andrew is just likely to go crazy right now. Try to keep him alive. I think Dagoth can protect a poor old woman."

"Damn you. Damn you for—"

"A little more imagination, please," Minerva said. Then, softer: "Don't let him go by himself, Juan."

I turned and followed Andrew. As I left I heard her whisper softly to Dagoth.

"Now, I've seen how you like our grapefruit. Do you think they might be good for export?"

* * *

We gathered at the ruins of the Big House, a few here, a pair of stragglers there, until what was left of the hall was full. I checked the guard posts once more, shook my head over the charred mess of the radar, and walked to the front of the hall.

Minerva sat behind me and to my right. I was surprised to see Dagoth in another chair, to my left.

Chairs scraped the floor as the men settled. Like a wasp nest knocked loose, the buzz of conversation filled the air. I studied the men, checking their armament. Here I saw a government issue particle gun, there an old slug-firing rifle.

I counted. Twenty men. All that were left, after the guard posts were manned and the wounded and dead protected.

"It's not enough," I whispered to Minerva. "We have to wait for the Army."

"Too little, too late," she whispered back. "The Army is slow, and slower still when the diplomats get involved. Our *kin* were taken. *Angela* was taken."

"Damn you," I said. "We don't even know where they are. Somewhere along the border, if they used horses. Maybe anywhere in Tamaulipas Province, if they had hovercraft. I'm not going to lead us blindly into the desert to get cut up, sniped, and captured."

"What about her?" Minerva asked.

I struggled with that for a moment. My first urge was to go in, guns blazing, and trust to God and gold to find us a guide who could be bribed. And stay bribed. But I knew what the odds really were.

"Honor cuts both ways. It isn't honorable to lead these men to their deaths."

"You're learning," Minerva said approvingly. "None too soon. Some day you'll be ready to take my place. But we have to do *something*."

"Perhaps I can help," Dagoth said.

We looked at him in surprise. His hood was thrown back, and his crest was fully engorged, each blood vessel pulsing.

"I can follow Angela. And I assume that if we can find her, we will find the others."

"Likely," Minerva said. She stroked her chin. "They'll stick together for a little while, until they can get to a town to sell the women. They they'll split the money. If you can find them before they reach town, yes, I think finding Angela means finding everyone. But the decision is Juan's."

"Why help us? Why risk your life? A few months more life for a handful of humans. Hardly seems worth risking your life to save them now, then kill them along with everyone else, later. So why help us?" I asked.

"Why do you take the risk?" Dagoth asked. He gestured to include the men in the room. "Why risk the little time they have left?"

"Because they took our kin," I said, puzzled. Sometimes I didn't understand Dagoth at all. "For them. And for ourselves, our belief in ourselves. We all live with a comfortable set of illusions about ourselves, and what we would do when the worst happened. Everyone in this room is frightened. Badly. But we have to do *something*, or we shatter our own illusions. And why live without self-respect? Who can live like an animal?"

"Who indeed?" Dagoth said.

I hesitated a moment, then nodded and turned to Andrew.

"Get everyone here organized and into the vehicles. Dagoth and I will take the lead flitter. He'll mindread the border guards and get us across the Rio. We track Angela and the rest until he can't find them anymore. Then we come home. With or without the women," I said. Andrew nodded and began to shout. Minutes later the men filed out of the room. I stopped Dagoth.

"Thank you," I said.

"I'm not doing this for you," Dagoth said.

"Then I thank you for Angela's sake."

"I'm not doing this for Angela. I'm doing it for my people," Dagoth said. "Let's get started."

They had us pinned down.

Al and Julio were dead, ambushed when Dagoth finally tired and relaxed his crest. Andrew got the flitters to the side of the road and got everyone out before the enemy mortars zeroed in. Now the flitters were just two flaming wrecks, tombstoned by greasy chimneys of smoke.

Dagoth crawled around the corner of my boulder. I grabbed him roughly by the collar and dragged him next to me.

"Fifty meters ahead. Four of them. Three rifles and a mortar. Follow the creekbed. Keep to the brush on the left," Dagoth gasped. I nodded to Art and Pedro.

We were alone.

Dagoth felt hot and dry, his skin like paper fresh from a microwave oven. His crest was high and full now, but it quiv-

ered and twitched. I wondered how long he could telepath before he collapsed.

Small-arms fire rattled in the distance, like gravel spilled across a newspaper. Andrew. I wondered how many men still lived.

Closer, the sharp crack of a rifle, the buzz-saw of Art's particle gun. Silence, broken by an explosion. Like a pile of mortar rounds going off. Dust danced as the shock wave passed us. I looked at Dagoth.

"Dead," he crooned, and tightly hugged himself. "Everyone is dead. Everything is dead. Everyone is dead. Everything is de—"

I slapped him.

Not once, not twice. Maybe a dozen times, until I was shaken and shaking.

"Shut up, damn you," I said slowly. Dagoth lay in the dust, one hand stretched out, his crest still rigid. "You can go catatonic when we get home. Not one minute sooner."

"I can burn your planet. I *will* burn your planet," Dagoth said. "You're nothing but animals. Dangerous animals."

"Burn and be damned," I said. I turned and cautiously looked over the boulder. No one fired. I used my binoculars and saw the ring of vehicles at the bottom of the hill. I couldn't see Angela, but Dagoth insisted she was still alive. I saw one guard.

"How many guards?" I asked.

"Two," Dagoth said. He turned slightly. "Andrew is winning."

"Good," I said.

"Bad," Dagoth said. "The enemy is falling back. They still have enough men to keep Andrew at bay until they can get back here and escape."

"How long do we have? Before they get back here?" I asked.

"Ten minutes. Fifteen at most," Dagoth said.

I dropped back behind the boulder. Five minutes to the vehicles. Kill the guards. Release the women. Five minutes back into cover. We could just do it, maybe.

"Here," I said. I unbuckled my pistol, handed it to Dagoth. He held it as if it were a rattlesnake.

"No."

"What?" I asked.

"I've . . . never used a gun. I don't think I could," he said. I looked at him for a moment, then laughed.

"A minute ago you were ready to burn this planet to a cinder. To kill everyone on Earth," I said. "Put on the gun. There's only one charge left. I'll take out the guards with the knife. You use the gun to cut the lock on the hover."

He stood silent, then buckled the gun into place. It hung awkwardly on him, his hips not built like a human, but when I stepped back he seemed different. Changed. I remembered the first time I wore a gun, knew I could point it at anything I saw and kill by just squeezing gently. You see the world differently when you wear a gun.

"Let's go," I said.

I killed the first guard with my knife.

He jerked, then flopped. I grabbed him by the feet and pulled him out of sight. The second guard walked into view, his laser slung over his right shoulder. He smoked a fat cigar, funny O rings puffed out as he walked.

Where the hell was Dagoth?

I saw him then, crouched behind the second hover from the right. His crest was loose, collapsed. He staggered a little as he aimed his pistol at the lock on the hover. The guard was almost to him. I hefted my knife and threw.

I watched the second guard crumple without a sound. Then I felt the bite of something cold in my back, and I heard metal scrape across my kidney guard. I fell.

Three guards, not two. Dagoth only read two.

And why should I be the only one he can't read, I thought.

No pain yet, but I couldn't seem to move. My head rested on the ground, face tilted. I watched as a pair of boots stepped over my head, then grew legs and a body as the guard cautiously approached Dagoth.

The pain came in, in waves, and I tried to ride it out. Bright shapes swam at the edge of my vision. The part of me that was metal and piloted a starship kicked in and kept me breathing and then the pain was gone.

I tried to shout, and could only manage a whimper. Dagoth kept the pistol aimed at the lock, the spatter of overheated metal and the sizzle of the laser drowning out my cries. The guard stopped about five meters behind him, carefully checking to make sure Dagoth was alone. The guard raised his rifle, my blood on the bayonet.

"No!" I shouted hoarsely.

The guard whirled and fired. The beam cracked over my head, lashed into the hover behind me. Dagoth crouched, half-turned, the pistol in his hand. The guard began to fall, and roll, and turn, his gun almost with a life of its own, firing, firing, firing. . . .

Dagoth squeezed the trigger.

I think I passed out, because the next memory I have is of many hands supporting me, pressing my back wound closed. I saw Angela helped by two of our people, and Dagoth loomed over me.

"Live, damn it, you coward! After what you've done to me. Damn you! Damn this world!"

I smiled.

"He's a combination of judge and jury. And now he's going home," Minerva said.

I finished my drink and tried to pour more wine. Minerva saw me wince and poured for me.

"The other two didn't have any luck," I said. "Brian and Emilia called me this morning. Their aliens were polite but the decision was unchanged."

"We didn't do a very good job, did we?" Minerva said. She glanced around at the fresh paint, and the new beams in the ceiling. The smell of paint and wood covered the memories like a quilt over dirty sheets.

"I think we did what we wanted to do. Who can ask for more? He knows that life here wasn't easy. He's grown his own food, fought his own battles. He knows what we were like, and what we had to do to live. He has to respect that, I think," I said.

"Our affairs are in order," Minerva said. "I'll not die owing anyone anything. All debts are paid. We'll die clean."

"That won't be necessary," Dagoth said. He stood in the doorway, a human-

style suitcase incongruously clutched in one hand. "You're not doing to die. It isn't . . . *fitting*."

I shook my head, and finished my wine.

"I can't believe you're giving us a star drive, after all you've seen. Hell, *I* wouldn't give us a star drive," I said.

"No star drive," he said.

"I don't understand," I said.

"I don't like you. I don't like your planet. But we're going to leave you alone. If you kill yourselves, that's your decision. If you survive, that's your decision. Our decision is to make no decision. We reject the responsibility."

"We know you're out there, now," I said. "No matter what decision you make, we'll keep looking for you. And one day we'll find you."

"That is your problem. And ours. But not for a long time," Dagoth said.

"We have all your literature, taped as you transmitted it. One story I remember, about a young man, a governor from a great empire, sent to a posting in a remote area. One day the natives summoned him to kill a great beast. He tracked it for days, as his respect for it grew and grew. One day he cornered the beast. It lay quietly, defying the hunter, as he aimed his gun.

"They stared at each other, while the natives watched and judged the young man. He, the conquereor, was trapped. He *had* to kill the beast.

"He did. And he regretted it for the rest of his life."

I watched the sun burn a scar across the sky down into Mexico.

"I am a telepath," Dagoth said proudly. "All I've seen and felt and done will be read by all my people, work its way through us like a virus. I will not let you haunt us with your death. Kill yourselves in war. Search the stars with your ships. We make this decision for ourselves."

Then he was gone and Minerva turned up the lamp.

"He's a strange one, Juan. He and his people," she said.

"Yes," I said.

"But, there was something . . ." she said, her voice trailing off.

"Yes," I said. "He was a good man."

"What will you do now?" she asked.

"My ship lifts in a week," I said. "I'll be on it."

"And when you find him? One day?"

"I don't know," I said. "If it takes long enough, maybe we'll grow up a little."

We sat on the porch and drank wine and the stars rose, and they didn't seem quite so cold and unfeeling as before. ■

● A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.

Max Planck

on gaming

Dana Lombardy

Come on, admit it . . . you've always secretly wanted to play the "bad guy" in a game. Maybe not all the time, but just once in a while for an interesting change of pace.

Now you can, in the SF board game *Struggle for the Throne* (a micro-adventure game by FASA Corp., $6.00 at your local store, or direct from P.O. Box 6930, Chicago, IL 60680). In fact, everyone in the game is a "bad guy"—each player represents a powerful Thought Admiral of the Klingon Empire. That's right, you play a "nasty" Klingon, representing the nemesis of Star Fleet and the starship *Enterprise*. However, in this game, Mr. Spock and Captain Kirk don't participate. This is strictly a "family" affair of internal politics and civil war within the Klingon Empire.

Struggle for the Throne begins with the Klingon Emperor's dying. Two to six players represent Thought Admirals heads of the Klingon families —negotiating and eventually fighting each other to seize the Emperor's throne when he dies. No one is powerful enough at first to take the throne directly. It will require diplomacy, backstabbing, and finally open warfare before one player emerges victorious with the Klingon crown.

This mini-game comes with: a 32-page, 4-by-5½-inch format rules booklet; 76 action cards; 112 playing pieces representing control flag markers, battle squadrons, squadron commanders, loyal commanders (family members who can't be bribed to switch sides), and the Thought Admiral (you); 7 hex-shaped "tiles" that fit together to form the game board; and 2 6-sided dice.

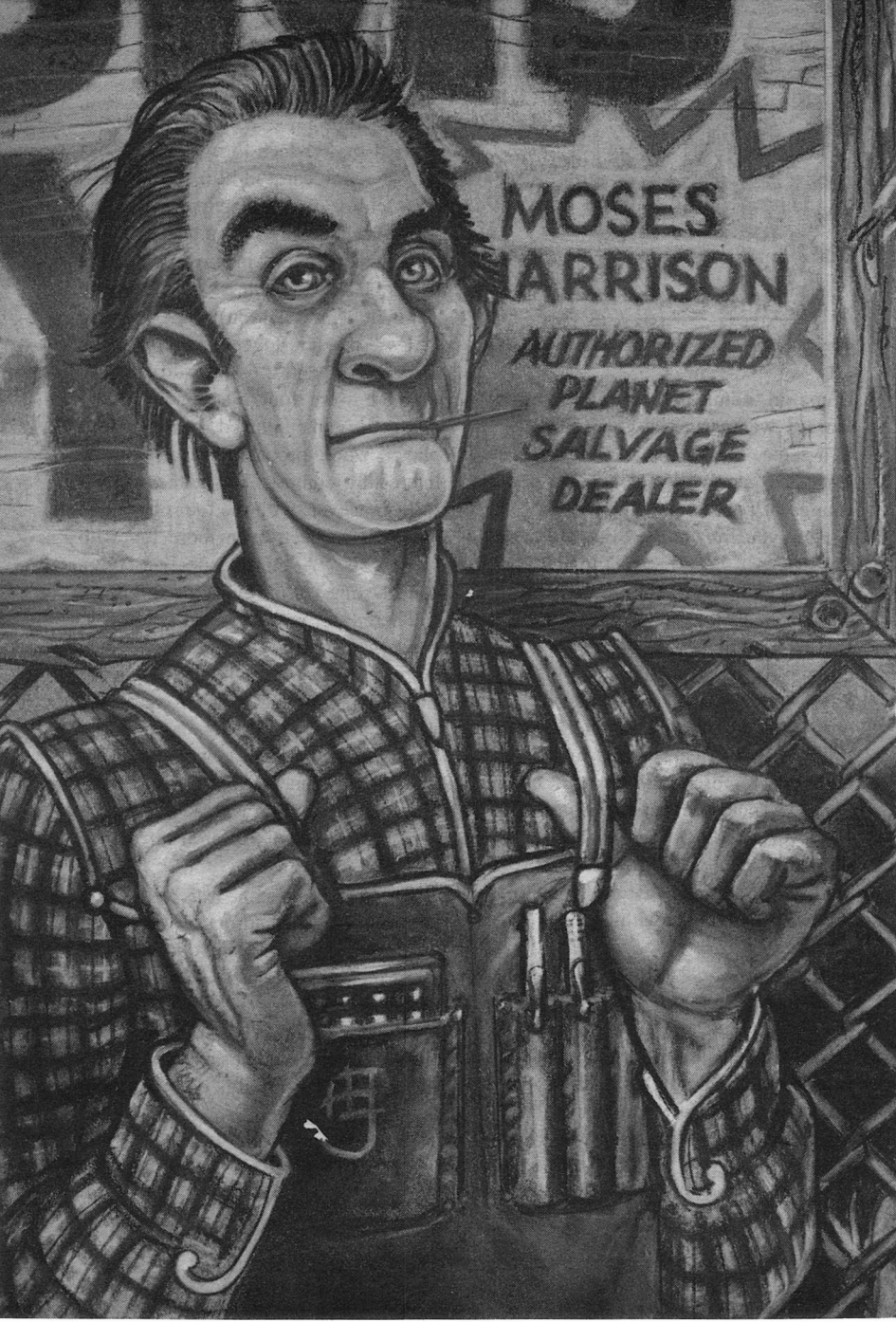
There were four players, including me, in the game I played. Less than four players would probably not make for an interesting contest. The game worked well, however, with the four of us, and would have been even more fun with five or six "Admirals" dealing, lying and blasting their way to the throne.

There are actually two games in *Struggle for the Throne*. The first game represents the phase of play when the Emperor is still alive. As long as the Emperor lives, the players may not fight a battle in the center tile where the Empire's home planet, Klinzhai, is located. This center section acts as a "sanctuary" for a fleet or Admiral threatened by ambush.

The goal of the game is to be the only player with any squadrons remaining on the board, or to force the other players to surrender and acknowledge you as the new Emperor. The key to accomplishing this is to defeat the other player's fleets through sabotage, battle, and bribing non-family commanders to switch sides.

In the first phase of the game, while the Emperor is alive, you assassinate commanders, steal plans, ambush an

(continued on page 169)


MOSES
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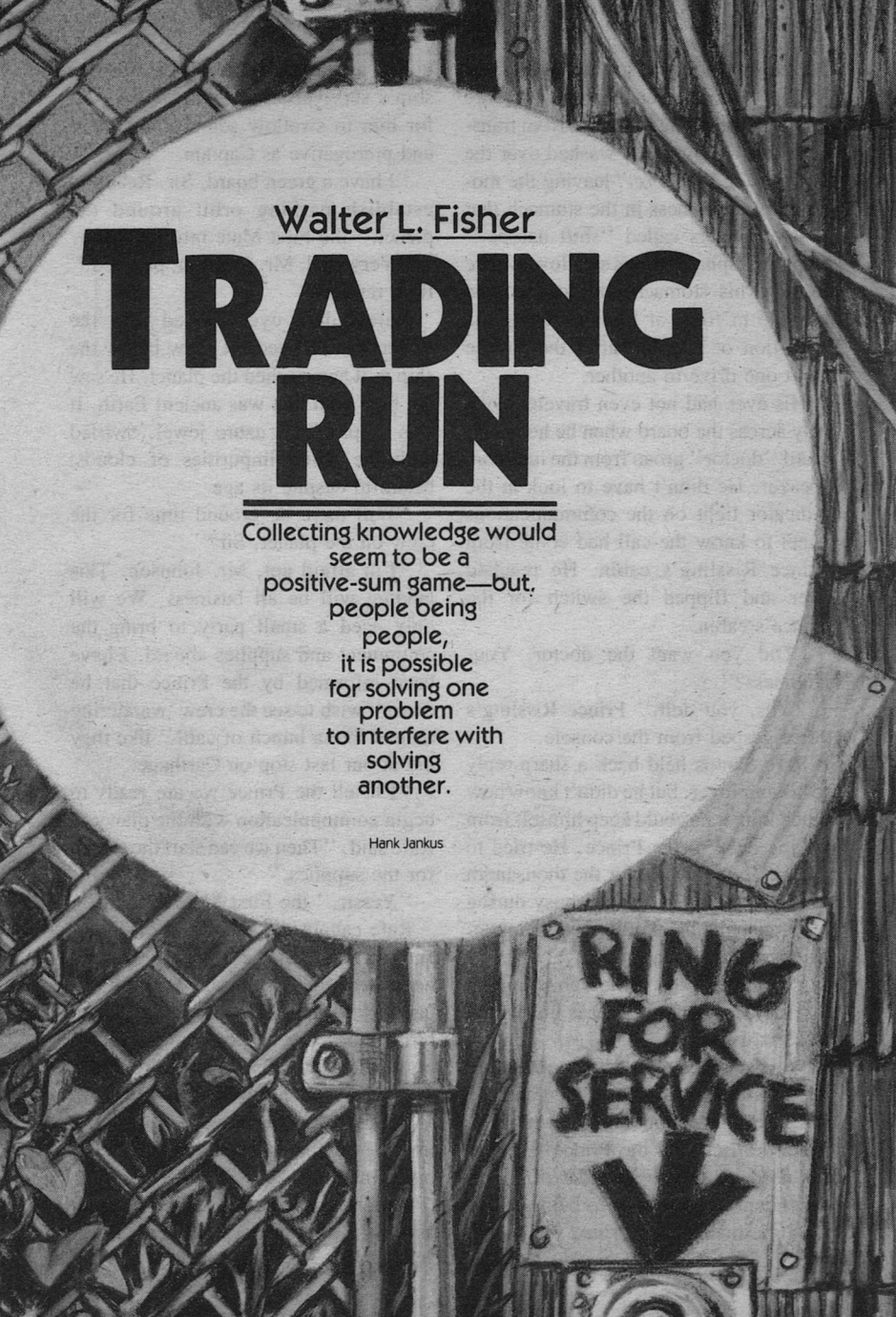


Walter L. Fisher

TRADING RUN

Collecting knowledge would seem to be a positive-sum game—but, people being people, it is possible for solving one problem to interfere with solving another.

Hank Jankus

"Breakout," the First Mate said.

The muscular tension and pressure which accompanied the shift from translight to sublight speed washed over the crew of the *Wanderer*, leaving the momentary queasiness in the stomach that space travelers called "shift nausea." Captain Raphael Santos swallowed once to calm his stomach and scanned the console in front of him, checking the condition of the ship after the change from one drive to another.

His eyes had not even traveled halfway across the board when he heard the word "doctor" groan from the intercom speaker. He didn't have to look at the indicator light on the communications panel to know the call had come from Prince Rissling's cabin. He reached over and flipped the switch for the Prince's cabin.

"Did you want the doctor, Your Highness?"

"Yes, you dolt," Prince Rissling's voice gasped from the console.

Rafe Santos held back a sharp reply to his employer, but he didn't know how much longer he could keep himself from talking back to the Prince. He tried to explain to the Prince for the thousandth time that the crew was too busy during the translight breakout to cater immediately to his Royal needs.

"Quickly," the Prince complained. "Your sloppy piloting has made me sick, as usual."

Rafe switched off the intercom before he said something which would damage the already tenuous relationship between himself and the Prince. He was not used, as the commander of an independent trading ship, to being talked to in the manner the Prince was using, but it had become necessary for the ship's survival as a trader of any sort for him to swallow some of his pride and prerogative as Captain.

"I have a green board, Sir. Ready to establish parking orbit around the planet," the First Mate informed him.

"Very well, Mr. Johnson, proceed," Rafe replied.

Rafe's dark eyes looked into the screen that showed the view below the ship as it approached the planet. He saw the blue gem that was ancient Earth. It was a sparkling, azure jewel, swirled with the white impurities of clouds; beautiful despite its age.

"Will there be ground time for the crew on the planet, Sir?"

"I'm afraid not, Mr. Johnson. This landing will be all business. We will only need a small party to bring the equipment and supplies aboard. I have been informed by the Prince that he doesn't wish to see the crew 'wandering around like a bunch of cattle' like they did at our last stop on Carthage.

"I'll tell the Prince we are ready to begin communication with the planet," Rafe said. "Then we can start the search for the supplies."

"Yessir," the First Mate replied.

Rafe caught the small hint of humor and sympathy in the Mate's voice and he smiled slightly himself. He took one last look at the planet of man's ancient birth. Normally he considered blue to be a cold color, but the blue of Earth seemed warm and inviting to him.

"Perhaps," he thought, "it's only inviting compared to the chill I feel in my own ship."

He reflexively bent his six foot height as he went through the hatch to the lower

decks. The lack of ground time for his men wasn't the only change that had been made in the normally informal routine of the ship.

The opportunities for an independent trader to make a profit, or even a stable living, had been diminishing in the last few years. The sphere of occupied planets had stabilized. As expansion slowed to a crawl and stopped, the emphasis for most planets shifted to stabilizing what was essentially a frontier atmosphere in the colonized galaxy.

Large fleets of ships from the older and more established worlds had moved into the trading marketplace lately and they were forcing the independents out. Commerce between the stars was no longer a business for a few brave men with a little money and cunning; it was a controlled and systemized business now.

The *Wanderer* had managed to stay in the trading business because of Rafe's skill. They had made a few trips dealing in luxury goods and novelty items, but even those markets were drying up as the more efficient fleets of the big planets expanded their operations. After the last less-than-successful trip, Rafe realized that all his skill as a trader would not keep the men of the *Wanderer* in space. They would have to go in a new direction or be forced out of space altogether.

Since the choices were limited, it was an easy selection to make. The crew agreed that the ship should align itself with one of the smaller feudal worlds and become the "trading fleet" for the world.

As he walked toward the Prince's cabin, Rafe could remember the day he had signed the contract with the Royal Family of Newcastle. The Prince, acting for his family, was seated on his throne, plump, purple and pompous. He had turned his cold eyes to Captain Santos and informed him that the crew was too "sociable" and from now on a strict consciousness of rank and position would be observed. He also told Rafe that the Royal Family would select the trade goods to be carried on the trip and those goods would remain the Prince's secret. The Prince made sure the Captain realized he would be little more than a chauffeur on this trading run.

Rafe knocked on the door to the cabin which had once been his own and waited for permission to enter.

"You may come in," said a petulant whine from within.

The short, paunchy form of Crown Prince Augustus Rissling reclined on the cabin's bunk, his hands clutched to his ample belly as if to hold everything inside. The doctor was bent over the Prince administering a shot that would calm the nausea in the Royal stomach. Rafe supressed a smile when he saw the doctor had anticipated the call for assistance.

The Prince tried to rise from his bed and address Rafe, but he fell back with a groan before speaking. "I thought I told you to have your engines checked, Captain. Something is making me sick every time we shift across the light barrier."

The doctor packed his equipment and left the cabin, shaking his head slightly as he passed Rafe.

"I've had the engineer check again, Your Highness, and everything is working perfectly. Some physical discomfort

is normal as a part of the operation of the Chaytor Drive. I'm afraid we all have to live with it."

"Well, I don't," the Prince snapped. "Have him check the engines again."

The Prince had been growing more animated in relating his discomfort, but he stopped moving suddenly and groaned.

"Well," Rissling snapped, when he had sufficiently recovered, "what else did you want besides the opportunity to see me suffer?"

"We have established a parking orbit around Earth. I wanted to inform you we could make contact with Earth Communications Control and begin negotiations for your supplies anytime you desire."

"When I feel better, I'll tell them what I want and they can ship it up to me."

"I believe we'll have to make a planet landing to trade, Your Highness. From the information I gathered on Carthage, Earth doesn't have the capability of transporting materials from the planet to transfer in orbit."

"I thought this was supposed to be the birthplace of man," the Prince said. "How can they operate under such primitive conditions?"

"Since the exodus was centuries ago, I would suspect the planet doesn't have enough trained personnel to maintain a transfer and cargo facility in orbit, Prince Rissling."

"Primitive. They probably won't even appreciate the value of the trade goods I brought. And you haven't had any dealings with the natives before?"

"No, Your Highness, I've never been this far out before. My information comes from another trader I met on Carthage. He made a deal here for some salvaged equipment about three standard years ago. He said the trading was good."

"What did he mean by 'good,' Captain?"

"He got the material he needed at a reasonable price. It wasn't the most modern equipment available, but he couldn't afford to pay what one of the larger worlds would want for the material."

"I don't suppose he said what he was trading for and what he paid for it?" the Prince inquired.

"No, Your Highness. Those are things one trader doesn't volunteer and questions another trader doesn't ask."

"I had heard you traders were a tight-mouthed bunch before I hired you, Captain. I know you don't talk much to outsiders, but if you won't tell each other anything what do you traders talk about?" the Prince asked sarcastically.

"We can discuss a lot of subjects without giving away secrets," Rafe answered mildly. "We exchange information which might be useful."

"Like where the natives can be cheated?"

"No, Prince Rissling. Information about planet wars or shifts in the political structure of a planet or region or technical information that might lead to a trade. On Carthage, for example, I learned about some breakthrough research being conducted in the area of providing power to a planet from its sun. There's an experimental satellite drawing power from the star in the Carthage system and broadcasting it to a station on one of the moons."

"What good is information like that?"

"It tells me that Carthage is a closed market for energy producing equipment if this experimental system becomes practical. It gives me a source of information on energy research that might be valuable to another planet. Every scrap of information can be useful if you know how or where to use it."

"I don't see why people should take all that time to learn how to suck energy from a star when there's plenty of fossil fuel and radioactive ores in the ground."

"It's not inexhaustable, Your Highness. Different planets have different resources. You have to understand that as a trader: what a planet needs and what it will take in exchange. Like what I learned about Earth on Carthage. The trader I talked to said that Earth would accept trade goods instead of hard currency. That will allow us to trade here where we couldn't on Carthage."

The Prince didn't speak at Rafe's mild rebuke of his Royal trading methods, but harumphed to himself. Rissling had been sure he would be able to make any deal he wanted with the trade goods he had stored so secretly in the hold of the *Wanderer*, but the dealers on Carthage had only been interested in galactic hard currency as payment for their goods.

The Prince fumbled around inside his tunic and produced a sheet of paper which he shoved in Rafe's direction.

"Go talk to someone in authority down there. Tell them what I want. When I feel better we will discuss payment."

The Prince groaned again and rolled over to face the wall of the cabin. Rafe cut off a second moan by closing the hatch as he left the cabin.

As he walked along the trail up the mountain from the landing field, Rafe could hear the Prince puffing heavily some ten yards ahead of him. As he had on Carthage, Augustus Rissling had decided it was his Royal duty and right to lead the trading party on this expedition and now he was struggling under the stress of unaccustomed exercise. Rafe only hoped the result of Rissling's leadership would not bring the same dismal results it had on their previous trading stop.

It was a small band that traveled from the field on the mountain plateau up the trail to the salvage yard to bargain for the material the monarchy on Newcastle needed. Rafe had brought along First Mate Johnson and the new Third Mate, Jacob Robison, who had joined the crew on Carthage when Mr. Phillips had decided to retire. It would give him the opportunity to break in Mr. Robison to his normal duties as the newest member of the trading ship's officer cadre. The Prince was the last member of the party.

Rafe was studying his surroundings as they journeyed up the path. Something didn't look right about the setup here, but he couldn't put his finger on what it was. The landing field had looked cracked and broken as the ship made its approach to the surface. But when the trading party had left the ship and started to the salvage yard, he could see the field wasn't in as bad a condition as he had estimated from the air. The field almost looked like someone wanted it to appear abandoned and broken down.

"Mr. Johnson, what would be your evaluation of this landing field?"

"A mess, sir. Coming in it looked like no one had been here in years. It makes me think the people who run this place don't know what they're doing."

"What does all that tell you about the trading possibilities?"

"Well," the mate speculated, "if they have what we want, I would think we could get it at a very good price. It should be very easy."

"Yes," Rafe agreed, "that's the first impression I got, but it's backwards. At a distance objects usually look better because the flaws are hidden. Why does this area look better close up than it does from far away?" He turned directly to the mate and asked, "Did you notice that large crater on the landing apron the other side of where we set the ship down?"

"Not close up, Sir. I was just glad we missed it when we landed."

"It wasn't a crater, Mr. Johnson. It was a burn mark on the surface like a chemical rocket had taken off. No one has used chemical rockets in recent history. That kind of mark would have been repaired years ago. It seems like someone has made that mark specially to look like a crater. I wonder why someone would go to all that trouble to make this place look like it's on its last legs?"

"I'm sorry, Sir. I should have noticed something like that."

"Don't feel bad, Mr. Johnson. I probably wouldn't have noticed it myself if I hadn't been in a suspicious frame of mind. Nothing on this trip has been normal and it has put me in a cautious condition."

At the top of the hill the Prince gasped to a stop and stared at the decaying area that was the salvage yard. Robison was right behind the Prince and almost bumped into him when he stopped suddenly. The First Mate and Rafe arrived a moment later.

Before the group a sagging chain metal fence stretched for a hundred yards in either direction. The links of the chain seemed more rust than solid metal, and all along its length sections of the fence had been repaired with an assortment of sheet metal scraps, wire, and boards.

The entrance to the fenced yard was directly ahead of the group and a small, run-down shack stood to one side of the opening just inside the gate. The gate itself had fallen from its hinges some time in the distant past, by the look of it. One day it had opened, had parted company with its hinges and to this moment continued to lie fully open in a heap of rusting pipe and chain metal.

Over the gate opening a large, faded sign proclaimed to all who entered that this establishment contained:

THE FINEST
RECYCLED MECHANISMS
IN THE GALAXY

At one time the sign would have been called gaudy, shouting in its offensively red letters, but years and weather had toned down the shout to a mere yell.

In smaller letters near the bottom, the sign told everyone the operator of this pile of decaying junk was:

Moses Harrison
Authorized Planet Salvage Dealer

Through the open gate, Rafe could see that a large area of the yard was filled with big, unidentifiable lumps

covered with a variety of heavy cloth and plastic sheets. Each pile had a number and letter combination painted on it which must have served as an organizing system at one time, but from the disorganized look of the place Rafe doubted that even the man named as operator could now tell what was contained in the yard.

Under the edge of the covering on the nearest pile he could see bent and rusting metal sticking out and knew the contents of the stack would be useless to anyone, but he remembered the strange condition of the landing field and reserved judgment on what kind of a deal he might be able to make here.

"What a mess!" the Prince grunted. "I'll never find what I want here." He surveyed the yard with a scowl on his brow and his nose wrinkled like he had encountered some bad smell. "What a garbage heap! And where's the cretin who inhabits this mess?"

"I'll find him, Sire," the Third mate said, starting into the yard.

"I don't think a search will be necessary, Mr. Robison," the Captain said, pointing to a sign on the front of the shack. It requested them to "ring for service." An arrow had been painted on the sign directing potential customers to a button at the bottom which, at one time, had been white, but now was an ancient shade of yellow approaching mustard. It seemed crusted over with undisturbed dirt.

Mister Robison walked over to the front of the building with all the confidence he could muster after not having seen the sign until it was pointed out to him. He pushed the button and the facade of confidence was shattered as he jumped when the loud, raspy horn sounded.

From the rear of the yard a large man in heavily patched, dirty coveralls emerged from between two of the covered piles of junk. He was a shaggy bear of a man with longish hair, a full beard, and a lumbering gait. His movements suggested he had been taught to walk correctly once, but his training was poorly remembered.

The big man approached the gate wiping his hands on a scrap of cloth, cleaning away the grime of whatever he had been working on.

"Howdy, folks. What ken I get fer ya?"

"Master Moses Harrison?" the Captain inquired.

"Yep," the big man replied. He seemed surprised by the formality of Rafe's question, and extended his hand toward the Captain.

"I'm Captain Raphael Santos," Rafe said, shaking the big man's hand. "This," the Captain continued, indicating the Prince, "is Crown Prince Augustus Rissling—"

"Give him the list," the Prince snapped.

Harrison stared at the Prince, appraising Rafe out of the corner of his eye all the time. His face looked blank of expression to Rafe, but the activity of his eyes told Rafe the big man was sizing up the situation.

Rafe introduced the rest of the group as he reached into his tunic and produced the shopping list for the expedition. He passed it to Harrison who studied it in detail for a minute.

"Reckon I ken get this," he said,

looking up from the list. "Leastwise most of it."

"Well, be quick about it," the Prince said. "I don't want to spend any more time in this garbage dump than is necessary."

Rafe cringed at the remark.

"Not a garbage dump," Moses said mildly, "salvage yard. Differ'nt thing altogether."

Rafe stepped forward hastily to prevent any further strain in the meeting. "I'm sure the Prince didn't mean to say anything that would offend, Master Harrison."

Behind Rafe the Prince snorted.

"We would like to strike a bargain which is beneficial to us both and to trade for the items on this list," Rafe continued.

Harrison looked at the paper again, checking off each item as he slowly went down the list. "Most o' the spare parts fer the groun' effeck vehicles er easy 'nuf." He moved down the list reacting positively to each item as he checked it off. "Microfilm labrary's no problem at all. This here Mark XXV computer's pretty scarce tho'. Gonna set ya back a bunch."

"How much," the Prince interrupted suspiciously.

Harrison looked over the list one last time. Rafe could almost see the slow adding up his mind was making as he figured the price of each item.

"Fer the whole lot . . . fifty kilos of power plant grade radioactives."

"Robbery," screamed the Prince.

Rafe swung around to quiet the Prince and he could see Harrison taking a step back in fear. The big man raised his hands to try and stop the flood of sputtering that was coming from the Prince's mouth.

"I'm sure we can come to some kind of agreement," Rafe said over his shoulder. He was standing between the Prince and Harrison, trying to make himself the focus of the big man's attention. "I have a variety of trade goods from Newcastle in the ship. If you'd tell me just what you needed, I'm sure there's something we can use as an exchange medium."

"Radioactives," Harrison said stubbornly. "Er the same amoun' in hard galactic currency."

"Ridiculous," the Prince yelled.

"Take it er leave it," Harrison said. "Won' get no better deal on them big colony worlds. Mark XXV's an old model. Not too many made 'fore every'n' hightailed it off Earth."

The Prince continued to sputter through Harrison's explanation, but as Harrison finished speaking he calmed and told Rafe he wished to leave.

"Mister Robison, accompany the Prince back to the ship. Mister Johnson and I will be along directly."

The Third Mate nodded and assumed a position two steps behind the Royal bulk as he started back to the ship.

Rafe was thinking about the trade as he watched Augustus Rissling trek back down the hill. The price Harrison was asking would not be the best bargain he had ever made, but it was not overly high considering the rarity of the items he was seeking.

" 'Citable fella," Harrison remarked about the retreating Prince.

"I'll need some time to consider your offer and perhaps make changes in my selections," Rafe said.

"Take all 'a time ya need. Ain't goin' nowhere."

Rafe nodded and asked, "Until then, I need to restock perishable foodstuffs and some other items on my ship. Could you tell me where I can go to complete my resupply?"

"Ken handle it here," Harrison said. "Got a list?"

Rafe reached inside his tunic again and handed the supply list to the big man. "When can I take delivery of these things?" he asked.

"Have em fer ya in the mornin'."

"That will be fine. We can also complete a deal for the other items then. Will that be satisfactory to you?"

"Reckon."

Rafe and his First Mate slowly walked back down the mountain. The Captain was in no hurry to face the Prince.

When he got back to the ship, Rafe could tell the atmosphere was decidedly on the cold side. He was greeted formally by one of his crew and informed the Prince wanted to see him immediately.

"Come in," the Prince snapped from inside the cabin when Rafe knocked.

He was barely in the cabin before the Prince started his tirade.

"We will not deal with that cretin, Captain. Find someone else to supply our needs."

"That's not possible, Your Highness."

"Anything I want done will be done, Captain."

"He's the only salvage dealer on the planet."

"What do you mean 'the only one'?"

"He is the only man the planetary government has authorized to deal in salvage."

"Junk, you mean," the Prince snuffed.

"I'm sure they don't view it that way, Your Highness. Besides, it's what you came here to bargain for."

"Just get the things I want from that man, Captain."

"Can I get the radioactives from the trade goods you stored?"

"I don't have anything like that in the hold. Take it from the ship's supplies," the Prince snapped.

"I can't do that, Your Highness."

"I told you to do it," the Prince yelled.

"You don't have the authority, Prince Rissling. Our contract gives you the services of the ship and crew. You also have control of the trade goods you provide, but you can't dispose of any items of equipment or supplies which are a part of my ship."

"Captain, you were engaged to get the material I need and I expect you to do, and use, whatever is necessary to obtain those things. If you fail in this, you can expect to suffer grave consequences. I will make sure no one in the galaxy deals with you again."

The Prince had purpled with rage as he yelled and he sat back now to gain his breath and watch the Captain shake with fear at his threat.

Rafe disappointed the Prince.

"I'll make the best deal I can with Harrison," the Captain said calmly, "but remember, since I'm using supplies which belong to this ship, the things I trade for are mine. You and I will have to strike a separate deal of our own later."

"You are working for me. What you

get in trade is mine and the Monarchy's. Are you trying to cheat me and break the contract?''

''The contract is very specific at your own insistence. You pay only our salaries for the use of the ship and for the perishible supplies expended in such missions as you undertake. Everything else is my responsibility. I'm using material you wanted no part of replacing, so what I get in trade is mine.''

''Insolent oaf!''

A small, thin smile lingered on the corners of Rafe's mouth. ''Perhaps, Your Highness, but at the moment the only oaf who can get what you and your family need. I'm your last chance.''

''Get out of my cabin.''

Rafe gave the Prince a mock bow. ''As you wish,'' he said, retreating from the cabin.

He knew he was walking on shaky ground. The Prince had made the situation here difficult, but the Prince would make sure Rafe paid for his mistakes. Even if Rafe could pull off this trade it could mean the end of the contract that was supposed to keep the ship on the trading lanes. It could also mean their lives if Prince Rissling felt his honor or his family had been insulted. Rafe knew he needed a plan and wanted to talk things over with his First Mate.

There was a serious expression on Mr. Johnson's face as he thought about what Rafe told him of the meeting with the Prince.

''We're in a bad spot,'' Rafe concluded.

''Everything is within the bounds of the contract, sir.''

''Which would only help in a galactic court. There is no surety we will ever get that far. We may have to deal with the interpretation of the contract which is made by the Monarchy on Newcastle. What was your impression of Moses Harrison?'' Rafe said, changing the subject.

''Slow, Sir. Not only physically, but he seemed like he wasn't too intelligent. It's hard to believe he's the kind of man a responsible government would put in charge of the only salvage yard and allow to make deals for the whole planet.''

''It would appear like that on the surface, Ben, but did you see his eyes?''

Johnson was surprised the Captain used his first name. It had been a long time since they shared the easy familiarity of friends. ''No, Sir,'' the Mate replied.

''They were quick, Ben. A slow man doesn't shift his eyes so rapidly and try to take in everything around him. Moses Harrison seems to fit the pattern of everything else we've encountered on this world; the reality is not what you may believe from the first impression.''

''Can we make a deal, sir?''

''It's possible. The price isn't unreasonable. I don't like the idea of parting with our reserves for the power generator, but it can't be helped if we are going to make any deal at all. And it's vital we get what the Prince wants.''

''Couldn't we try another planet and make a deal for the trade goods the Prince has stored in the hold?''

''No,'' Rafe said flatly. ''I made a little trip to the hold before coming up here. It's full of native handicrafts and art objects from Newcastle. They might sell on one of the big trading worlds, but they'd never bring enough to buy

what we needed there. We'd have to take currency for his goods and then go to another planet where things were cheaper.''

Johnson considered the possibilities for a moment before speaking again. ''Do you think we can get what the Prince wants from Harrison for less than he's asking now?''

''Not unless I have some leverage,'' Rafe said. ''I need to know more about what's below the surface impression of this planet.''

''How do you find out, sir?''

''The new Third Mate, Robison. He has a background in electronics, doesn't he?''

''Yessir. He was with the planetary police on Carthage.''

''Get him up here. Robison and I are going to do some looking around that junkyard. We'll continue his education on what it takes to be a trader.''

The night was cold, but Rafe was sweating under his tunic. The trip up the mountain in the dark had been easy enough, so he knew it came from tension. He looked above him and saw a clear view of the stars. He would have liked some cloud cover to hide their movements.

Rafe paused outside the gate to the junkyard with Robison crouched down behind him. He gestured to the Third Mate, indicating that they would enter the yard and go to the left. They moved to the nearest stack of junk and paused a moment to see if their movements had been observed.

When there was no indication they were being watched, Rafe began his investigation of the yard. He lifted the canvas covering on the pile and carefully shined a small light on the material underneath. Whatever it had been, he decided, it was only useless, rusted metal now.

''Why would anyone be saving this?'' he wondered. ''it's good for nothing but scrap.''

They moved carefully from one stack to another, heading deeper into the junkyard toward the huge shed at the rear of the yard. Along the way, Rafe looked under the coverings of several more stacks. There were more piles of rusted metal, some identifiable and some not, and a few stacks that seemed to be composed entirely of empty crates. None of it made any sense to Rafe. There didn't seem to be anything here that was worth trading for.

Deep in the yard, Rafe made the only significant discovery of the trip. He lifted the cover on a stack and found a well-used ground effect vehicle. He motioned for Robison and let him see what was concealed by the canvas.

''How old?'' the Captain whispered.

''Ten years. No more,'' the Mate said.

Rafe nodded in reply and lowered the cover. He pointed around the stack toward the rear of the yard and the large building there. They continued.

Earlier in the day Rafe had seen the building at a distance and assumed it was used to store the larger or more delicate items that Harrison used for trading. He thought it butted up against the mountain, but now he saw it was actually built into the side of the rock wall.

The two men arrived at the corner of the corrugated metal building. Rafe sig-

naled for Robison to break out his electronic equipment and wait while he scouted the side of the structure. He was gone a few minutes and when he returned he drew Robison after him down the side of the building toward the mountain. Fifteen feet down the side of the structure he stopped beside a window.

"Check for alarms," Rafe said.

Robison studied the glass for a minute and then checked the frame with his hands. He took a small meter from his belt and used the probe of the machine at several points around the window.

"Seems like a pretty primitive system, sir. I can bypass it easily and we can get in through there."

"Anything sonic or heat sensitive, Mr. Robison?"

"This place is too crude for that, Sir."

"Never overlook anything, Robison," Rafe said shortly. "That ground vehicle was more like eight years old and couldn't have been made on this planet. It may have seen heavy use, but it was in excellent repair. It tells me that we can't assume everything will be as easy as we want. Check the window again."

The mate broke out his instrument again and spent several minutes probing the window frame. He grunted in surprise twice and double-checked his readings.

"The window is only wired for a contact system, sir, but the room beyond is only a few feet deep. The system only seems to cover that room. I get indications of a much more sophisticated sonic system in a room beyond this one, but I can't read much about it from here."

Rafe led the way to the front of the building, checking the structure along the way for a weakness that might be exploited. He found several places where it looked like the exterior wall had rusted away, but each was patched from inside the building. A careful inspection revealed the patches, which looked like they had been slapped in place, had actually been welded to the exterior wall and formed an airtight seal.

The main door of the building opened by being rolled to one side, and a smaller door had been cut into the large one to admit people to the structure without having to open the big door. Rafe pointed to this small door and indicated that Robison should check it out.

The mate spent a considerable amount of time probing and testing. When Robison turned, Rafe favored him with a questioning expression.

"I've seen banks that weren't as well wired as this place, Sir. I can bypass the contact trigger on the door and the personal scramblers on our belt should take care of the sonic alarm."

Rafe nodded. He outlined a plan for entering the building and set the mate to work bypassing the alarms.

The Captain went through the door first and ducked behind a stack of crates to the right of the entrance. The Mate followed and closed the door. He turned to find the Captain, gasped and stumbled when he saw the inside of the building. Robison caught himself and joined Rafe behind the stack of crates.

Outside, the building was maybe a hundred feet wide and thirty feet deep before it butted into the mountain. Once

inside the mountain, the roof went up from twenty feet to well over fifty. A concrete floor stretched for a hundred feet into the mountain and the sides of the building went outward until it was nearly two hundred feet wide. In contast to the disarray of the yard outside, here the stacks of crates were aligned in neat rows and anything could be found at a moment's notice.

Rafe looked around and realized he had been wrong. There were still things about this place that could surprise him. He felt a warm breeze on his face and knew the structure was climate controlled. He grasped the gaping Robison by the tunic sleeve and brought the Mate's attention back to the business at hand. He signaled and the two men continued down the right side of the building away from the large center aisle between the stacks of crates.

They moved from one stack to another, pausing every so often for Rafe to inspect the stacks of crates for a clue as to their contents. Most were coded with letter and number combinations, but a few had a label that plainly stated what was inside: manufacturing equipment, household appliances. All the things he could identify were the remnants of the civilization that had once populated Earth.

Ten minutes of scuttling around crates brought Rafe and the Mate to the rear of the building. The Captain carefully led the Mate to the edge of the last row of crates when he heard a noise at the very back of the room. He peered around the edge.

Twenty feet ahead, across an open space, Rafe saw a huge elevator at the back wall which would go to deeper levels of storage. He was studying the elevator when the Mate tugged on the sleeve of his tunic and pointed farther along the wall to the left. There were two men poised over a console and Rafe realized their conversation was the sound he had heard that caused him to stop.

The larger of the two men was Moses Harrison and he seemed to be issuing orders to the second man. He pointed down at the console to a computer screen that glowed amber. The second man seated himself at the console and went to work at a keyboard. Rafe strained and made out a few of the words Harrison was saying.

"... the microfilm library from level twenty ... take about two hours ... contact Smith about the food. ..."

Rafe watched for another minute. He heard nothing else, but he had enough information. He drew the Mate back behind the crates and motioned for him to start back toward the front of the building.

The Captain and Mate had only taken a few steps when a voice called out from the rear of the building.

"Leaving already, Captain Santos? Don't you want to see it all as long as you've come this far?"

Rafe froze. He motioned for Robison to split up and make a break for the front door, but before either could move two men came from behind stacks on either side of them. The men were big, silent, and armed with stunners. Holding their weapons rock steady, the two men led Rafe and the Mate to the back of the building where Harrison waited.

"I applaud your enterprise, Captain Santos, but I'm afraid it will prove very costly."

"You seem to have lost your accent, Master Harrison."

"A charade, I'll admit, Captain, but most times an effective one."

"Only one of many it seems," Rafe said, waving to include the building around them.

"You are very sharp, Captain. It's probably why you survive as a trader in these hard times."

Rafe inclined his head at the compliment, but reserved comment until he knew more about what was going to happen to him and the mate.

"I wonder how someone as smart as yourself got hooked up with that bloated pomposity I saw this morning."

"Hard times bring hard compromises," Rafe said flatly.

Harrison nodded his head knowingly. "And desperate measures. Such as tonight's venture?" the big man said. "Unfortunately, this desperate measure will cost you your life."

"Violence hardly seems like it would be a part of your charade."

"As you said, Captain, hard times call for hard compromises. You've seen rather more than we can let you report somewhere else."

Harrison directed his men to search the two traders and while they were doing it, Rafe was studying Harrison. The big man seemed to stand even taller now than he had earlier. He still reminded Rafe of a bear, but now the power was combined with a purposefulness and control that wasn't visible earlier. Rafe knew this man was not only capable of killing him and the mate, but of doing it swiftly and without compunction.

Rafe's trader instinct was to seek every scrap of information that could help him, so he questioned Harrison. "Why?" he asked, indicating the building, but meaning the whole charade Harrison performed.

"Survival, Captain. The continued existence of myself and every soul on this planet depends on making the best trade possible."

"And the appearance of being primitive gives you a little edge in your deals," Rafe stated.

"Correct. It's a matter of confidence and pride. A man who is overconfident that he has the upper hand can become sloppy, and one who thinks he is better than the man he is dealing with, lets his pride get in the way of clear thinking. I have to come out on top of every deal to survive and I'll use any trick I have to."

"One deal couldn't make or break you."

"Yes it could, Captain. I'm dealing with a very limited supply of things to trade and every year there is less demand for items as old as mine. I hold no illusions about myself, Captain Santos; I'm a carrion eater. I live, all of us on Earth live, off the remains of a dead culture. When all the tradable items are gone, so are we,"

"Food?" Rafe asked.

"Energy," Harrison replied.

Now Rafe understood the inflexible demand for radioactives. A planet, even one that had been ravaged, could renew itself over time, but certain things were finite: oil, gas, and radioactive ores.

"We survive only on what you see here and on twenty-seven underground floors. When it's gone or when no one wants it anymore, we stop surviving."

"It doesn't make sense," Rafe said. "This is the birthplace of man. I would have thought the energy problems would have been solved centuries ago."

"It might have happened if it wasn't for a fluke, Captain. We were rapidly approaching a fatal energy crisis and research was being pushed as fast as it could be, but then Dr. Lee Chaytor stumbled on her secret."

"The Chaytor Drive," Rafe said, finishing the thought.

"Yes," Harrison said bitterly. "An accident in weapons research turns up a usable translight drive. Energy research stopped immediately. Why struggle on a used-up world when there were thousands of fresh ones to move to. And so the exodus."

"And you couldn't continue the research yourselves?"

"Not enough qualified people remained," Harrison said. "We try to keep up on the latest energy research in the galaxy, but even our communications equipment is old and limited."

"You can't travel off planet to find what you need?"

"We haven't the manpower or resources to build and maintain a ship," the big man admitted.

"Then I have a solution for you, Master Harrison."

"Talking won't get you out of this, Captain. If everyone finds out how desperate we are, we'll never be able to make the deals we need to survive."

"No talk, Harrison, a trade. The lives of myself and my mate for the life of your planet."

"More than a fair trade, if you're serious, Captain Santos."

"Do you know what a sun tap is?"

Harrison's eyes opened in amazement. "Yes, the theory anyway. A power station in orbit around a sun picks up its energy and converts it to broadcast power. It's transferred to a series of satellites around a planet and then broadcast to ground stations. It's only a theory, Captain."

"It *was* a theory. It is now a system in experimental use."

"Where," Harrison demanded.

"My secret," the Captain said.

"I could torture it out of you."

"Yes," Rafe agreed, "but you still couldn't get there and purchase what you need. My proposal is this: I become the authorized agent for Earth. I trade your goods for currency and purchase the sun tap."

"That's all?" Harrison asked warily.

"And whatever profit I can make above the cost of the system."

"I said you were a sharp man, Captain."

There was a long silence while Moses Harrison considered the deal Rafe had proposed. Finally he spoke. "What guarantees do we have, Captain. What stops you from taking our information and our goods and never coming back."

"This deal helps both you and me to survive, Master Harrison. Times are hard, as you said, and I have to have something to trade to keep me in space as a trader. Sometimes you have to trust somebody to help you. Let's call this a matter of faith between two men of honor."

"In other words," Harrison said, "you have as much to lose as we do?"

Rafe nodded in accession.

"I can only give you a possible agreement, Captain. I'll have to talk this over with the planet council, but I believe they'll agree."

Rafe sighed in relief.

"Your man here," Harrison contin-

ued, indicating Robison, "will be our guest for the night. In the morning I'll have your answer and we can conclude our other deal for your pompous friend if you still desire."

"I have a contract," Rafe said. "A trader always fulfills his contracts."

"I've heard that," Harrison said. "It's what makes me want to trust you."

The screen on the console of the *Wanderer*'s bridge showed the deep black of space surrounding the blue jewel of a planet. The jewel shrunk as the ship retreated from it. Prince Augustus Rissling was on the bridge berrating his Captain.

"This will be our one and only trade, Captain Santos. You are finished as a vassel of Newcastle and as a trader."

Rafe regarded the bulk of the Prince mildly and replied. "Yes, our business is concluded, but I think I'll be in space for a while yet."

"Not if I can help it," the Prince shouted as he left the bridge.

Rafe turned from the retreating figure to the console for a check of the ship's condition.

"Ready to engage translight drive, Sir," Mr. Johnson reported.

"Thank you, Ben. Engage immediately."

"Shouldn't I wait until the Prince is settled in his cabin, Sir?"

"It isn't necessary, Ben. We're a trading ship, not a passenger liner to cater to the whims of guests."

The First Mate engaged the Chaytor Drive and a loud groan issued from the corridor. Both the mate and the Captain were smiling. ■

RESULTS OT THE NAME THE UNIVERSE CONTEST

I want to thank all of you who took the time and effort to write and enter the Name The Universe Contest which was announced in my AV column of September, 1984. There were a surprisingly large number of entries (more than I can possibly acknowlege individually), they are still coming in, and there were lots of interesting suggestions. I'm sorry that only one person can win ... but that's the way our universe works.

And now ... (drumroll) ... the Winnah is ... (the envelope please) ... Colin R. Leslie of Victoria, British Columbia! Colin complains that, in the case of galaxies, while others have exciting names like "Andromeda" our own galaxy is stuck with "Milky Way," with its implications of candy bar wrappers and cholesterol collected from four-legged animals with udders. He feels that we need to do better for our universe and suggests the name **Gaea**. Gaea (with apologies to John Varley) refers to the primal Earth-Mother goddess of Greek mythology, worshipped at a time when the Earth *was* the universe as far as its inhabitants were concerned. And so **Gaea** is appropriate as the name of our universe-mother, sustaining all of us and making life possible against all odds.

The first runner up is Linda L. Clements of Fremont, California, a Professor of Materials Engineering who suggests that "Technetium-43" is an appropriate name for our universe because technetium, element number 43, is the first element in the periodic table (aside from the neutron, which may or may not belong there) that has no stable nuclear isotopes. In an H-space containing a multiplicity of bubble universes with slightly different force strengths this characteristic should uniquely distinguish our universe from others. I like that as a quick way of identifying our universe, but I find it less appealing than Gaea as a name.

The second runner up is my friend Gene Wolfe, who hasn't been daunted by my rejection of his "Malkuth" and has persisted by suggesting that "BOB" is the appropriate name for our universe. He explains that at the time of the Big Bang the universe was named "BB" (a small hard pellet-like object), that its name has now expanded to BOB, and that when it expands further it will become BOOB (or maybe even BOOOOB). He then goes on to make allusions to the filling of a Size D Cup which I will, in the interest of decorum, refrain from repeating here.

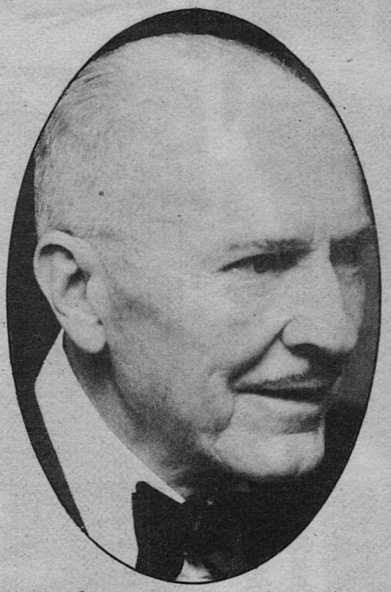
John G. Cramer

Jay Kay Klein's biolog

Analog is a four-dimensional object, the issue now held in your hand being a thin slice of what is a long line of thin slices stretching back along a timeline to January, 1930. In this it may be likened to a living organism, whose current body is really the most recent expression of a long line of gene-bearing chromosomes stretching back toward some distant past. Though Robert Anson Heinlein's fiction has not surfaced here in over a quarter-century, what he contributed is still within, affecting pretty nearly everything that appears in these pages. Though his name is not on the current contents page, by rights he ought to appear in one of the "Biologs" since his presence remains in the pages.

His contribution lies in both style and substance. Stylistically in the long-ago days of the late 1930's there were the "pulps" exemplified by science fiction magazines such as *Astounding* (as *Analog* was called then) and "mainstream" fiction magazines personified in *The Saturday Evening Post.* An Annapolis graduate of 1929, Robert was five years later forced by ill health to leave the Navy. He had long been a reader of the available science fiction, mostly in pulp magazines. Graduate study at UCLA in mathematics and physics helped complete the background he would bring to his own writing. A life-long patriot and believer in the American system, Robert was induced by monetary incentives to try his hand at fiction when he read in the July, 1938 ASF an editorial by John Campbell titled "Contest." Offered were $450 for a three-part novel, $200 for a novelette, and $60 for a short story. The "contest" ran continuously; anyone could enter anytime. Just send a story in, and if it pleased the editor, it would be bought. If it pleased the reader, more stories would be bought.

Robert's first submission appeared in the August, 1939 issue. More stories followed and readers quickly found that the style was exciting and new to them, but it was like the writing found in the slicks of the day. Robert had introduced "realistic" prose with well-rounded characters, coupled with a matter-of-fact acceptance by the people in the stories

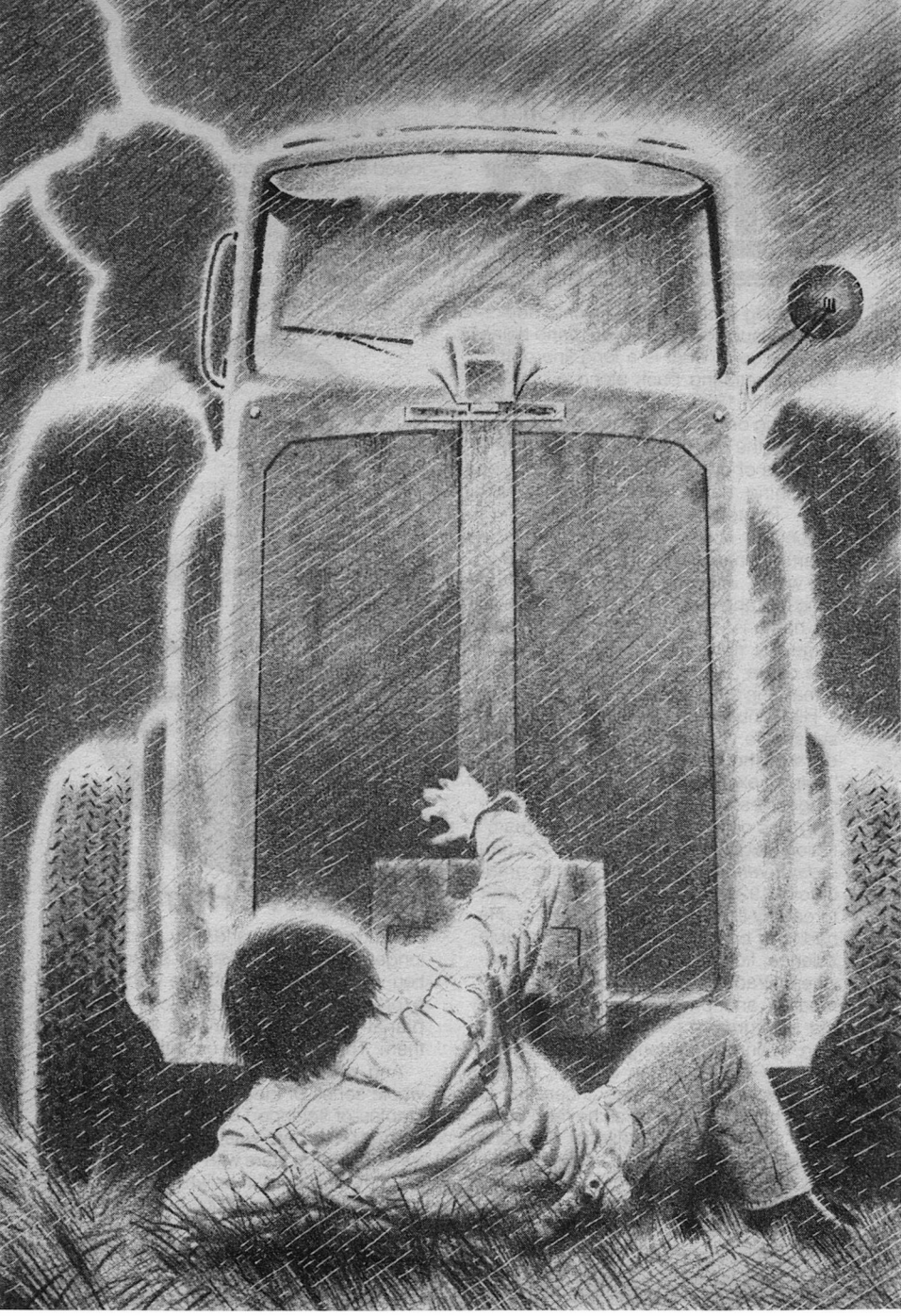


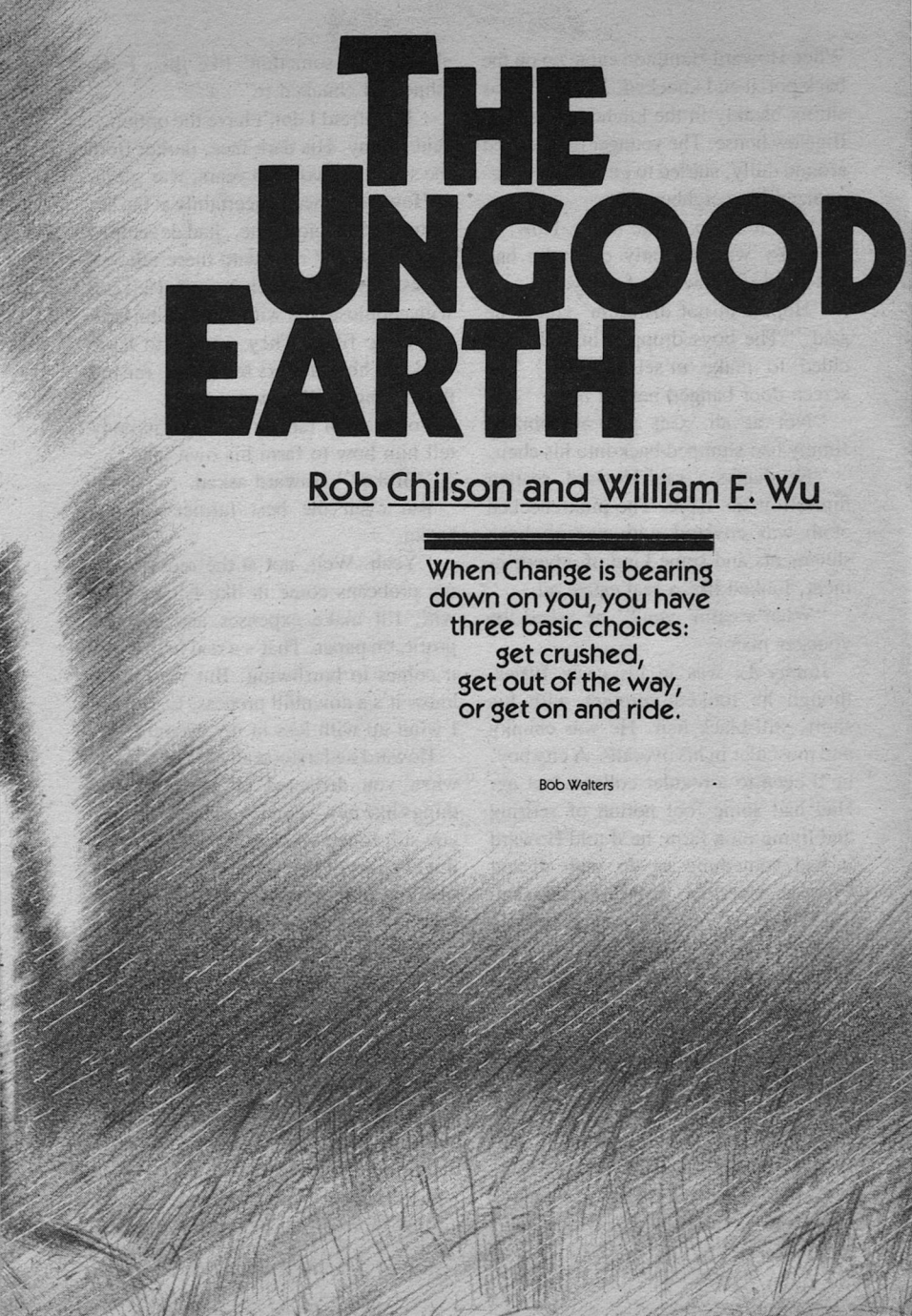
Robert A. Heinlein

of the "everyday" world they lived in. No longer would characters in science fiction wander about the future with dazed expressions amid declamations and explanations of the wonders bemusing them. They simply got on with the story.

And what stories! Robert launched a whole series of ideas that have become staples of science fiction. In "Universe" (May, 1941) there was a generation ship traveling to the stars with a crew forgetful of what they were in or where they were going. His second story in that issue, "Solution Unsatisfactory," dealt with ra-

(continued on page 190)





THE UNGOOD EARTH

Rob Chilson and William F. Wu

When Change is bearing down on you, you have three basic choices: get crushed, get out of the way, or get on and ride.

Bob Walters

When Howard Hampton came up on the back porch and knocked, Jimmy Li was sitting bleakly in the kitchen of the old Bigelow house. The younger man looked around dully, started to get up, then recognized his neighbor.

"Oh, it's you; come on in, How."

Jimmy was the only one who had called him "How" in forty years.

"Hope I'm not disturbin' you," he said. "The boys dropped in and I decided to make m'self scarce." The screen door banged behind him.

"Not at all. Get you anything?" Jimmy had slumped back into his chair.

"No thanks," said Howard, seating himself at the table. The pink-checked cloth was covered with papers: bank statements and some kind of advertisement, looked like a real estate ad.

"What's eatin' you?" he asked the younger man.

Jimmy Li was in his early fifties, though he looked younger with his short, still-black hair. He was chunky and muscular in his overalls. A city boy, he'd been to a regular college, not ag. Had had some fool notion of retiring and living on a farm; he'd told Howard it had something to do with distant Chinese ancestors. Howard had taken more interest in the younger man's struggle than he had in his own. His help had paid off; the boy'd become a competent farmer.

Those distant Chinese must've passed on something. Howard's grandsons lacked a quarter of Jimmy's feel for the land.

"Don't know if you saw this," said Jimmy, pushing the ad toward him. Howard glanced at the glossy brochure.

"Come to think of it, my son John showed me somethin' like this. Foolishness. I chucked it."

"I'm afraid I don't have the option," said Jimmy. His dark face, darker from the sun these past two years, was glum.

Howard glanced uncertainly at the ad. National Chemical, Inc., had developed a new dry-land reed with these tailored genes they had, which braced itself not with cellulose, but with some damn kind of plastic fiber. They wanted to lease land and hire farmers to farm it, raising these things—their way.

Poor sort of farmer that lets anybody tell him how to farm his own land.

"Broke?" Howard asked.

But even the best farmer can go broke.

"Yeah. Well, not at the moment. If my probeans come in like I hope they will, I'll make expenses and a small profit, on paper. That's a real help when it comes to borrowing. But you and I know it's a downhill process. Each year I wind up with less in my account."

Howard understood all too well. Even when you deducted all expenses for things like new vehicles and equipment, you still found you had gone in the red. It was a fact of life; farmers sold wholesale and bought retail, and who could compete with the food factories?

"So you're sellin' out?"

"Haven't made up my mind. I can still wait till next year, but not longer than that; by then NCI will have leased all the land it will want. And there won't be any other market; once NCI leases most of the land here, their competition will look elsewhere. So if I don't sell before then, I'll be stuck."

Since Howard hadn't considered taking up their offer, he hadn't thought

about it before. But now that Jimmy mentioned it, he could see that this offer was only good for this year or next. It hadn't been easy for Jimmy. It'd been a lone fight, except for Howard. His wife Lily had refused to accompany him to the country.

"Well. Reckon I'll miss you." Howard spoke slowly, watching him, but got no rise out of the other man. Jimmy just looked at him, haggard.

"And I'll miss you—unless I take this leasing offer."

Howard couldn't conceal his distaste for the idea. "Not my kind o' farmin'."

"Mine, either." Jimmy grimaced. "How long do you think you can hold out, as an old-time farmer?"

"What do you mean?" Howard asked carefully. He had given much thought to that lately.

Jimmy sighed. "I spent twenty-five years in business, mostly in the food industry, learning all about marginal businesses among other things, and trend analysis. I've tracked this trend back as far as 1960."

Howard blinked at him, shaken.

"Yeah. It was a better, simpler life then. But modern problems were already visible, though the cloud, as they say, was no bigger than a man's hand. In that year, the American public spent a mere 19 percent of its income on food. In 1970, it spent a mere 17 percent. At that rate it would have hit zero in 2045 or thereabouts. Think that's bad? It's worse than that."

Jimmy got up and crossed to the fridge, pulling out two bottles of beer. "It's worse than that. Because it dropped to 15 percent, not in 1980 as you might expect, but in 1978—and the trend followed that curve from there. It could actually hit zero by 2010!"

Howard stared at him, the open bottle forgotten in his hand. "That's impossible! Who'd grow food if they couldn't sell it? Who'd process it, pack it, transport it?"

"What's the world's largest market for food?"

"Th' gov'ment. But—"

"Quite. How long has it been since you've sold wheat—corn—beans—millet—on the open market? Ten years?"

Howard was silent, but he made it more. It startled him, thinking back, to realize how long it had been since he could make a profit with commodity foods on the open market. Whole protein beans, now, he still could sell—but already there was agitation in the industry for the Department of Agriculture to raise its floors there, too; the market price was falling steeply. That was why John'd shown him that thing from NCI—and no doubt why Jimmy was looking it over.

"So you think the government will buy up all the food and give it away?"

"Already a third of the food we grow is sold to and given away by the government. Practically everybody qualifies for it. Some of it's eaten by poor people overseas, but unfortunately every big city on Earth these days has modern sewage treatment facilities."

The modern way to treat sewage was to sterilize it, then feed it to algae, then do things with the algae: it made good but nowadays too expensive fertilizer; it could be used as the starting point for a thousand chemicals that used to be made from oil; or it could be made into

food, or fed to yeast and the yeast made into food.

Butter and cheese and milk, fake flour, cornstarch, flaked potatoes, pea soup, fake meat from textured vegetable protein, fruit juices, vegetable soup stocks, pasta—why, the list was endless and getting longer every day.

"The world just doesn't need farmers anymore," Jimmy said sadly.

"They're turning farms into plastic mines, and producers of luxury foods, and most of all, parks and dude ranches. Even dude farms!"

Jimmy sighed. "My father was an engineer, and his father was a doctor. Beyond that, I forget. But far enough back, in southern China, my folks were peasants—which is to say, farmers. I guess my family never lost some of that thinking, because my folks used to say that only land has permanent value. And that everybody has to eat, so the people who grow the food support the entire society. Somehow or other, that sunk in. I've always wanted to be a farmer. Only now it's too late. It's the food factories that really feed the public. The only use they have for us is amusement parks!"

Those were Howard's own sentiments. But— "Folks'd never eat all that fake stuff if they could get real food," he growled.

Jimmy shrugged unhappily and set his bottle down. "My grandkids prefer the fake stuff, especially meat. I don't mind eating chicken myself—even killing my own, now you showed me how—but not rabbits. Or cows."

Howard frowned, drank beer. It was a common attitude. All his life long he'd known people who were too fine-haired to eat, say, rabbit or squirrel, at least not any they'd known personally. Stubbornly he said, "Yeah—but the fake stuff just don't taste right."

"Tasting right is a function of what you're used to—what you ate when you were growing up. My grandkids are growing up on the fake stuff; it tastes *right* to them."

That was a new thought; Howard was shocked by it. Why, there must be a whole generation growing up out there that maybe *wouldn't want* real food if it could get it!

"My God," he said softly, despairing. "How can the farmer make a livin'?"

Jimmy dropped his gaze to the floor and shook his head.

Howard had crossed Jimmy Li's fields and was half across his own before he raised his head. This was a field of protein beans, his major crop for the past six years; on the back side he had a field of the new genetically altered corn to sell to the government to cover expenses. This would be the last year for that; they were cutting the floor back down in staple foods, because the food factories could feed the population so much more cheaply that farmers no longer had any support from the taxpayers.

Now probeans were going the same way—first the price falls under competition from the food factories, then the gov'ment steps in and subsidizes the farmer till the taxpayer howls, then the farmer's got to scramble.

Turn the whole world into a goddam amusement park next. . . .

The beans looked good, the shoulder-

high plants sturdy, the ripening beans at the tips where the harvester could get at them turning ripe straw-yellow. Across the field Howard found the old footpath among the trees along the creek. Walking silently from an old hunter's habit, he came up behind a line of those aspen that in Missouri are called "red birch."

Voices sounded from beyond it, speaking casually.

Through the trees he saw his son John and two of "the boys," his grown grandsons Bill, John's son, and Allen Wade, Susie's boy. "In those days this field and the corn field were in pasture." John jerked a thumb over his shoulder. "Man could raise cattle in them days and make a livin'."

"They don't need stock raisers at all now, or so I read," said Bill. "They can cut off and culture bits of the carniculture, so they will never have to kill another cow—when they go to full production."

Howard had read that. It would kill the ten-thousandth of a market there had been for livestock.

Carniculture had beaten back textured vegetable protein. They cut up a cow—or pig or chicken or rabbit or peacock—into, say, ten thousand pieces and put each piece into a suitable nutrient medium. Pretty soon the piece was as big as the animal it came from, pure firm meat, no bones, fat only if wanted. The nutrient medium was made from protein beans—only now they were making it cheaper in the food factories.

"There's just no way a farmer can compete, I mean a regular dirt farmer, Dad," said young Bill. "Factory farming, now, is no assurance either, because they can make plastics and things out of sewage and algae too. But there's a limit to the kind of capacity the factories have, and if they're making food, they can't make plastics."

"There's still a market for fruit," said John quickly.

"Diminishing," said Allen. "The major market was fruit juices and things like pies, and the food factories have moved in."

Howard faded back and presently turned off on a little-used path hidden between bushes. Despite the blurring of his vision he bent, under the trees along the creek, and touched the earth. Deer tracks; big doe and a fawn. They got fat on probeans.

There was a footbridge here, a mere plank laid across from bank to bank. A two by six, what they called a five by fifteen nowadays. Howard hadn't crossed it in a year or so and bent again to check the ends for rot. They were laid on rocks and besides, he'd used artificial wood —rayon fiber in rayon foam, with clay mixed in to discourage termites. It was sound; he crossed swiftly.

There was an old log not far from the board. It had been here since he was a young man, a meter thick in those days but sunk to half that now, soft and punky. He seated himself on it, put elbows on knees and chin on the backs of his hands. It was cool and dim in the cavern of the trees.

It wasn't merely that they wanted to sell his land. God knows, that was nothing new. This leasing business was a blind, their way of getting him to accept the inevitable. Sell and retire! But "the boys" had not been raised on the farm as John had been, and he had been, and his father Morris had been. It was noth-

ing new, that they should counsel selling it, even in a sneaky round-about way like this.

No, what caused this slamming about the breastbone had been what Jimmy Li had said. For years the boys'd been saying farming was playing out and he'd refused to listen. But Jimmy knew his stuff, and besides—once the trend was pointed out—

And now here in the cool shade cave his heart was burning faintly. He grinned dryly, looking out at the sun-blasted field outside. No doubt his old body was trying to give him a way out, but modern science had closed that door. His heart wouldn't fail.

After a bit his breathing slowed and he stood up. But he stood with head hanging, arms dangling, like an old cow run too far.

Always, since the days of flint and clay sickles, there had been farmers. In the time of "the breaking of Nations," as the poet Hardy had said, there had been, would always be, seed-time and harvest, the immemorial round. These were the universal invariants, and in a fast-changing world, you had to have someone who had his feet firmly rooted in the universal invariants. When the shiny cities collapsed of their own artificiality, he'd always felt, he'd still be here—

But—*free food?*

Who could compete with free food?

The shiny cities with all their vulgar artificialities had eaten *him*. His heart had tried to stop, horrified, at the prospect of the loss, not of a farm, but of a way of life.

In the yard he glared at Bill's sporty airboat and snorted. Never catch him up in one of those things. It was sleek, a shiny green, not made of metal as he well knew, but of one of the fortalics that'd chased metal out of most high-strength applications. It looked like a breathless bit of tomorrow against the house beyond.

The house had been stylish and expensive when new. His father had built it to *his* mother's plans in the glory days of farming, before food factories and tailored genes. It was made of wood, on a foundation of square stones, neatly sided and painted white. The shutters were green with a design on them and there was a little of what his father'd called "fiddle-dee-dee work" around the gables; those were the only decorations. Brick chimneys they didn't need anymore, but he could remember the scent of woodsmoke from them. Trees and lilacs in the yard, and a porch, with porch swing. The house was old enough to be comfortable and homey, but in excellent condition.

On the step he paused. Bill's wife Fiantha had a shrill voice—city folks seemed to get louder with each generation.

"It's not as if the land can be made to pay for many more years. And a deal like this doesn't come along every year."

"Johnnie wouldn't want to break his heart," said John's wife Tinette. John and Tinette ran the farm these days, with Howard a junior partner. "Even keeping the house and yard—"

Howard stamped and scraped noisily on the mat and they broke off. When he entered they exchanged glances as transparently as children and changed

the subject. The other men appeared presently and a meal was served. Howard as usual was taken by surprise by this. The women hadn't gone off to the kitchen, and he didn't know how they'd cooked it.

He decided to jump their guns, and while Tinette was still serving he said, "Been thinkin' about sellin' the land again?"

Even John, who knew him, looked startled. "How'd you know?"

"Figures. Only reason the boys come by."

Bill flushed and Allen looked angry.

"Well, you know the state of affairs. Haven't had a good profitable year for ten, 'leven years. How long can we go on like this?"

Not past 2010, he wanted to tell them, but only nodded tersely, swallowed stewed corn.

"Fruit's a possibility, but I don't like it any better'n you do. It's a fully developed market, and long ago you warned me against going into a fully developed market. Now, I'm of no mind to sell the land. But this deal with NCI—"

"How long a lease they talkin' about?"

It was the first show of interest he'd made. "Ten years, with option for another ten."

"And it'd say that if they didn't like plastic reeds, they could switch you to some other crop? And you'd have to do just what they say?"

"Yes." John banged his cup down. "It's hardly a new proposition! Farmers've been raising food for canneries and doin' it just their way for a hundred years!"

"Mebbe so." Howard studied it for a few minutes, eating sullenly. He shook his head at last, stubbornly. "Just not my kind o' farmin'."

Nobody said anything, though Fiantha's sigh was comment enough.

It was nice of them to hold the house and yard out of any deal. Oh yeah, not selling the land—that was a crock. Once he'd spent a year farming for NCI, they'd figure it easy to persuade him to sell, at least the boys would. They didn't realize that the house meant less to him than the fields. The fields were his independence. And even his independence meant less than his way of life.

Which was doomed.

He looked up. "You boys just never understood, not either of you. Should'a been raised on the farm, then you'd know. The place never was nothin' to you but a summer amusement park. Bein' a farmer's more than a job. . . ."

But it was no use; they couldn't understand. The generations of men of the soil that lay behind him, those of his blood and those others back to the stone age—they'd junk it all like. . . .

"So it all ends with me," he said bitterly.

They ate in silence till Tinette got up to bring the pies.

"What's that?" Bill's head jerked up.

Wind.

"My boat! I want it in the lee of the garage—the wind might get under the wings."

It would take a tornado to lift the airboat. Electric arcs in those stubby flanges sucked air down from above and blew it out underneath. But Howard jumped up at another thought.

"The beans! The rain'll knock'em

off—specially if there's hail!'' He set off at an old man's lope.

''Dad! Don't worry about them—''

''Shag yourself out, boy! It's a month's crop!''

''Uncle John? Is it important?''

''No, Fiantha. Few of them will fall; they're not quite ripe, and they're designed for Midwestern thunderstorms. Besides, it's only a month's crop, out of three or four in the season. Gov'ment insurance'll cover it. But let him go.''

''It's getting dark out there!''

John Hampton smiled faintly. ''The old man's not afraid of the dark.''

Howard was hardly conscious of the cloud-shadow dusk. He ran by ''Dear John,'' the antique gasoline-powered John Deere he'd been so proud to drive as a boy. The modern tractor stood near it. It hummed alive at his thumb against the lock, and he backed it up to the multiharvester in the shed. They coupled like railroad cars and Howard hopped down to set the harvester for probeans.

Coming out of the shed to climb onto the tractor, he looked at the sky for the first time. It was still light where the clouds had not hidden it, and he was treated to an awesome vision: the wide pale sky, the massive black clouds lowering upon him, rushing out of the west; the trees lashing in the wind and showing the undersides of their leaves; already an occasional flash of lightning in the clouds.

It was the face of his old enemy, but he paused a moment to savor the sheer spectacle of it.

Then he advancee the exciter, the carbon-14 and strontium-90 atoms began to die at a faster rate within the tractor's can, and power came humming forth. The tractor skimmed for the fields through the watery light. Howard hit the headlights as they turned into the first row.

The harvester swung arms out and began to comb the beans from the bushes; he drove between the close-set rows rather than straddling them. A stream of white flowed into the cart. They'd have to be dried after the rain, but no problem.

The clouds came on like the end of the world and the wind lashed around the cab. He closed the side windows and the noise subsided. The tractor charged humming down the row at a run through air that smelled of rain.

The land can't be made to pay for many more years, Fiantha had said.

How long can we go on like this? John had said.

Howard's eyes stung and the row blurred ahead of him.

Bein' a farmer's more than a job, he'd argued. But the hard facts ignored him.

The world doesn't need farmers any more, Jimmy had said.

Jimmy'd been like another son to him—and now he too was ready to sell out. Again Howard felt the pain around his old heart.

One dazzling blaze of lightning lit the field white and the rain was on him like a giant's foot. Howard flinched at the rage and the roar. The rain instantly turned his windshield opaque white. As he hit the wipers he heard the rustle and grind of the bushes and knew he'd veered into the row.

Swearing, he tried to back, and the harvester got cross-wise. He didn't have

adequate lights back there and he swore again. The front tires skidded as the rain lashed down on the sloping field. Growling a little in irritation and haste, Howard swung down, snatching a flashlight loose and aiming it aft to see just what kind of predicament the harvester had gotten itself into.

It wasn't supposed to happen, but the deadman switch was an irritation—you often had to stand up to see what you were doing—and Howard had disconnected it. Now the tractor began to creep forward. It couldn't move fast without someone to advance the exciter, but it would attempt to hold this speed.

Alarmed, Howard jerked away from the tall wheel rolling slowly toward him. Betweeen the rain in his eyes and the mud underfoot, he slipped. He hit his head against the frame and stars shot through his vision. Then he was down, his head under the tractor, his feet under the bean bushes, and the flashlight pointing offside. The wheel was advancing toward his midriff and chest and he jerked up, hit his head on the frame again, and subsided.

What flashed before his eyes was not his whole life, but the simple fact that he couldn't escape. He was floundering around in the mud, he was old and stiff in the joints, and though the tractor was moving slowly, it was too close. It'd walk up over his belly and chest and down his shoulder, maybe missing his head, but surely stopping his heart, modern medicine or no. And behind it was the harvester's narrower wheel to finish the job.

Well . . . so be it.

Relaxing, he took his last deep breath, let it out slowly. The wheel buried the flashlight in mud and he closed his eyes.

After eight or nine seconds he opened them.

The wheel had rolled up to him and stopped. The tractor didn't say anything; it was not one of these newfangled ones that could talk. But it was smart enough not to run over him.

Howard lay and looked up at it, mud soaking him, and debated whether to get up or not. But the damn thing probably had an alarm built into it and would like as not begin yelling for help if he lay here too long.

He eased out from under and sat up, conscious of the mud, the rain. He hit the big driver with his fist. "Damn a world where a man can't even die with dignity!"

He sat there for awhile, wiping off mud and pondering his choices. It was nearly intolerable to get back into the cab, muddied as he was, but it was the least undignified thing he could do. There was mud on his head.

"Should've retired long ago," he said vindictively, pulling himself to a stand beside the tractor. It quivered and backed ten centimeters like a live thing, having him so near its wheel. "Let them worry about feeding themselves, they're so smart!"

He kicked the driver and it backed again.

It was dark and the rain had slacked off to a steady drizzle when he had the last of the beans in the bins. Howard stomped into the house, ignoring Tinette's gasp at his muddy clothing; she could guess he'd fallen. The boys were still here; possibly they had intended to

spend the night. He looked at them sullenly.

"Before you start another round of argument, let me tell you here and now that I'll never permit the land to be sold. Never! So if the only reason you can find to come out here is to git me to sell, you don't need to come back ever again! Hear?"

Startled by this assault, Allen said stoutly, "It's *not* the only reason, but never mind that—leasing isn't the same as selling—"

"It's as good as, when they run the land! Besides, you were just usin' that as an excuse—next thing you know, you'd've been around urging us to sell. Right?"

Bill had the grace to nod reluctantly; Allen flushed in acknowledgement. Fiantha swelled with anger, but had better sense than to intervene in an argument between men—that surprised Howard.

"Well, forget it—there'll be no leasing, neither! Not to no damn chemical company. This is a *farm*, not a goddam plastic mine!"

Bill still had no better sense than to try to argue with him—in that mood. Howard blew up and ordered them off the farm, forgetting he no longer was sole owner. But John, half behind him, nodded, troubled, and the boys arose reluctantly.

"Rain's slacked off," Howard added sullenly. "You shouldn't have any trouble flying out."

He went to his room where any spiteful comments from Fiantha could not be heard. He'd shared this peaceful oasis with Marian for so many years; before that it was his parents' room. It was much as Marian had left it; he looked dully at the crocheted cover on the chair, the doily and vase of silk flowers. *Looks like a preserved room in a damn museum: the good old days!* Howard kicked off his overalls and put them in the basket Marian had bought for muddy clothes. Presently he heard the scream of the airboat, the howl of its departure. Howard waited in his underwear. But John didn't come. He was prepared for argument, for defense of the boys, for urgings to agree to the leasing of the land. Instead, he heard John and Tinette depart for bed.

That was a relief, but a let-down. The emotions of his struggle in the dark and the mud had worn off, leaving him melancholy. Hell of a way for a farmer's life to peter out, he thought, stepping into a warm shower. He came out, put on clean overalls, hesitated for a time, and went out to his car. It wasn't late yet.

Jimmy Li's light was still on, he saw. Lily Li had refused to accompany her husband to the country, though his children sometimes visited, with their children. Those grandkids'd been looking forward to spending the summer with him. *His* grandkids had never much cared for it, though he could remember the pleasure he'd gotten from starting Allen on "Dear John."

"How!" said Jimmy, swinging wide the door and stepping back. "What brings you over so late?" He sounded concerned, but glad for the company.

"Dust-up with the kids," he said grimly. "Ordered'em off the place. Jimmy, was I right or wrong? But they got no business tellin' us to sell or not to sell, bein's they never lifted a finger

about the place. It ain't nothin' to do with them."

"True enough. So you're not selling—or leasing, I take it?"

"Nope, not neither one. I'll be a farmer till I die."

Jimmy nodded slowly. "Unless you go broke and have the farm sold out from under you."

"Unless I go broke, of course." He spoke without concern, accepted coffee, drank. Jimmy was looking at him in surprise.

"You don't seem troubled about the prospect."

"It's always been a prospect for a farmer, Jimmy. Gettin' sold up was as much a part of farmin' as weather, drops in prices, cuts in farm support, and all th' other things we always have to contend with. You can't let these things get you down."

'You can if it's your life's dream going down the drain," said Jimmy with an edge to his voice. "My savings are melting away; in a year or two, barring impossible profits, they'll be gone. Why should I wait till I'm wiped out? Better to sell the land for what I can get and have a stake to start something else."

"Such as what?"

Jimmy was silent for a moment, idly stirring his coffee. "I could get a job back in the food industry again," he said, sighing at the thought. "Or maybe try to set up some other kind of farm —luxury goods closer to St. Louis, maybe. You have to be close to your markets for that."

"That's a well-developed market; you'd have to borrow money to go into it, and no guarantee you'd make that profit every year you'd have to have to pay off," said Howard impassively.

"Or I could take up NCI's offer." Jimmy looked at him defiantly. "Dammit, How, it's the only way I can be even halfway the kind of farmer I wanted to be."

"Hell, I thought better of you than that," said Howard, disgusted. "I thought you was a real farmer, else I wouldn't've taken such pains with you. A *real* farmer doesn't quit just because he's broke. There's been good years for farmers, sure, but by and large farmers've *never* made much money. It's always a struggle. But *real* farmers stick it out till they're sold out. Where'd people be if farmers had been the kind to throw up their hands at the first reverse? Starvin', that's where!"

"Oh, come on, How. There has to be a limit. I see no virtue in waiting to be evicted by the sheriff. It makes good movies, but—"

"You *are* a quitter. Told me so when you first moved in, how you'd run from one business to another, always movin' on. To your own advantage you said, but never fightin' to keep somethin' alive."

"Now, that's not how I put it. In business, forecasting the markets and cutting your losses are skills, not failures."

Howard remained firm. "You say you're a farmer—I say you're a fake, though you had me fooled."

"C'mon, How—"

"As long as you got anything to fight with, you got to keep on fightin'. You can do what you like, but I ain't quittin' till I'm sold out. Long as I'm strong enough to ride a tractor, that's where

I'll be—John can sell the land when I'm past farmin', but not till then!''

''Aw, How, I respect all that, but—''

''So this *is* just another business to you. You once said it was more.''

Visibly stung, Jimmy dropped his gaze and idly rubbed his thumb along the edge of the table. ''It *is* more. It's my life's dream.''

''You don't act it,'' said Howard. ''Now me, if I have to I'll take to raisin' garden truck, like my granddad did in the Depression! Not this modrun gene-spliced stuff, neither. I'll grow the good old stuff people don't see no more. And if necessary, I'll peddle it door to door!''

Jimmy stared at Howard silently for a moment without seeing him, the flesh tightening around his eyes. ''I know something about farming, and a lot about business . . . hell, farming *is* business.'' His voice was distant with wild surmise.

Howard looked back bitterly, unaware. ''Yeah? And is your business sense gonna stop this trend you told me about?''

Jimmy shook his head, a visionary smile starting on his tight mouth. ''No . . . business doesn't stop trends. It *rides* them.''

The back screen door to Aunt Lily's Old-Style Food Farm and Restaurant slammed shut and Jimmy Li came out, calling a last word back to Lily. Howard looked up from where he and John were working on ''Dear John''; Eric Li sat in the iron seat, revving the antique gasoline engine for the benefit of the patrons who'd drifted outside, some with plates in their hands.

''We're gonna have to have that carburetor rebuilt sooner or later, but this'll hold us through the rest of the season, with luck,'' said John.

''Take'er away, Eric!'' Howard said, and the boy eased the John Deere into motion.

''Isn't it dangerous for such a young boy to drive a tractor—and without any safety circuits?'' one of the patrons asked.

''Sure,'' said John. ''But how can he grow up, if he never takes risks?''

Jimmy drew Howard aside. ''I haven't been on a tractor for nearly a week, myself. And it's gettin' late in the season for much tractor driving.''

''So you're about to throw a tantrum if you don't get to play with the big boys' toys?'' Howard grinned. ''Time'll come when we have tourists up on the newer tractors with safeties on 'em.''

''Not soon, even buying second-hand ones from farmers gone bust.'' Jimmy shook his head. ''I didn't believe it when you told me, but it's true; they just go on farming till the land's sold out from under them. The stuff we've picked up at sheriff's sales—''

''Made the difference between success and failure,'' said Howard. ''Poor sods, they tried, but hard work alone don't cut it.''

They looked around at the thriving restaurant. It now occupied all of the Lis' house; they had had to move in with the Hamptons. Tinette and Lily Li and Susan Wade were kept busy cooking old-style foods in old-style ways, and the various kids and grandkids in serving it and otherwise backing up the operation.

Howard shook his head. "How long can we survive, Jimmy?"

Jimmy stood with head on one side, eyes half closed—the image, Howard suddenly realized, of his father Morris Hampton studying the weather—as he considered it. It was amazing how the city-bred boy had assimilated country ways; have him talkin' the lingo next. Howard could already hear it coming, and his grandkids had it down pat.

"I should say we'll hold out well for another three years, and not so well for a couple, three more," said Jimmy. "Competition is beginning to pinch. But advertising pays, and our customers go away satisfied and tell their friends. It's a long drive here from St. Louis, but word-of-mouth advertising helps a lot. Yes, I'd say three to five years."

Howard snorted with laughter, punched him on the shoulder. "Hell, that's good enough for me! I don't have many years left. And afterward John and the boys can sell the damn farm if they still want to!"

Jimmy punched him back and laughed. "Listen, if you hillbillies are going to start your feudin' again, let me out. Which tractor is not in use and which field needs fertilizer?" ■

IN TIMES TO COME

● Next month we begin Timothy Zahn's first *Analog* serial, *Spinneret*. I can't tell you what the title means without giving away more than you should know going into the story, but I can tell you that Zahn has spun quite an original yarn out of what starts out looking like a familiar situation—but doesn't stay that way for long. Humankind has its first star drive, which would seem to open up some impressive new solutions to pressing old problems. There's no shortage of human-habitable planets, but neither is there any shortage of beings who can inhabit them, and most are already claimed. The only nearby planet available for us is one that nobody else wants, because of such oddities as a bafflingly complete lack of metals. But that's only the beginning. . . .

The fact article is a special one which you, the readers, helped write. A couple of years ago David Brin had an article here about a mystery currently worrying many scientists: if life is as widespread as it seems it should be, and if interstellar travel and communication are as feasible as they seem, why haven't we met any aliens? Many answers have been proposed; Brin pointed out these may suffer from lack of imagination, and challenged you to come up with better ones, which he promised to talk about in a future article. This is that follow-up: "Just How Dangerous *Is* the Galaxy?"

The Alternate View

LIGHT IN REVERSE GEAR, I

John G. Cramer

The purpose of this AV Column is to describe a physical paradox involving what seems to be a loophole in a well-established physical law, the famous Second Law of Thermodynamics. The 2nd Law states that the amount of disorder (entropy) always either increases or remains constant for any isolated system of particles, whether they are gas molecules or light photons. And yet, as we will see, laser physicists seem to have provided us with a way of making the 2nd Law work backward for a system of photons, and the disorder *decreases*.

Everyday experience tells us there are some processes that once done can be undone, while others cannot. For example, a padlock can be repeatedly locked and unlocked, but an egg once scrambled can never be unscrambled. In physics we call the first kind of process *reversible* and the second *irreversible*. The essential difference between reversible and irreversible processes is related to the 2nd Law and the increase in disorder. In a system that is designed to limit the amount of disorder that can occur (like the padlock), the growth of this disorder may be so small as to go unnoticed, and the process seems to be reversible. In a system where few limits are placed on the disorder (like an egg) the system may grow very disordered indeed, and the process is clearly irreversible.

As an example of a simple irreversible process, let's allow the gas to escape from a sealed steel cylinder full of gas molecules into a surrounding vacuum. At the start we open a valve holding the molecules in. The cylinder then contains 100% of the molecules and the surrounding space contains none. We will call this situation State A. Now we let this system evolve with time until it reaches State B in which 1/2 of the molecules are still in the cylinder and 1/2 of them have emerged into the surrounding space. After a while longer the system reaches State C in which almost all of the molecules have left the essentially empty cylinder. The disorder has grown progressively in this sequence. The system was "perfectly" ordered in State A. less well ordered in State B, and minimally ordered in State C. And somehow, when the system was in State B the molecules "knew" that they should proceed to State C rather than State A. The probability of the system's returning to State A through the random motion of the molecules is negligibly small. This is the essence of the 2nd Law.

But suppose that by some magical process we could intervene when the system was in State B so as to "flip"

instantaneously the velocity direction of each individual gas molecule. Then (at least in the opinion of most physicists) the gas would do a most unusual thing: all of the molecules would retrace their steps and *go back into the cylinder*, returning to State A. The order of the system, instead of decreasing as the 2nd Law requires, would increase in violation of the 2nd Law. In principle if we could perform the same "velocity flip" operation on a more complicated system, for example an egg and its immediate surroundings, the disorder of that system would also be reduced and the scrambled egg would be unscrambled and would retreat into an unbroken shell.

But the 2nd Law is a well established physical principle that has never been found wanting in a century of experimental testing. Surely natural laws can't be broken with such abandon; there must be something funny about the operation of reversing velocities. Physicists have considered this point carefully and have concluded that this operation is indeed impossible. Velocity reversal is an example of what is called a "fine grain" process. A "fine grain" process requires detailed information about each individual molecule, as opposed to a "coarse grain" process which requires only average overall information such as pressure, temperature, etc. The famous Maxwell's Demon, a little man equipped with a little tennis racquet with which he bats fast molecules in one direction and slow molecules in another, is also an example of a fine grain process. It has become a physics dogma, supported by the success of the 2nd Law, that fine grain processes are impossible (except in cases where the mechanism behind the process increases disorder more than the process reduces it), and that only coarse grain processes are allowed without restriction.

Recent work in laser physics, however, seems to have created an annoying flea presently nipping at the back of this dogma. Light photons should in principle obey the same thermodynamic principles (including the 2nd Law) as gas molecules. And laser physicists seem to have provided us with a means of performing the operation of *perfect velocity reversal* on a system of light photons. The apparatus for performing this thermodynamic miracle is called the *four-wave conjugate mirror*.

To understand what this device does, let us first consider what an ordinary mirror does. Basically, a mirror reflects light by reversing the component of the light's electric field which is parallel to the mirror surface. This makes the light change direction, moving away from the mirror but usually also away from the direction from which it came. If you wanted to bounce a laser beam back in exactly the reverse direction, you could use tricky mirror arrangement called a "cube corner" reflector. You may recall that the Apollo astronauts left some of these on the surface of the Moon for use in laser ranging. But even with a cube-corner reflector, if the light beam is spreading out before it hits the mirror (as it usually is), it will continue to spread.

The four-wave conjugate mirror that laser physicists have recently devised is quite different from an ordinary mirror in that instead of reflecting the incident beam in *space*, it reflects it in

time. The incoming light wave is mixed with two other oppositely directed light waves generated by lasers within the apparatus. These three waves interact with a transparent medium through which they pass to produce a fourth wave which is the *time reverse* of the wave that came in. A way of thinking about what happens is that the incoming light wave and one of the laser waves combine to inscribe a temporary hologram on the medium, and that the other laser wave then interacts with this hologram to produce the fourth time-reversed wave.

Since the fourth wave is the time-reverse of the incoming wave it will go back along precisely the same path taken by the incoming wave. If the original wave was spreading out from a source point, the new wave will converge back to that source point. If the original wave was distorted and diffused by irregularities and dust particles in the intervening air, the new wave will travel back through the same irregularities and *undo* the distortions to produce a wave just like the one that originally emerged from the source. The photons comprising the fourth wave are just velocity

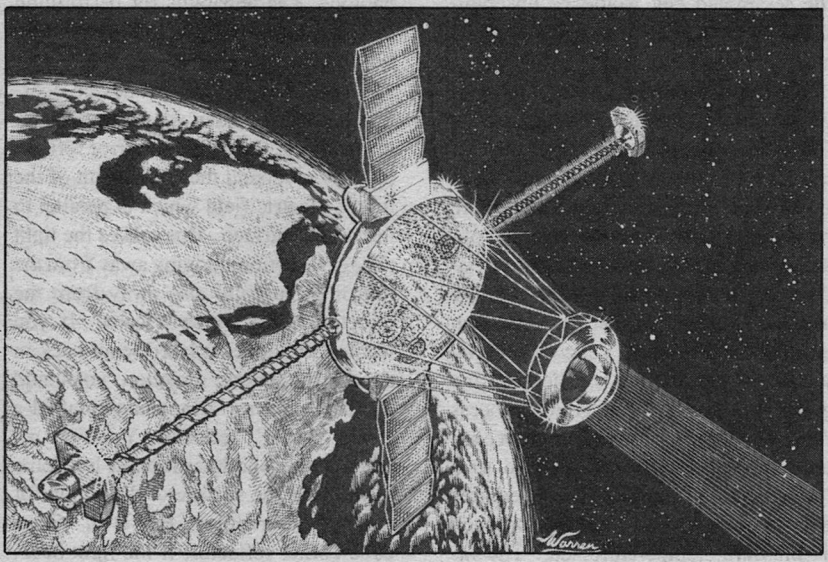


Illustration by William R. Warren, Jr., 1985

flipped counterparts of those which entered the apparatus.

This trick may have "space war" applications of both the science-fictional and the DOD variety. If someone tries to zap your space ship with a laser beam you can return fire right up his gun barrel. A four-wave mixer will "shoot back" with perfect aim and accuracy, automatically compensating for distortion, etc. There is another laser-based device called a light amplifier which effectively "Xeroxes™" light waves passing through it to produce

multiple copies. If we place a light amplifier in front of the conjugate mirror, the beam which shoots back can be given much more power than the original beam, so an assailant can be outgunned.

And it's also possible to shoot first. Instead of precisely aiming a laser beam one can send out a weak wide-angle beam that reflects from a "target," and then use the reflected wave after four-wave conjugation and amplification to send a vast quantity of light power back to the target. (A note of warning to would-be Star Warriors however: this technique will not work over satellite-scale distances because most potential targets will have changed positions during the transit time of the light.)

Of course physicists are, for the most part, not particularly interested in target practice with ray guns and have other reasons for being interested in conjugate mirrors. An example is laser-produced inertial fusion, which may one day provide a solution to our energy problems. The trick here is to hit a tiny pellet containing tritium with as much laser energy as possible, causing thermonuclear reactions. Focusing and aiming the high power lasers through windows that may be distorted by the reactions is a serious problem. Amplified conjugate mirrors may provide an answer to that problem. The trick mentioned above is used here. A "guide laser" is flashed at the pellet. Waves reflected from the pellet are amplified, sent back by conjugate reflection, and amplified again up to an enormous power level. Since the original reflected waves were diverging from the tiny pellet, the amplified time-reversed waves will be converging on the pellet and will score a "direct hit" on it from many directions at once. Even if the windows introduce distortions, the aim and convergence of the waves is still perfect.

But let's return to the original point: the application of the 2nd Law to devices involving four-wave conjugate mirrors. It would seem that this device is the velocity reverser, and as such has the capability of reversing an "irreversible" process that involves light photons. Of course, the machinery behind the four-wave mirror may increase disorder more than it is decreased for the photon system, but I can think of ideal arrangements where this does not seem to be true. Since the four-wave mirror is a wave device perhaps there is a subtle connection between the 2nd Law and the particle-wave duality of light which has not up to now been appreciated. In any case, I am not presently able to offer a solution to this thermodynamic paradox. Solutions from you readers will be read with interest. I would like to think that perhaps we have a handle on a way of building a truly "fine grain" device and that perhaps the progressive increase of entropy isn't as inevitable as we had believed. ■

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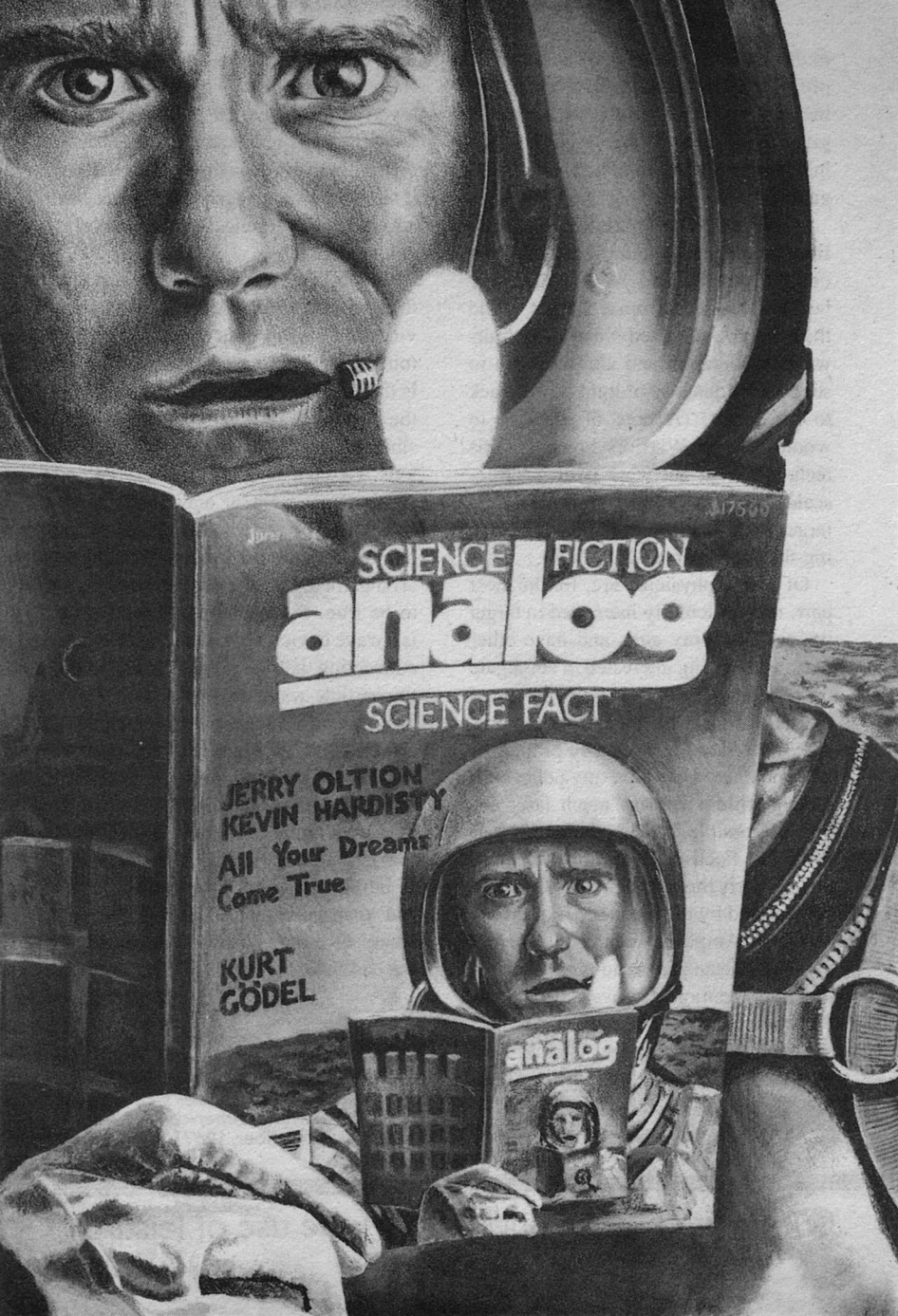
● The aim of education is the wise use of leisure.
Aristotle


SCIENCE FICTION
analog
SCIENCE FACT
JERRY OLTION
KEVIN HARDISTY
All Your Dreams
Come True
KURT
GÖDEL
analog

Jerry Oltion and Kevin Hardisty

ALL YOUR DREAMS COME TRUE

What occupational hazard could be more distressing than the discovery that for years you had *really* been doing what you thought you were *pretending* to do?

Nicholas Jainschigg

The worst part had been the waiting. Not the hundred or two hundred or a thousand years he knew he must wait while medical science learned how to cure his cancer—he had been in cryogenic freeze throughout that and he hadn't felt a thing—and not even the time in the hospital waiting for the court to declare him legally alive during those years, for any time he could win an argument with his wife was an occasion to savor. No, what almost drove him insane was that ten or fifteen seconds after they'd given him the shot, waiting for the sleep-inducing drugs to knock him out before they put him into the tank and flash-froze him. The wondering. Would he ever wake up again? He had preserved his estate, but would he fare as well?

He heard voices. Evidently he had.

He tried blinking his eyes. It took him a while; either the drugs hadn't worn off yet or they'd given him others. When he did finally get them open he saw a cluster of faces looking down at him.

"How long?" he asked.

"One hundred and forty-four years," one face replied. It was female. He assumed the owner of it to be the head doctor.

One of the others saw him trying to work out the math and said, "Twenty-one thirty-six."

"Thanks." Something felt very strange about his body. He wondered if it was just the absence of pain, or if . . .

"I feel light. Am I on Earth?"

"No," the doctor replied. "You're on the Moon. Copernicus dome."

"Oh," he said. "Well." Inside, he was thinking *On the Moon!* He took a deep breath. "Did you . . . ?"

"We destroyed over two hundred separate sites of cancerous activity in your body. You were a very sick man, Mr. Nichols."

"I'm not now?"

"No. At least you no longer have cancer."

He wondered if he would cry. He'd lived this moment so many times in his fantasies, sometimes crying, sometimes not, sometimes getting up off the bed and dancing a jig, most times not—now that the time had really come he wondered which to do. He didn't feel like crying, nor dancing, either, despite the gravity.

So he said, "Thank you, Doctor . . ."

"Holly. Gwen Holly."

"Doctor Holly. Thank you . . . very much. I wish I could do something for you in return."

"Just regain your strength. That's all you should worry about for now." She gestured toward the doorway and watched as the others trooped out, then she turned back. "Tell me; you *are* the Nicholas Nichols who wrote *All Your Dreams Come True*?"

That question took him by surprise. "Pardon?"

"The book *All Your Dreams Come True*. Did you write it?"

"I shouldn't claim it, but yeah, I did. The worst thing I ever published. Why do you ask?"

She hesitated before she answered. "Just making sure."

"Why? I'm not remembered for *that* am I?"

"Among other things, yes. All your books are famous, Mr. Nichols, but that one has been generating a lot of interest

lately."

He lay back against the pillow, not sure how to react. To be remembered at all after two hundred years was more than he could ask for, but for *that?* He wondered how Asimov had fared after all this time. A million other questions sprang to mind. The future! What was it like?

"Hey, could I have today's newspaper, or whatever you call it nowadays?"

Doctor Holly smiled. "Newsscreen. It's on your bedside table."

He looked over his shoulder and saw a flat piece of plastic about the size of a thin notebook. When he picked it up he found three buttons along one side. He looked up for help.

"Go ahead. You can't hurt it."

He held it in his hands like he would a magazine, the fingers of his left hand resting on the buttons. "Be it on your head, then, if it blows up," he said, and slid the first button upward. Why up? Well, it was the way he would have done it if he had designed it. If it turned on by pushing down, then it would be too easy to turn it on by accident, say when you slid it into a cover or something. And of course the top button would be the on-off switch.

The front face showed a table of contents. The letters were black against the milky white plastic. Try as he might, he couldn't get the light to reflect off it. He would have given it an anti-glare coating too.

His index finger fit just right over the second button when he held the screen in a comfortable reading position. He slid it down and got page one. Sliding it up brought back the table of contents. Holding it up or down made the pages flutter by at just about the speed of fanning a magazine. The third button put a blinking square at the top of the page. Nicholas thought about it a moment, then turned the screen off. When he turned it on again he was on the same page.

"Not bad," he said. "I like it."

Doctor Holly said, "You should. It's just the way you described it in *The Literacy Plague*."

"The—" He looked up, suddenly blushing. "Are you a fan?" He'd always reacted that way to adulation.

"In a sense," she replied.

"In what sense?" That had not been the usual response.

"I've read your writing. I thought a lot of it was childish, but I liked some of it. You've got an interesting mind, Mr. Nichols."

"I—Thank you. I think."

She winked at him, and he wondered what a wink meant in 2136. He was trying to decide on his response when she said, "I'll let you read for a while. If you need anything, call. Don't get up, okay?" Without waiting for an answer, she turned and walked out the door.

He watched her walk down the hallway. After she was out of sight, it hit him that she was very beautiful. Why hadn't he noticed it before? He shook his head as if to clear the cobwebs out. Hopefully his reflexes would improve along with the rest of his health. Now that Marla was safely part of history, he would for the first time since their wedding be able to appreciate the company of the opposite sex. It would be a shame if he could no longer work up

the enthusiasm. But then, he supposed he could always re-learn. He smiled at the thought and began to read the news-screen.

The first thing he noticed about the news was the writing. The people who wrote it were good. The changes in the language were offset by a straightforward style that made for easy reading, and the stories stuck to the point all the way through. Evidently the quality of education had risen again after he had been frozen.

And so had the standard of living, judging by the content of the articles. On Earth, air cars had replaced ground cars, freeing space in the cities for better housing, parks, public buildings, and so on. Cars were electric-powered, and electricity came from solar power satellites, which meant that the air was cleaner.

But Earth was no longer the only piece of real estate with people on it. There were colonies on the Moon, Mars, and in L-5 orbit (he realized with a start that he had probably missed the final meeting of the L-5 society), and the World Space Agency had even sent out ships to Alpha Centauri and Tau Ceti and a few other close stars.

It was like finding himself in one of his own stories. This was the kind of world he had always written about, the kind he had believed could happen if only people could learn to see things the way he did. It was the reason he had become a writer, to spread his ideas as far as he could in hopes that more people would catch on. And now, reading the newsscreen, he felt a burst of pride. In a small way, perhaps, he had helped create this world.

There were still problems. He even understood a few. One article had him laughing so hard that tears came to his eyes. The Sierra Club had filed for an injunction against the Selene Mining Corporation to stop them from mining in the Sea of Tranquility. They felt that the site of the first manned landing on the Moon should be preserved as an historical monument. Selene Mining contended that the lunar lander was sitting over the richest pocket of germanium ore yet discovered in the entire solar system, and the value of the germanium outweighed any historical considerations. Both sides had supporters, but for Nicholas the crowning blow had come when Neil Armstrong had offered to pilot another lander down a few kilometers away and plant a flag and leave a few footprints for the Sierra Club.

Neil Armstrong! Evidently there had been more than one "crazy nut" to have himself frozen for posterity. That was encouraging. There would be someone to help Nicholas through the culture shock. He wondered if there was some kind of twentieth-century club, with conventions where everybody got together to drive old cars and talk about the "good old days."

He wondered how many burgers McDonald's had sold by now.

It was more than he could assimilate all at once. The future was beginning to catch up to him. If he read much more he didn't think he would be able to maintain what little grasp on reality he had. He put the newsscreen away and tried to sleep.

Doctor Holly was in the room again when he woke. She looked up from a

bank of instruments and said, "Good morning."

"Good morning. What's for breakfast?"

"What would you like?"

"Chateaubriand in béarnaise sauce." He smiled to show he was kidding.

"I take it you feel well."

"You take it right. I'm alive. I don't have cancer anymore. I've successfully left my past behind me, and from what I read in the paper—excuse me, on the screen—it doesn't look like I'll have any trouble adjusting to the future at all. In fact, it seems like I'm in one of my own books. And here I am on the Moon, which is something that less than fifty people could claim in my day. Of course I feel well."

Something he'd said seemed to startle her, but it only showed for a second. He guessed wrong and asked, "Why *am* I on the Moon, anyway? It must have cost a fortune to ship me up here."

Doctor Holly relaxed again. "Not really," she said. "We bring all our sleepers here for wake-up. The light gravity is easier on them. Also, at least in your case, there's someone here who wants to talk to you."

"Oh? Oh, of course. The administrator for my estate. I was wondering when I'd hear from him."

"I'm afraid not, though I'm sure he'll be getting hold of you as soon as he learns you're awake. No, the man who's waiting to talk to you is William Strahler. He's an Admiral in the navy."

"Navy? On the Moon?"

"Space navy, I should say. There are two different branches now."

"Oh." Nicholas shrugged. "Well, sure, I'll talk to him." He sat up in bed. "Do I have time for a shower first? It's been a while."

Dr. Holly smiled. "Would you settle for a bath? Showers are tricky in this gravity."

"A bath would be fine." He swung his feet off the bed and, scratching his head, said, "Still a military, huh? Well, I guess everything couldn't have worked out the way I'd written it."

"But it—" She stopped herself, the same startled expression on her face. She hid it with a professional smile and said, "I'll have an aide help you. Just a moment." She left the room, leaving Nicholas wondering what that was all about. He looked down at his open hospital gown. Maybe she was just overly modest, or she thought he was.

The bath was a long-missed luxury, though different. The tub was wide and tall and tapered in at the top, like an oversize, oblong brandy snifter. When Nicholas started to wash, he realized why. Even when he tried to be careful, he still managed to slop water over the rim. No wonder Doctor Holly hadn't let him take a shower. He would probably have drowned in the airborne water.

He dressed in a long, loose robe that the aide held for him, and accepted his shoulder to lean on. Even on the Moon his legs were barely strong enough to hold him up. It had been six months, subjective time, since he had walked.

Breakfast was waiting for him in the room. He laughed when the aide sat him down and uncovered the tray, and Doctor Holly blushed a little, but she said, "You'd have gotten steak anyway. You need the protein to rebuild your muscles."

"You're right, I do. Join me?"

"Admiral Strahler will." She went to the door. "Admiral?"

At first glance, the admiral couldn't have been over thirty, but his mannerisms were those of a much older man. Nicholas accounted it to improvements in geriatric medicine.

He held out his hand. "Pleased to meet you."

"Wish I could say the same," Strahler said, shaking his hand anyway. "So you're the man with the crystal ball."

"Pardon?"

"We'll call if we need you," the admiral said to Doctor Holly. For a moment she looked as if she would protest, but a scowl from the admiral changed her mind. When she had left and he had closed the door, he said, "You wrote *All Your Dreams Come True*, didn't you?"

Nicholas picked up his fork and said, "Why is everybody so obsessed with that? Surely we could find something else to talk about."

"They did, that's why," the admiral said, sitting down across from him.

"What did? What are you talking about?"

"Your dreams. They came true. Along with predictions from nearly every other book or story you ever wrote. Just the way you said they would."

Nicholas cut a slice of steak and cut it into squares while he thought about that. At last he smiled and said, "I almost thought that too, but you're proof that it didn't."

"How so?"

"Don't take it personally, but I don't like the military. Never did. I was careful to leave you out of just about everything I wrote."

The admiral smiled for the first time. "Just about isn't good enough. There are over two hundred proven correlations between your 'fiction' and our world today, including our present military structure. You did write us in, in twelve separate stories, to be exact, and what you wrote has come true."

Nicholas took his time chewing and swallowing. When he was done, because he still hadn't thought of anything else to say, he said, "That's interesting."

"It's more than interesting. It's damned peculiar. I want to know where your ideas came from."

"From the future," Nicholas said automatically, smiling. It was a conditioned reflex by now. People always asked him that question; after a while he had developed a standard response to it. It was a private joke among writers, a little contest to see who could come up with the best response. The unchallenged winner was Ellison's classic, "A post office box in Schenectady," but Nicholas liked his own simple "From the future," too. And the smile to go with it, of course. The smile explained better than words could how silly the question was.

But the admiral didn't react the way a fan would have. Instead of dropping the subject, he said, "I'm serious, Nicholas. You had a knack for prediction that Nostradamus would have envied. Either that or you had actual control over things."

"Oh come on now. A few coincidences, a few lucky guesses, that doesn't make me a prophet. I just wrote about the way I wanted things to be, or I thought I did. I guess a lot of people

liked what they read and decided to work toward making it come true. I'm flattered, but it's nothing supernatural.''

''It is when you predict what we found around Tau Ceti.''

''What did you find around Tau Ceti?''

''A habitable planet. Point nine g's orbital period of two hundred and five days, more land than water, high in oxygen, covered with native life that we can eat—I could go on. You described it perfectly over a hundred and fifty years before we found out that it was there.''

''Luck.''

''Uh-huh. That's just one for-instance. There are others. Whether you believe it or not, you were able to predict the future, and I want to know how you did it.''

Nicholas picked up his orange juice and swirled it around in the glass. ''How can you be taking this so seriously? You act like—'' He suddenly remembered why he didn't like the military. ''You don't really think you can make a weapon out of this, do you?''

Strahler's eyes widened in surprise. ''As a matter of fact, yes.''

Nicholas managed to swallow before bursting out in laughter. He put the glass down and leaned back in his chair and laughed long and hard, laughing still more when he saw the admiral begin to blush.

The admiral took a deep breath, reached into his pocket, and withdrew an object about the size of a cigarette packet. He depressed its one button and set it on the tray between them. The room was suddenly silent.

Nicholas couldn't even hear his own laughter. All the humor seemed to drain out of the situation. The admiral motioned him to lean forward, and when he did, he heard him say, ''This sonic deadener provides a three-foot sphere of audibility. If we are to hear each other we must both be inside it. But then, you must already know that, mustn't you? You predicted it, too.''

''I did?''

''You did. Perhaps you've forgotten. You originally invented it to cure noise pollution, but we've modified it for our own use. Mr. Nichols, what I am going to tell you is classified information. As of this moment, you have a class A security clearance, which means that you can be tried in a military court and executed if found guilty of divulging any of this information to anyone who doesn't also have a class A clearance. Do you understand?''

''Perfectly. Don't tell me a thing. I don't want that responsibility.''

''It is also a capital offense to refuse aid where lives are in danger, no matter what your security clearance. Another one of your predictions, I might add. The Navy believes you are in a position to render such aid to the entire human race, which means, Mr. Nichols, that you are stuck either way. So listen, and keep your mouth shut.''

Nicholas nodded, slowly, and speared another piece of steak. His plate was evidently outside the sound bubble. Without the familiar clack of fork on plate, he felt uncomfortable. In fact, he felt uncomfortable with the whole situation. He wondered if anybody had ever had themselves frozen twice.

''Six months ago, in the course of seismic exploration, a group of Martian colonists discovered an underground

cavity near the edge of the Chryse Basin. That was not terribly unusual in itself—Mars is riddled with caverns—but this one was perfectly circular, and according to the echoes, lenticular in shape. Also the roof of the cavern was less than ten meters from the surface. Naturally they were curious. They drilled into it, dropped a camera down the hole, and discovered a complete Martian city. Still intact. Does this strike you as familiar?''

''Pardon?''

''You are being deliberately difficult. Your novel, *All Your Dreams Come True* begins in exactly that way. Do you recall what happened after that?''

Nicholas remembered. ''The colonists began to develop psychic powers. Community intelligence. They all started to think alike, and work for the same goals. It sounds nice, but it turned out to be less than a blessing.''

''Exactly.''

''What do you mean, 'exactly'?''

''That's exactly what happened. They also tried to send a ship to Earth, to bring their newfound power to us. We barely captured it in time.''

''You expect me to believe that?''

The Admiral smiled again. ''You expected your readers to believe it. Why not yourself?''

''That was fiction! It was the most ridiculous story I ever wrote. The Martian invasion, for Christ's sake! I regretted it from the moment I wrote it, but I had a contract obligation, and I—''

''And you what?''

''I just realized where I am. I died in that tank, didn't I?''

The admiral looked concerned. ''What are you talking about?''

''I died. I'm not alive. The moment they froze me I went straight to Hell, and now for my sins you're going to torment me with scenes from my worst novels until I go insane.''

''Mr. Nichols. Try to be serious.''

''What's more serious than wishing your way to Hell? That was the whole point of the novel, wasn't it? That you can have anything you want, provided everybody wants it? Except nobody wants *all* their dreams to come true. Well here I am: no cancer, no wife to nag at me, the future just the way I ordered it and a long life ahead of me—and you telling me my worst fantasy is happening. What am I supposed to think?''

''I don't care what you think, as long as you cooperate. As you accused earlier, I am a military man, and even an admiral follows orders. Mine are to find out what means you employed to determine so much of your own future and to enlist your help in keeping it from happening the way you originally wrote it. Now, if you will recall, your book had the plague reaching Earth and nearly causing a nuclear holocaust as each nation tried to protect its own autonomy. You can understand why we would like to avoid that.''

Nicholas speared another piece of steak and ate it. He didn't know what to believe. He didn't really think he was in Hell. Nobody believes he can die. It's an impossible concept for the human mind to grasp; at least it was for his. But what Strahler was saying was just about as impossible. Controlling the future! Even predicting it was ridiculous enough.

But if it came to the choice of be-

lieving that or believing in Hell, Nicholas knew which one he would choose.

"So why don't you finish the book?" he asked. "Didn't I write my way out of it somehow? I don't remember writing a defeatist ending to it, even if it was a crappy book."

"That's our problem. We've tried your ending. It doesn't work. You postulated that the psychic powers were the result of a virus that altered the structure of the brain. We were supposed to come up with a vaccination against it. That doesn't seem to be the case, at least in the two bodies we recovered from the ship. There appears to be no virus at all."

"Well then, I guess that blows your theory, doesn't it? I mean, if I were influencing things then it would have worked out the way I wrote it, wouldn't it?"

"That's what we thought, too. We had hoped you would provide an explanation."

Nicholas nodded, and chewed. If he hadn't been feeling so good, he would have told the admiral to take a walk without a pressure suit long ago. But the conversation was interesting, at least. And the admiral did have a point. Nicholas *had* described the future with far more accuracy than even a science fiction writer had a right to.

How had he managed it? Where *did* he get his ideas? The future? Suddenly his little joke didn't seem so funny any more. He was willing to believe that a few of his ideas might have been good enough to become self-fulfilling prophesies, but not all of them, and certainly not something like the Martian telepathic plague. The only reasonable explanation was that he had some kind of a link with the future, some way of seeing what was going to happen before it did.

But he hadn't been doing anything supernatural. No seances, no altered-state voyages—hell, he hadn't even read the *National Enquirer*. He'd just been fooling with ideas as they came along, twisting them into stories in whatever way worked best. That was the way any writer worked. His methods were no different.

But his ideas were.

Round and round, he thought. Where did he get his ideas? Answer: The future. Somehow, he grudgingly admitted, his ideas were not ideas, but images of the way things were going to be. But how was he getting them? Telepathy? If he could believe the admiral, then telepathy had just been proven to exist. And psychic phenomena were notoriously independent of time. Most of the documented cases were of people looking into the past, but that didn't necessarily mean that it didn't work the other way, too. Was there someone in the future with whom he shared a strong bond, seeing through their eyes in his search for interesting ideas?

If so, then he'd evidently blinked at the crucial moment when he was thinking up the Martian virus story. Somehow he had gotten that wrong. In a way that was reassuring. Evidently everything he thought of didn't come from the future. He must have had spells of genuine creativity too.

There was only one thing wrong with that explanation. In all the accounts he'd ever read of psychic phenomena, one characteristic common to them all was

the feeling of having another presence in your mind; but, at least for as long as he'd been using it, there had been only one resident in *his* head. Wouldn't he have felt it if he was reading someone else's mind?

The admiral was waiting impatiently for him to say something. Nicholas felt a little sorry for him. He didn't have it figured out either.

"Maybe I wrote the wrong ending," he said.

"Pardon?"

"Look, when I write I just make up things as I go along. If it sounds logical I keep it and go on; if it doesn't I pitch it and try again. I could have ended that book any of a dozen ways. Maybe I picked the wrong way."

Strahler stared in sudden shock. "What were the other possibilities?"

"How should I know? It's been years since I even thought about it."

"Well think about it now. If the phenomenon reaches Earth we could lose what little individuality we have left."

"Pardon?"

"That was your main premise, Mr. Nichols. When everybody's wishes come true, they have to be the same wishes. Everyone must think alike. You get a world government and social stagnation, because nobody comes up with new ideas. We've had sociologists studying the situation—hypothetically, of course—and they agree with your assessment. Whatever the cause, this newfound psychic rapport between individuals will cause the eventual fall of civilization."

A memory settled lightly into place in Nicholas's mind, along with the beginnings of an answer. Two answers, really. There *had* been an alternate ending, plus a sequel that he'd plotted out but never written. It looked now like both of them might have been true.

"The fall of civilization," he said. "That's how it happened on Mars."

"We can only assume that to be the case."

"It's no assumption; it's true. And that's the solution to your problem."

"What?" Strahler snapped. With the deadener absorbing all the echo, his voice sounded like a gunshot through a pillow.

"You said the power would cause a world government, but it's the other way around. World government caused the power. The Martians were facing crisis after crisis: their world was drying up, they were too close to the asteroid belt and they kept getting hit, they were constantly at war for what was left of the crop land—their only hope of survival was to set up a planetary government. The power was their way of enforcing its decisions."

"I don't follow you."

"It was their way of ensuring that everybody worked together for the common good instead of fighting for mutually exclusive goals. They couldn't *afford* mutually exclusive goals. Unless everybody worked together, they would slide into extinction. They had already developed telepathy as a science anyway, so the solution was obvious: they built a gigantic thought projector and projected the same ideas to everybody. By the time they realized that they'd stifled creativity, it was too late. You won't find any live Martians."

Strahler was frowning. "This sounds faintly ridiculous, Mr. Nichols."

"That's what my editor thought, too. She made me change it to a virus used in biological warfare. But that's the way I originally wrote it, and I'm willing to bet that's the way it is."

"And your solution, in the original story?"

"Very simple." Nicholas whacked his hand on the table, startling the admiral with the motion, but not with the sound. "Your 'modified' sonic deadener. By one of those amazing coincidences that my editor hated, it just happens to block out the frequency of radiation that carries the telepathic signal. All you have to do is send in a few people carrying deadeners and have them blow up the projector." *Projectors*, he added to himself. The Martian colonists had to have made a second one; what else would they have been sending to Earth on the ship that the navy had captured? But the admiral didn't need to know about that one. Nicholas would take care of it too, right after he used it to send himself a few ideas in the past.

Strahler drummed his fingers on the table, silently. Nicholas watched him debate whether or not to believe him. At last he said, "Very well then. We will try it. Is there anything else I should know?"

Nicholas wondered, *Is there? No, I think not. In fact, maybe a little misdirection is in order. If Strahler thinks I can control the future with what I write, he might not look for another reason.* He smiled. Aloud, he said, "If I think of anything, I'll just write it down. Sooner or later you'll wind up doing it."

Strahler laughed, a rough bark of a laugh. "Touché, Mr. Nichols." He reached out and turned off the sonic deadener, returned it to his pocket. "Remember your security clearance," he said.

"Don't worry, I will," Nicholas replied, still smiling. A class A clearance would be more than enough to gain access to the Martian ship.

At the door, Strahler stopped, turned, and said, "You are probably wondering what you will do for a living now that you are revived. May I suggest that you write utopian novels in the future?"

Nicholas smiled, laughed. "Without the military," he said.

He watched Strahler stiffen and stalk out, then turned back to his breakfast, which was now almost cold. He thought about it a moment, trying to remember. After a moment he looked under the edge of the plate and pressed the button he found there. His steak began to steam again.

He couldn't help but chuckle inside. So much of it was coming back now. In his sequel he had had a man sneaking into the Martian ship and using the telepathic projector to send stock market tips into the past. With a sonic deadener around the projector he could be sure that the signal wouldn't spread through space, but would instead be focused backward through time. Luckily, he had never resolved the paradox of finding someone in the past who had already received the signals, and then the changes his editor had requested in the first novel had ended any hopes for the sequel anyway.

Now he found his emotions caught between disappointment and pride. The disappointment stemmed from not re-

solving the paradox in the first place; he had always thought of himself as an innovative writer who could turn a plot, if not a phrase, with the best of them, but that time he had fallen short. He'd gotten stuck in a search for someone with a brain similar enough to the main character's to receive signals through time at all, someone who had already received them in the first place *and* who would be willing to share the fortune he earned. At the time it had seemed like an insurmountable combination of conditions to satisfy.

But his earlier self hadn't had the advantage of a future viewpoint, either. He might have missed it then, but he had it now. Oh yes. How simple it would be if the man in the past and the man in the future were one and the same. If he were, in fact, himself.

Stock market tips indeed. He had something a thousand times more valuable than that. Ideas!

That was the realization that gave him his almost overwhelming feeling of pride. If he could get to the projector on that Martian ship, then he could single-handedly orchestrate the most twisted, impossible story of his life, and it wouldn't even be fiction. With the military breathing down his neck he couldn't write it anyway, but he didn't mind. Living it would be enough.

Maybe it was for the best at that. Given the nature of editors, he would have probably had to rewrite the ending anyway.

He raised his orange juice in toast. "To the future!"

"Did you say something?" Dr. Holly stood in the door, holding a paperback book in her hand.

"Just muttering to myself. What have you got there?"

She blushed. "I, uh, I was wondering if . . . I *do* have a favorite book of yours, and I was wondering if you would sign it for me."

"Of course! Here, sit down." Nicholas waved her into the chair the admiral had used. "Do you have a pen?"

"Right here." She produced an elegant, wood-covered pen and handed it to him. On impulse he twisted the cap, and watched the nib change size.

"Thought so," he said. He adjusted the point for a medium inkline and reached for the book. *'Till Death Do Us Part*, eh? That was one of my favorites too. It was the only story I ever wrote with a purely evil villainess in it. I based the character on my wife."

Doctor Holly laughed. "You're kidding. She strikes me as a very congenial person."

"That's what I thought too, when I married—" Nicholas stopped writing in mid-word. "Wait a minute. You said 'strikes.' Present tense."

"Yes."

"She's—she's *here?*"

"Yes, she is. We just thawed her out a few hours ago. Her instructions were to wake her as soon as possible after you." Doctor Holly beamed. "She must have really loved you, to have herself frozen just to be with you."

"Oh dear God, tell me you're joking."

From the expression on her face, Nicholas knew that she wasn't. He began to tremble. Pushing the tray away from him, he said, "I think I just lost my appetite." ■

the reference library

By Tom Easton

Trojan Orbit, Mack Reynolds and Dean Ing, Baen Books, $2.95, 374 pp.
Killer, David Drake and Karl Edward Wagner, Baen Books, $2.95, 270 pp.
In the Drift, Michael Swanwick, Ace, $2.95, 208 pp.
Dinner at Deviant's Palace, Tim Powers, Ace, $2.95, 304 pp.
The Adventures of Terra Tarkington, Sharon Webb, Bantam, $2.95, 192 pp.
The Grand Adventure, Philip José Farmer, Berkley, $7.95, 329 pp.
Dayworld, Philip José Farmer, Putnam's, $16.95, 320 pp.
Valentine Pontifex, Robert Silverberg, Bantam, $3.95, 369 pp.
The Earth Will Shake, Robert Anton Wilson, Bluejay, $8.95, 370 pp.
The Moment of the Magician, Alan Dean Foster, Phantasia, $17.00, 266 pp.
Gryphon's Eyrie, André Norton and A. C. Crispin, TOR, $12.95, 248 pp.
Brisingamen, Diana L. Paxson, Berkley, $2.75, 261 pp.
The Voice of the Mountain, Manly Wade Wellman, Doubleday, $11.95, 192 pp.
The Tomb, F. Paul Wilson, Whispers Press, $19.95, 365 pp.
The Users Guide to Small Computers, Jerry Pournelle, Baen Books, $9.95, 342 pp.
The Essential Users Guide to the IBM PC, XT, and PC Jr., Dian Girard, Baen Books, $6.95, 255 pp.
The Small Business Computer: Today and Tomorrow, William E. Grieb, Jr., Baen Books, $6.95, 287 pp.
The Users Guide to CP/M Systems, Tony Bove and Cheryl Rhodes, Baen Books, $8.95, 303 pp.
Local Area Networks in Large Organizations: A Manager's Briefing, Thomas Wm. Madron, Hayden, $16.95, 150 pp.

Mack Reynolds's long-time positive outlook isn't totally missing in **Trojan Orbit**, but it is overlaid with a darker tone that surprised me. It may be that Reynolds was turning pessimistic in his last days, or perhaps his posthumous co-author, Dean Ing, played a stronger role than Reynolds might have liked.

Reynolds died in 1983, but in his last months he produced a number of first drafts. Jim Baen reports that, "When it became clear that Mack would be unable to bring them to completion, I, with Mack's and later his estate's approval, commissioned Dean Ing to take the entire group to a fully polished state. Dean's purpose has not been to collaborate posthumously, but to finish them exactly as Mack Reynolds writing at the utter top of his form would have done." I haven't read the first two Reynolds-Ing yarns—*Eternity* and *The Other Time*—though I think they're buried around here somewhere. The fourth one is still in the works. The third is *Trojan Orbit*, and as I hint, it does *not* seem pure Reynolds. I suppose it couldn't be.

In *Orbit*, the first L-5 is under construction by an international company that has worked out a scheme— reminiscent of the old school War Bond stamps—to tap *everyone*, from widows and orphans to tycoons and governments, for pennies, dollars, and megabucks. So much loot is pouring into the project that it should be done yesterday. But there are delays. The outfit always needs more bucks. And a certain government advisor gets suspicious.

Special agent Peter Kapitz (there's a clue there!) is sent to the building colony. There he finds a downright feudal setup, with well-fed kingpins lording it over myriad serfs. Dissenters are recycled. And Kapitz spots a few faces whose true names have a suspiciously Sicilian ring.

You got it. The space program has turned into the grandest scam of all time. The capos think a real space program would never work—there are too many tons of toothpaste and toilet paper to ship from Earth—but it is still worth milking for all they can get before letting it fail.

Reynolds and Ing do have a point. O'Neill and his followers have a grand dream, but they may not have thought out all the necessary details, all the incidental trivia of life support. Space colonization may therefore be more expensive than we suppose.

We see more of the old Reynolds at story's end. Kapitz, of course, triumphs and the project gets back on an honest track. He pulls a coal of glowing hope from the ashes of despair. The future beckons.

David Drake has a reputation for blood and guts. Karl Edward Wagner is a fright merchant. As you might expect, their joint effort, **Killer**, both grosses you out and scares your socks off. Be careful not to slip when your bare feet land in the gore.

Back in the first century A.D., a space ship crashes in Africa. It carries an intelligent beast used by depraved starfolk for Roman-style blood sports. This "phile" is female, pregnant, and an egg-layer. It lays its eggs in warm-blooded prey, where the young hatch and eat. Young and adult are both ravenous predators, and they have been known to depopulate worlds. They are also agile, strong, and virtually unkillable. And Earth has been chosen as an illicit breeding ground for the monsters.

The phile, stunned by the crash, is captured by natives and sold to Lycon, a Roman beast-catcher. Lycon sells it to an old friend, Vonones the beast-dealer, who intends it for the arena. But then it escapes. It is loose, first in the Roman countryside and then in Rome itself. The mad and bloody-handed emperor Domitian is not pleased. Lycon and Vonones must catch the phile, preferably without killing it.

The way Drake and Wagner set things up, Lycon and his buddy have an im-

possible task. Yet Lycon is a killer too, an ex-mercenary and a grim figure indeed. The phile does its best, but it is doomed. The story moves from human defeat to human defeat, amid the squalor that was Rome, while Lycon grows more and more determined and learns more and more of his foe. Finally, he uses one of the phile's young, fried in an earlier battle, and the schoolmaster who had seduced his son, to set a trap.

And then there is the alien sentient, the creature responsible for landing the phile on Earth. He has been assigned by his masters to retrieve it, but he has his own plan for a beast-farm. What happens to him is most excellent poetic justice.

Michael Swanwick's **In the Drift** (a New Ace Special) is a collection of linked novelettes posing as a novel. A super-Three Mile Island has turned most of Pennsylvania and New Jersey into a radioactive wasteland, the Drift. Philadelphia survives, its government an evolution of the theatrical paraders, the Mummers. The U.S. itself has altered in the chaotic aftermath of disaster, and Philly is very much on its own.

We see Philly's society in the book's opening segment, which first appeared in *Universe 11* as "Mummer Kiss." Keith Piotrowicz, ne'er-do-well, shelters a refugee from the Drift and receives the Kiss that turns him into prey. He flees into the Drift, where he learns a powerful secret, that Philly too is in the radioactive, mutating Drift. He returns to blackmail his way back into the Mummers' good graces. Later he becomes politically powerful. The rest of the book focuses on people who seek to survive in the political minefields he lays in the Drift. War looms, the secret revives, and Keith's own unknown daughter must die to unify her people.

Swanwick paints a persuasive portrait of a people adapting to disaster. However, his characters are less than fully realized and despite the novelty of government by mummery, his thoughts seem less than wholly original. Many of his observations have been made before, perhaps most notably by Edgar Pangborn. Yet *In the Drift* is a very readable book. It's worth your attention.

Tim Powers's **Dinner at Deviant's Palace** is a less astonishing work than his *Anubis Gates*, but it is both more original and more readable than Swanwick's book. The setting is a post-holocaust Los Angeles. The hero is Greg Rivas, musician and deprogrammer of Jaybirds, people who have been sucked into a new cult. He gave up the Jaybird-hunting after nearly losing himself, but now he is approached with a deal he cannot refuse. A long-ago love has been drawn into the cult, and he is offered enough of the local medium of exchange—distilled booze—to make him wealthy. He will track her down and bring her back. In the process he will deal with the doppelganger that grows from a ghostlike, blood-sucking "hemogoblin," learn what goes in the holy city to the south, discover the awful source of the drug known as Blood, and survive the Palace where the depraved dine on mutated, radioactive seafood. He will also learn that Norton Jaybush, master of the Jaybirds, is a thing of many worlds and responsible for what Greg's world has become.

If I tell you much, I risk spoiling the tale. Let me say only that Powers has assembled a basket of strange delights, cast new light on a traditional theme, and spun a very fine yarn. His use of telepathy didn't entirely please me, but I must admit that abjuring it would have made the story difficult or impossible.

Too, Jaybush struck me as a thoroughly unlikely creature, but I'll give Powers that for the sake of the rest.

Sharon Webb falls a long way from the level of *Earthchild* and *Earth Song* with **The Adventures of Terra Tarkington**. Assembled from a series of *Asimov's* stories (1979–1981), the book is something of a take-off on the nurse/romance genre. Terra Tarkington is a young nurse assigned to an interstellar hospital far from Earth. The elderly chief physician and the handsome young doctor are the only human males around. Terra latches firmly onto the obvious love interest, and then the fun begins. Unbeknownst to her, she was programmed in training to do certain nefarious things. One supersecret spy agency is constantly seeking to press her buttons. Another is struggling to prevent disaster. Poor Terra confronts one peril after another and survives largely because of her wide-eyed luck.

The greatest strength of the book is its remarkably feeble-minded humor. Its best use might be as a gift for nurse-romance fans; perhaps it could wean them to SF. Other readers will be endlessly irritated.

The latest Byron Preiss Masterworks Edition is Philip José Farmer's **The Grand Adventure**. It is set up as a tour of a future World's Fair on New Atlantis, a mid-Atlantic island built of garbage. The Fair is dedicated to Farmer, and its pavilions are devoted to his several realms of discourse, Adventure, Psychology, Mythology, Space, and Tiers. Such a frame has to be flattering as all getout to Farmer, but it is also a mite too pretentious.

As we can expect from a Masterwork, there is an essay of autobiographical reminiscence. I found this one far less interesting and informative than, say, Leiber's, who is a much more reflective man. There is also an original novelette, a Holmesian parody called "The Adventure of the Three Madmen"; Farmer brings in The Shadow, Mowgli, and other figures of literary myth much as he has before. The other stories are reprints —"Totem and Taboo," "The Shadow of Space," "A Bowl Bigger than Earth," "After King Kong Fell," and "Sketches Among the Ruins of My Mind."

The book is worth recommending for only one reason. It also contains the imaginative gem, "The Sliced-Crosswise Only-on-Tuesday World," in which the problems of overpopulation are solved by giving each seventh of the people one day of life per week. All are "stoned" for the other six, and a few individuals find great frustration in their lack of access to other days and subpopulations.

This story is of special interest because Farmer has just published **Dayworld**, the first book in a new series built on the concepts of the short story. Farmer introduces an awkward calendar and elaborates the machinery of his society. He also posits a clique of immortals who are working to make their tightly controlled world more open to themselves. As messengers, these "immers" use members who duck the stoning requirements to live all seven days of each week; they are "daybreakers."

Dayworld is the story of immer Jeff Caird, who has other names and personalities Wednesday through Monday. Unlike most daybreakers, he has grown these separate personalities into independent life from fragments of his self. He thus has great trouble when an immer scientist who believes he is God escapes from an asylum and begins to

slaughter the immers who had put him away. Jeff must carry more awareness than usual from day to day, and when the authorities begin to hunt him too, he must somehow integrate his selves for the sake of survival.

At book's end, the immers stand revealed, interrogated, and removed from society. Jeff is confined to a shrink ward, but he has hopes of escape. What will happen next? Will the immers conquer? Will Jeff make all humanity immortal when he learns about such things as transfusions? Will . . . ?

The trouble is that while I can suspend my disbelief long enough for a "sliced-crosswise" short story, I cannot for the novel. *Dayworld* is not one of the rare exceptions to Farmer's inability to convince, and I cannot recommend it.

I found Robert Silverberg's **Valentine Pontifex**, the last of the Majipoor books, a bore. Valentine is Coronal. His world is threatened by a shapeshifter (native) plot to destroy the human/alien economy with crop plagues. The Pontifex Tyeveras, kept alive in a bottle, aches for death, but Valentine hates the thought of becoming Pontifex in his turn and dwelling in the vast warren known as the Labyrinth. He would rather roam the oversized planet, Majipoor, in quest of victory. Yet he knows the inevitability of fate and he grooms the one-time urchin Hissune to take his place as Coronal on his own promotion.

Valentine's roamings encompass years while Hissune grows toward majesty. Majipoor's sea dragons stand revealed as godlike intelligences that help the shapeshifters but are equally willing to help Valentine, once his mystic powers conveniently emerge. Yet victory owes less to Power than to Valentine's immense good will. He sways rebels with his saintliness. Love is his panacea. And February 14 would be an entirely appropriate publication date.

The first Majipoor book, *Lord Valentine's Castle*, was much more satisfying. It had a more vital, personal problem for its hero, his lost identity. It had a more personal focus, with Valentine's growth from amnesiac to juggler to Coronal. And it managed a much more vivid portrait of the vastness of Majipoor. Alas, it is all lost.

With Bob Shea, Robert Anton Wilson was responsible for the original Illuminatus trilogy, that most antic of paranoid, conspiracy-theory views of the world. Alone, Wilson followed up with several conspiratist books all his own. Now he gives us the first volume of a new trilogy, the Historical Illuminatus Chronicles, **The Earth Will Shake** (to be followed by *The Widow's Son*).

Shake is a historical novel, but if political science is science, it is also SF. The hero is teen-ager Sigismundo Celine (presumably an ancestor of Hagbard Celine). We meet him as his uncle is murdered in church on Easter Sunday by Sicilian agents of a renegade sect of Illuminati. He is soon inducted into Free-Masonry, which is allied with the true Illuminati (unless Free-Masonry *is* the true Illuminati), learns that his uncle's killer is his true father, and finds himself embroiled in the world-shaking conspiracies that will lead to . . . what? His murderous half-brother becomes Cagliostro. Baron Frankenstein enters the story (or does he?). Casanova appears, and the Greystokes are mentioned. All are shadowed by the Holy Inquisition, and Sigismundo must seek his future to the north of his home in Napoli.

I found the book a delicious treat despite the occasional anachronisms, some

of them apparently accidental (nine planets), some deliberate (Sigismundo's attempt to design a self-propelled vehicle, the autokinoton). Wilson is a vivid portraitist with a perfervid imagination, and he regales his readers with occasional infusions of wit, as with the four kinds of sons of you-knows (ordinary everyday, revolving, on wheels, and transcendental Sicilian). Buy and enjoy.

Alan Dean Foster's **The Moment of the Magician** is fourth in the tales of Jon-Tom the Spellsinger, California law student and rock guitarist magicked into a world of oversized, upright animals by the wizard turtle Clothahump. Here he treks to the tropics, drawn by a report of a strange and power-hungry magician who just may have come from his own Earth. His companion, as always, is the otter Mudge. Their perils are a bizarre congeries, ranging from lonely plant mimics to animated model airplanes. The magician is a transported second-rater from New Jersey who has found a place where his mystic passes really work; he has it made, and he is not about to let go.

A delight is the return engagement of the Marxist dragon Falameezar. More delights are more otters and the subterranean geolks. There is, of course, victory. But Jon-Tom remains stuck. He's a long way from getting home, and Foster has room for many more books. Will Jon-Tom become the Dumarest of fantasy?

André Norton joins with A. C. Crispin, who novelized the movie *V*, to return to the Witch World in **Gryphon's Eyrie**. We have here the further adventures of Joisan and Kerovan in Arvon, the land beyond the Waste that borders the Dales. They have dwelt among fisher-folk until Kerovan feels the pull of a mysterious geas. Joisan protects her love as best she can, but after some time among the horse-folk, the Kioga, the geas returns. They must leave, drawn to the mountains and a mysterious castle, a monstrous curse and a marvelous inheritance.

It may simply be that it has been too long since last I read a Witch World tale, but I felt a lack of context, of the mystery and awe and setting that I recall as hallmarks of the tales when Norton was writing them alone. Perhaps age is the reason for the coauthor, and Norton is near the end of her long list of unique gifts to the world of readers. I hope I am wrong.

Diana L. Paxson's **Brisingamen** is a joy. Grad student Karen Ingold finds in an antique chest a handful of beads and pendants. Cleaning them, she finds they are gold. Stringing them, she finds they make a necklace of astounding beauty. Eventually she identifies the necklace as Brisingamen, which once adorned the throat of Freyja, Norse goddess of love and war. And its restoration awakens the spirits of the Norse gods. Freyja possesses Karen to grand effect. Loki appears, malevolently intent on seizing the necklace and bringing on the Fimbulwinter and Ragnarok. Thor is a carpenter who follows the old rites as best he can in the California parklands. Odin is a one-eyed poet and motorcyclist. All-seeing Heimdall is Karen's virginal professor and mentor.

The tale brings the ancient magic to life in a most effective way. The characters enchant, and their fates reek of high drama, even unto the climactic scene in a theatrical warehouse. Paxson convinces me anew that we lost far more than we gained when we gave up the joys of paganism.

* * *

Manly Wade Wellman brings back Silver John the Balladeer one more time with **The Voice of the Mountain**. Once more we hear the Appalachian rhythms of a master storyteller, though he gives us less of the folklore. In *Mountain*, a wandering John finds the mountain called Cry, which periodically moans aloud. The locals avoid it, though some years before one boastful young man had gone off to climb it and never returned. John decides to follow his predecessor's path.

Naturally enough, John survives. Atop the mountain, he finds a stockade enclosing the home of wizard Ruel Harpe and his three female associates. There are also such legendary monsters as the flat, the bammat, and the hide-behind. And there is a dream of world destruction and restructuring to suit Harpe's wishes, a dream that hinges on finding the long-lost Book of Judas, and an invitation for John to join the effort.

Cry Mountain reeks of evil, and John has a keen nose. He resists, though he is tricked into helping gain the coveted Book. He balks, and he inevitably must fight a desperate battle. *Mountain* is an elemental story, perhaps the perfect distillation of Wellman's appeal: he writes drawn-out fairy tales, with all the drawing power of absolutes and high places. He writes the cautionary dreams of simpler peoples in simpler times, and they resonate with our modern discomforts.

Don't miss this one.

New Jersey physician F. Paul Wilson brings us a classic tale of curses and demons and treasure. **The Tomb** is so much in the Victorian tradition, mixed with a bit of superhero modernity, that it has to be called a loving parody. A century ago, Sir Albert Westphalen sacked a temple to Kali in India, torching its protective demons, the blue rakoshi, before marching off with an urnful of jewels. Sir Albert's line, curses the dying priest, will end in blood and pain. The priest's children, the boy having lost an arm to British steel, survive.

Now, in the 1980s, a one-armed Indian diplomat appears in New York, home to the last Westphalens, two spinster women and a six-year-old girl, Vicky. Vicky's mother is the beloved of Repairman Jack, a specialist in violent, appropriate retribution on assorted scoundrels the law cannot touch. His lover has spurned him on learning of his career, but she calls him for help when one of the spinsters disappears.

And then—we learn that diplomat Kusum Bakhti has brought with him a nest of rakoshi. He feeds them on winoes. He uses them to catch and destroy Westphalens, and his ultimate target is Vicky, whom Jack loves perhaps more than her mother. Fortunately, Kusum's sister falls for Jack and provides him with a number of helpful, if inadvertent, clues. He knows what to do when a rakosh carries Vicky off in its talons.

The book ends in a desperate chase, a bloody battle, and a fiery immolation. For a time, we wonder what will be the fate of Jack, Vicky, New York, and the world. But we emerge from the book with great satisfaction. Wilson has delivered a grand tale.

I urge you to support Whispers Press (70 Highland Avenue, Binghamton, NY 13905) with your money. You won't be wasting it.

For the past few years, Jerry Pournelle has been writing a "User's Column" for *Byte* magazine. He became a user when he got his first word processor and got interested in all the other things he could do with the machine.

He grew with the microcomputer industry, until he is now as knowledgeable a curmudgeon as anyone in the field. His column entertains and informs; it also influences, for Pournelle has apparently been responsible for a number of salutory changes in both hardware and software.

Jim Baen has gone from *Galaxy* editor to publisher. He has long been prominent in the SF field, and his interests too have grown to embrace computers. He is now responsible for one of the better SF lines, and he is publishing computer games as well. Now his Baen Books is branching out to bring the computer word to users of all stripes, and he has enlisted Pournelle's aid and blessing. The new line is the "Pournelle Users Guides," and the first is Pournelle's own **The Users Guide to Small Computers**. Most of the book is drawn from the *Byte* columns, cut-and-pasted (electronically, of course!) to provide a more bookish flow and updated with numerous parenthetical comments. The book provides a satisfying overview of both a growing field and Pournelle's own home operation, Chaos Manor. It also gives one a decent feel for many abstrusities of small computers, so that I now feel much more up on CP/M and TRSDOS and utilities and the language controversy and so on. This will surely help when I go out to buy my own system Real Soon Now (to use Pournelle's recurring phrase).

Three more Guides are also on my desk. Dian Girard's **The Essential Users Guide to the IBM PC, XT, and PC Jr.** is exactly what it calls itself. It describes the IBM machines, tells how to set them up, and reveals all the marvelous things you can do with them. It even provides some trouble shooting tips. However, it is far more approving in tone than Pournelle sounds in his book. I am left unsure of just how good the IBM machines really are, though they do seem more than adequate for my own needs.

William Grieb, Jr., gives us **The Small Business Computer: Today and Tomorrow** as a guide to selecting and using a computer for business purposes. He warns against picking either too small or too large a computer, but he does plunk for the micros for most applications. The book is a useful one, derived from Grieb's notes for a night course on using small computers in business.

The Users Guide to CP/M Systems, by Tony Bove and Cheryl Rhodes, is a more abstruse tome. It focuses on the most popular microcomputer operating system and its variants, emphasizing their use to format and copy disks, create and maintain files, edit text, assemble and patch programs, and more. It's very much a guide for users, and it looks like a useful supplement to the documentation that comes from software suppliers and that, says Pournelle, is too often virtually useless to the relative novice.

There will be more in this series, every one of them (according to the blurb on the back cover) personally guaranteed by Pournelle to deliver on its promises. I can't say whether they're *that* good (since I am not yet a user myself), but they do impress me. The authors clearly know what they're talking about, and they all write clearly. I will be holding onto these books against that day, Real Soon Now, when I will need them.

I can understand why I should receive and review computer books from Pournelle and Baen. They are, after all, Our Own People. But why do I have Thomas Wm. Madron's **Local Area Networks**

in Large Organizations: A Manager's Briefing? Neither author nor publisher is known to SF, though they clearly know of *Analog's* techie orientation. Equally clearly, they hope that I will tell you how wonderful their book is.

Well, I won't. It isn't. For openers, it's vastly over-priced, at $16.95 for 120 pages of paperback text (plus 30 more of appendices, glossary, and index). For closers, it's jargon-ridden and vague and full of typos (two tables on pp. 54 and 60 are even switched). The book tries to be a general orientation for potential installers and users of Local Area Networks (LANs), but it saves giving any decent feel for what LANs are and can do until late in the book. All in all, it seems a very poor way to learn that the best LANs, until fiber optics are perfected for the purpose, seem likely to be broadband (fast data transmission) systems based on CATV (cable TV) technology (using coaxial cables). Baen and Pournelle, I'm sure, could do a better job. ■

ON GAMING

(continued from page 111)

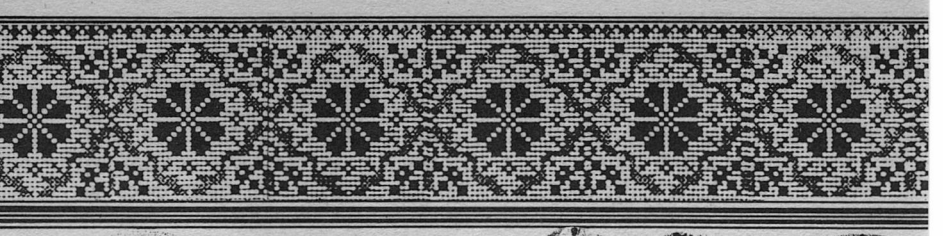
enemy fleet (this is the only way you can fight a battle as long as the Emperor is alive), bribe enemy commanders to switch sides, and use "Influence" cards to get the Emperor to act for you (in the hopes of gaining more squadrons) or against an opponent (to take away squadrons from that player). There's no sure thing in playing an Influence card, however, since a dice roll is required and the fickle Emperor might reward your enemy—or take away squadrons from your fleet.

There's also one "Emperor Dies" card that can be played, held, or traded. As soon as this card is played, the complexion of the game changes. The actions printed in red on the cards are now used, and open warfare ensues.

In the first phase of the game, diplomacy and co-operation with the other players is necessary. This interaction includes trading cards, "selling" or "buying" cards you need (in return for promises that may or may not be kept), and doing anything you feel is necessary to put your fleet in an advantageous position when the Emperor dies and open warfare begins.

As an example of how this works: in the game we played, an Admiral, as one of the three actions he may perform each turn, used a "Bribe Commander" action card against my fleet. As I had no counter to this action in my hand of five Action cards, the enemy Admiral could have taken control of one of my squadron commanders and moved him to his fleet. However, another Admiral immediately offered me an "Outbid Bribe" card which I used to stop the attempt. In return, I "promised" to give that player one of my "Influence" cards when his turn came. I agreed—then conveniently "forgot" my promise when he needed the card. Never trust a Klingon.

Struggle for the Throne can take several hours to play, but the game is a lot of fun. Our group attracted a lot of attention at a beer hall where we played it one night. The only thing the game doesn't have is a glossary of Klingon swear words. Otherwise, this game is highly recommended for four or more players. ■



THE ANALYTICAL LABORATORY

Once again it's time to thank all of you who voted in our annual poll on the previous year's issues, and to give you the results. This kind of feedback is very useful to us, and indirectly to you, so we always appreciate getting as many votes as possible.

In case you're not familiar with the procedure, we ask everybody to look over all our previous year's issues and list, in order, his choices for the best three items in each of these categories: novelettes and novellas, short stories, fact articles, and covers. (Sometimes we also ask you to vote on serials, but in 1984 we only had one plus the conclusion of another.) Every first-place vote for an item counts as three points, second place two points, and third place one point. The total number of points for each item is divided by the maximum it *could* have received (if everyone had ranked it #1), and multiplying that fraction by 10 gives the scores as listed below. In principle, those scores can be anything from 0 to 10, higher numbers corresponding to high popularity, but in practice scores run significantly lower in categories with many entries than in those with few. So, to provide a more meaningful basis for comparison, I've included in parentheses at the head of each category the score that each item in that category would have received had all been equally popular.

NOVELLAS AND NOVELETTES (0.61)

1. "Valentina," Joseph H. Delaney and Marc Stiegler (2.38)
2. "The Weigher," Eric Vinicoff and Marcia Martin (2.13)
3. "Summer Solstice," Charles L. Harness (1.56)

4. "Floodtide," Ben Bova (1.54)
5. "Return to the Fold," Timothy Zahn (0.98)

SHORT STORIES (0.51)

1. "The Crystal Spheres," David Brin (1.70)
2. (tie): "A *Thrrup* for Teacher," Mary Caraker (1.51)
   "Symphony for a Lost Traveler," Lee Killough (1.51)
3. (tie): "Winter Snow," Eric Vinicoff and Marcia Martin (1.32)
   "Teamwork," Timothy Zahn (1.32)
4. "Low Midnight," Alison Tellure (1.13)
5. (tie) "Rory," Steven Gould (0.98)
   "Slan Libh," Michael F. Flynn (0.98)

FACT ARTICLES (1.54)

1. "The Deadly Thing at 2.4 Kiloparsecs," David Brin (3.33)
2. "Advanced Machining in Ancient Egypt," Christopher P. Dunn (2.53)
3. "Axes, Saws, and Alphabets," Margaret M. Bishop (2.36)
4. "Xenopsychology," Dr. Robert A. Freitas (1.83)
5. "The Galaxy Before Man," Thomas Donaldson (1.58)

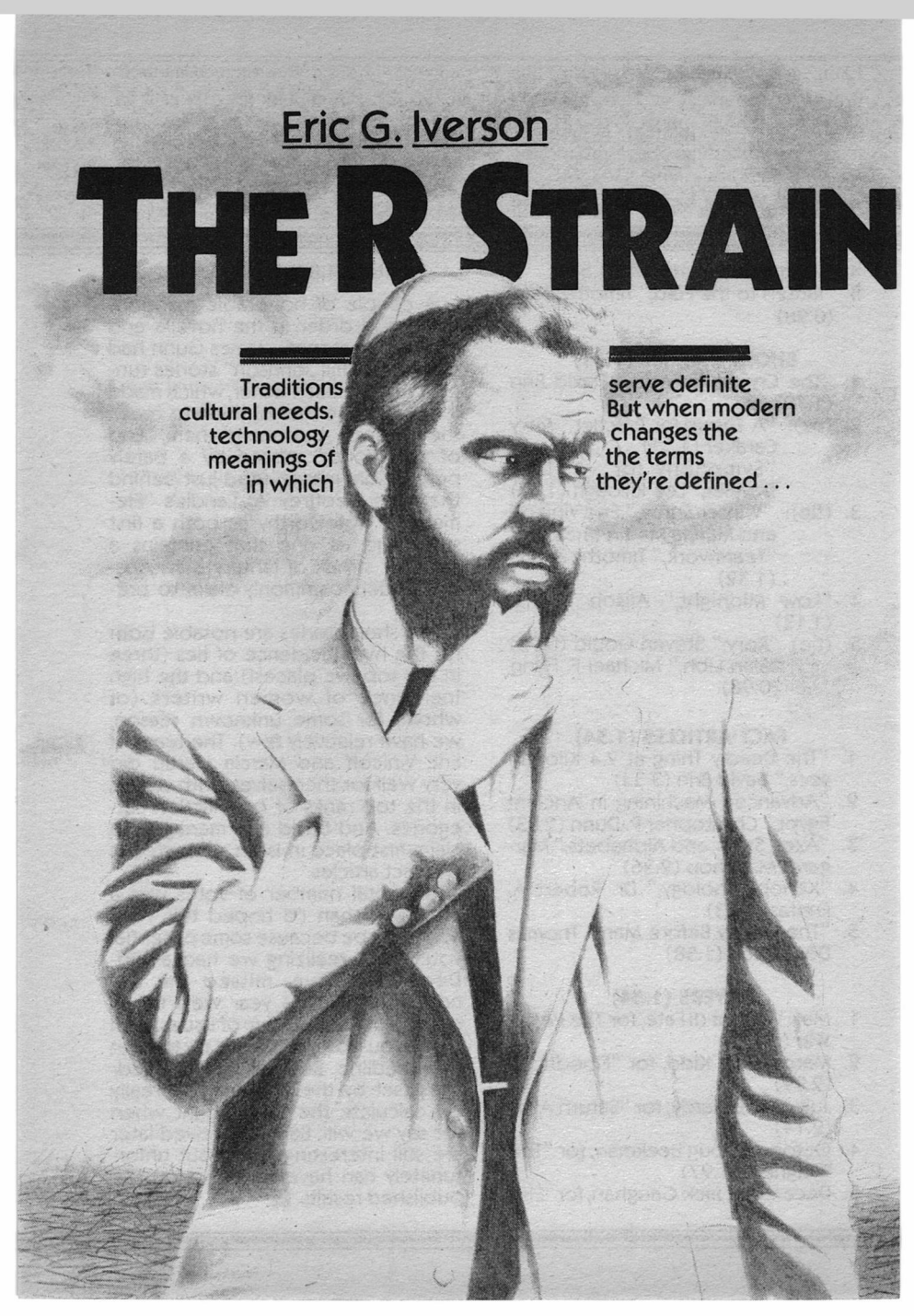
COVERS (1.54)

1. May: Vincent di Fate, for *The Peace War* (3.41)
2. March: Tom Kidd, for "Floodtide" (2.99)
3. July: David Hardy, for "Saturn Alia" (2.14)
4. October: Doug Beekman, for "The Weigher" (1.97)
5. December: Jack Gaughan, for "Elemental" (1.87)

A couple of honorable mentions may be in order in the novella and novelette category. James Gunn had two of his "Bill Johnson" stories running against each other, which made it harder for either of them to reach the top five—but one of them, "End of the World," missed by a barely perceptible margin. And just behind that was Geoffrey A. Landis's "Elemental," noteworthy as both a first story and as one that contains a stronger streak of fantasy than *Analog* readers commonly claim to prefer.

The short stories are notable both for the high incidence of ties (three in the top five places!) and the high incidence of women writers (of whom, for some unknown reason, we have relatively few). The team of Eric Vinicoff and Marcia Martin did very well for themselves, with stories in the top ranks of *both* fiction categories. And David Brin managed to claim first place in both short stories and fact articles.

The total number of votes was a bit lower than I'd hoped this year. Might this be because some potential voters, not realizing we had a Mid-December issue, missed the announcement? This year we'll try to put it in the last *couple* of issues. And when you do vote, please try to beat the deadline. Because of *our* deadlines (set by the printers), we really do calculate the scores right when we say we will. Ballots received later are still interesting to us, but unfortunately can have no effect on the published results. ■


Eric G. Iverson
THE R STRAIN
Traditions serve definite
cultural needs. But when modern
technology changes the
meanings of the terms
in which they're defined . . .

Even in Los Angeles, it is out of the ordinary for the star of a press conference to be a small, pink pig. Peter Delahanty had been anxious about how Lionel would react to the SV lights, but the shote was doing just what he'd hoped: ignoring them. He was happily feeding his face from a plastic washtub full of potatoes and carrots. Delahanty beamed at him like a proud father, which, as he headed Genetic Enterprises, in a way he was.

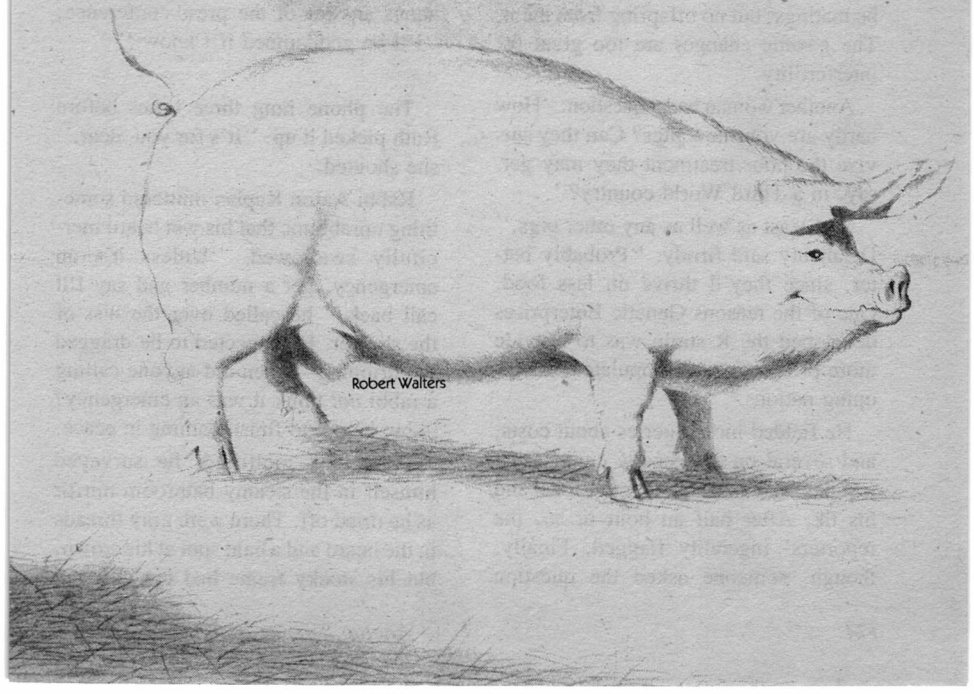
Still cameras flashed and stereovision cameras whirred, but there are, after all, only so many pictures to be taken of a pig. After a while, Delahanty took the tub away from Lionel and put it on a table by the lectern.

Following it with his eyes, Lionel let out a grunt of piggy indignation. "Sorry, pal," Delahanty told him. "Maybe later." As if he understood, Lionel settled back—he really was a good-natured beast. His throat and jaws began to work.

More flashes went off. "That's what you came to see, ladies and gentlemen," Delahanty said. "Lionel's one of Genetic Enterprises' new R strain of pigs—R for ruminant, of course. In other words, unlike ordinary, unimproved swine, he chews his cud."

"Just why is that an improvement?" asked a lady reporter in the second row.

"It makes him and his brothers and sisters more efficient food processors. Ruminant animals—cattle, sheep, goats, deer, antelope are some of the ones occurring in nature—partially digest food, then store and regurgitate it for rechewing and more complete digestion. They get more out of a given amount of food than non-ruminants. Lionel will gain



weight on less feed or lower quality feed than an unimproved pig.''

''Which means lower cost to the farmer?'' someone asked.

''Exactly.''

''But of course buying your R strain is going to be more expensive for the farmer. What's the net savings?''

Delahanty turned to a chart behind him. ''Here you have costs for the R strain compared to those for ordinary swine. As you can see, the break-even point is at three and a half months if the farmer buys piglets; it's even sooner if he chooses to have fertilized ova implanted in his own sows. And the extra expense is all in the first generation—the R strain breeds true.''

''Will they interbreed with unmodified pigs?'' a man with a gray mustache wondered.

''No,'' Delahanty said. ''There may be matings, but no offspring from them. The genetic changes are too great for interfertility.''

Another woman had a question: ''How hardy are your new pigs? Can they survive the poor treatment they may get, say, in a Third World country?''

''At least as well as any other pigs,'' Delahanty said firmly. ''Probably better, since they'll thrive on less food. One of the reasons Genetic Enterprises developed the R strain was to provide more protein for overpopulated, developing nations.''

He fielded more queries about costs, and several on the genetic engineering techniques that had gone into Lionel and his ilk. After half an hour or so, the reporters' ingenuity flagged. Finally, though, someone asked the question Delahanty had been hoping for: ''What do these beasts of yours taste like?''

He smiled. ''I'll let you all be the judges of that. The chops and hams on the buffet to my left here come from the R strain. If there aren't any more questions—''

The surge forward was so sudden and urgent that Lionel snorted in alarm. But somebody was still waving a hand—not a reporter but a cameraman, a fellow with curly brown hair and a big nose. ''Yes? You want to ask me something?'' Delahanty called.

''Yeah, if I could,'' the man said. ''My name's Stan Jacoby. Here's what I want to know—''

Delahanty had been ready for every question the reporters had thrown at him, and a good many they hadn't. Now, though, he felt his jaw drop. ''Mr. Jacoby,'' he said in the most spontaneous answer of the press conference, ''I'll be goddamned if I know.''

The phone rang three times before Ruth picked it up. ''It's for you, dear,'' she shouted.

Rabbi Aaron Kaplan muttered something unrabbinic that his wet beard mercifully swallowed. ''Unless it's an emergency, get a number and say I'll call back,'' he called over the hiss of the shower. He expected to be dragged out dripping—when did anyone calling a rabbi *not* think it was an emergency? —but he got to finish bathing in peace.

Somewhat mollified, he surveyed himself in the steamy bathroom mirror as he dried off. There were gray threads in the beard and a bald spot at his crown, but his stocky frame had not changed

too badly since his days as a high school linebacker twenty-five years before.

Ruth came in with a scrap of paper. He smiled at her, thinking how lucky he was; if she had not been a rabbi's daughter, she would have been a *rebbitzin* decorative enough to make half his congregation nervous.

At the moment, she was giggling. "What's so funny?" he asked. She gave him the paper. He recognized Peter Delahanty's name; they had worked together on a couple of fund-raising committees. Underneath were a phone number and a one-sentence message: "Wants to know if pigs can be kosher."

He laughed himself. "A practical joke?"

"I don't think so. He seemed very sincere."

"Well, all right, I'll call him. He's got *chutzpah*, if nothing else." Kaplan went into the bedroom, put on a T-shirt and pair of shorts. Not for the first time, he was glad he hadn't added video to his phone system.

He punched the number. "Genetic Enterprises, Dr. Delahanty's office," a woman said. He asked to speak to Dr. Delahanty. "May I ask who's calling?" the secretary said. When he gave his name, she answered, "One moment. I'll connect you."

"Oh, Rabbi Kaplan. Thanks for returning my call." Delahanty sounded young and earnest. If he was a practical joker, he was first-rate.

Kaplan said, "My wife tells me you were inquiring about the possibility of, uh, pork being acceptable under Jewish dietary law."

"Yes, that's right. You see—"

Kaplan cut him off. "I'm afraid it's out of the question. Leviticus 11:3 and 11:7 are the relevant passages. Here, let me give you the exact wording." He reached for the Bible on the nightstand. " 'Whatsoever parteth the hoof, and is cloven-footed, and cheweth the cud, among the beasts, that may ye eat.' And again, 'And the swine, because he parteth the hoof, and is cloven-footed, but cheweth not the cud, he is unclean to you.' The fourteenth chapter of Deuteronomy repeats the same prohibitions. So I really don't see how—"

It was Delahanty's turn to interrupt. "Forgive me, Rabbi Kaplan, but I do know that under normal circumstances Jews are not supposed to eat pork. Let me tell you about Lionel, though."

"Lionel?" Kaplan echoed, confused.

"Yes. This would have been easier if you'd caught the news last night. Lionel is a pig who chews his cud. . . . Are you there, Rabbi Kaplan?"

"I'm here," Kaplan said after a long pause. "I think you'd better tell me more." He felt a headache coming on.

"The easiest thing to do would have been to say that pigs is pigs, whether they chew their cuds or not. That would have been that," Ruth said when he finally got off the phone with Delahanty and, still wearing a bemused look, explained the dilemma to her.

"Simplest, yes, but would it have been right?" Kaplan said, shaking his head. "It goes against everything I've been brought up with to say 'kosher' and 'pig' in the same sentence. But if a pig has a cloven hoof and chews its cud, doesn't it meet the criteria the Bible sets for permitted beasts?"

"It meets the criteria for trouble,"

his wife said practically. "If you start saying pork is kosher, you'd best thank God there's no Jewish Inquisition, because if there were, it would burn you at the stake."

"At the chop, actually," said Kaplan, who had a weakness for bad puns.

Ruth did not groan, as he had hoped she would. She set her hands on her hips, saying, "I'm serious, Aaron. Do you want to make yourself a laughingstock for the congregation, to say nothing of other rabbis?"

"Of course not." Just the same, he winced as he imagined the headlines: "Only in Los Angeles." "Rabbi Kaplan's Favorite Ham Recipes." A caption under a picture of a pig: "Funny, he doesn't *look* Jewish." Oh, he was opening a can of worms, and no mistake.

But it was such a *pretty* problem. Kaplan had been a rabbi going on twenty years now: a teacher, a counselor, a preacher, a social worker, sometimes even a scholar. Not since his student days, though, had he had a chance to be a theologian.

His wife recognized his faraway stare, and it alarmed her. She chose a question close to the issue at hand: "Aaron, have you ever tasted pork?"

As she had intended, that snapped him out of his reverie. He looked at her in surprise. He was Conservative, not Orthodox; he did not pretend to observe all the minutiae of dietary law. Pork, however, was something else. It was like asking if he had ever been unfaithful—exactly like that, he thought uncomfortably.

"Once," he admitted. "I was eighteen, in my senior year in high school, and out to do anything my father didn't

want me to do. And so, one morning I stopped for breakfast with some friends, and I ordered bacon and eggs.''

''Was it good?''

''You know, I really don't remember.'' He supposed that was like a lot of infidelity, too—he had been too nervous to enjoy it. ''What's all this about?''

''If you do decide this meat could somehow be kosher, I was just wondering how you were going to react when people said you did it because you liked pork yourself, and wanted an excuse to eat it.''

''That's ridi—'' he began, and then stopped. It was not ridiculous, even in the twenty-first century. It might very well be one of the kinder things Orthodox rabbis would say. They would, he thought with a curiously mixed metaphor, crucify him if he had anything at all good to say about pigs. The only thing they could not do was excommunicate him; Judaism didn't work that way. It was something of a relief, but not much.

Ruth was still watching him. ''You're going ahead with this.''

''You know me too well,'' he sighed. ''I'm going to investigate it, anyhow.''

''I wish you wouldn't.''

''I sort of have to,'' he said, but he was talking to her back.

Sighing again, he went into his study. His books would not argue with him. He went first, as would anyone unraveling a problem of Jewish law, to the *Shulkhan Arukh*, the *Ready Table* of Joseph Karo. Published in 1564, it was still basic almost five centuries later, and its commentators reached to modern times.

Chapter 46 sounded promising: ''Laws Concerning Forbidden Food.'' He turned to it in some hope. It had nothing to do with pork, but dealt with meat and milk dishes; with eating food prepared by gentiles or from utensils used by gentiles; with wormy fruit, vegetables, and fish. Karo, reasonably enough, had never entertained the prospect of a pig that chewed its cud, nor had the rabbis who came after him.

Kaplan did find a reference to swine in Chapter 5, ''Laws Regarding the Cleanliness of the Place for Holy Purposes.'' There Karo remarked, ''The mouth of a swine is considered like a chamber pot, for the reason that it pecks at excrement.''

The rabbi frowned. In modern times, pigs were no more filthy than any other domestic animals. Perplexed, he got down the *Guide for the Perplexed*, Maimonides's great twelfth-century effort to reconcile religion and science. He found the reference to pork in Chapter 48 of Part III:

''I maintain that the food which is forbidden by the Law is unwholesome. There is nothing among the forbidden kinds of food whose injurious character is doubted, except pork, and fat. But also in these cases the doubt is not justified. For pork contains more moisture than necessary, and too much of superfluous matter. The principal reason why the Law forbids swine's flesh is to be found in the circumstance that its habits and its food are very dirty and loathsome. It has already been pointed out how emphatically the Law enjoins the removal of the sight of loathsome objects, even in the field and in the camp; how much more objectionable is such sight in towns. But if it were allowed

to eat swine's flesh, the streets and houses would be more dirty than any cesspool, as may be seen at present in the country of the Franks. The saying of our Sages is well known: 'The mouth of a swine is as dirty as dung itself.' ''

Again, the medical argument that swine's flesh was inherently dirty: a physician himself, Maimonides would naturally reason thus. And again, it did not necessarily apply now, or indeed even in Maimonides' day; chickens hardly had cleanlier habits than pigs. The quotation from the Talmud was in the same vein, if of even weightier authority than Maimonides.

Who else had spoken of the pig? He thought of one source, and pulled a well-thumbed book from a shelf apart from the religious tomes. As usual, Ambrose Bierce had a word for it: ''Hog, *n.* A bird remarkable for the catholicity of its appetite and serving to illustrate that of ours. Among the Mahometans and Jews, the hog is not in favor as an article of diet, but is respected for the delicacy of its habits, the beauty of its plumage and the melody of its voice. . . .''

Smiling, he put the *Devil's Dictionary* away. Bierce's mordant wit helped put things in perspective. He was certain his predicament would have amused the old cynic immensely, and perhaps inspired a fresh verse or two from that worthy bard, Father Gassalasca Jape, S.J.

At that, the mythical Father Jape might have sympathized with Kaplan. In Bierce's time, Catholics refrained from eating meat on Fridays. Somehow the Catholic Church had survived when the prohibition was lifted.

But the ban against pork was centuries older than Christianity itself. And Judaism, unlike Christianity these last seventeen centuries, was mostly a minority religion, all too often a persecuted one. Jewish dietary laws expressed and emphasized the separateness of the Jews of the Diaspora from the peoples among whom they lived. Because they helped Jews maintain their cohesion, they became emotionally ingrained in believers; that was why even the thought of modifying them brought such a wrench with it.

And yet, he thought, Judaism always retained a certain flexibility other faiths lacked. In the Middle Ages, Jewish thought never accepted Aristotelian science as part and parcel of the tenets of the faith, as the Church had—and therefore never had to go through a painful repudiation when Renaissance scientists showed Aristotle did not, after all, know everything.

Adaptation to a changing world had been going on ever since. Among the observant in both Israel and the United States, a common item was a switch that could be set in advance to turn electrical appliances on and off on the Sabbath, when kindling a light was forbidden.

So—there was the question: was eating one of Delahanty's R strain accommodation to be gratefully accepted, or was it abomination? Whichever way he decided, he was going to be in trouble. He wondered if he ought to call another rabbi, someone older and maybe wiser. He thought it over, decided not to; it felt too much like passing the buck. The problem had been dumped in *his* lap, and he had to deal with it now. The time for others to judge would be later.

Ruth knew better than to disturb him in his study, but she pounced when he emerged. "Well?"

He spread his hands. "I don't have any answer yet, I'm afraid."

"Wonderful."

He did his best not to notice the sarcasm. "The trouble is, the authorities so automatically think of pigs and pork as being beyond the pale that they don't even discuss conditions under which it might be permissible."

"Shouldn't that tell you something?" Ruth asked pointedly.

"The rabbis of the Talmud didn't have modern technology to complicate their lives. All they had to worry about was famine, insurrection, and Roman legions—they didn't know when they were well off."

"Now what?"

"I think I'll call Delahanty back. Maybe he can tell me something that would make this all make sense."

"I can tell you something that would make this all make sense—forget it."

But Kaplan was already hitting the phone buttons. The chief of Genetic Enterprises came on the line at once. He seemed so bright and eager, Kaplan thought, and almost as intrigued as the rabbi over their mutual problem. It had to be honest intellectual curiosity; even if every Jew in the country started eating the new product, it wouldn't bump consumption up more than a couple of percent.

"Damn, too bad," Delahanty said when Kaplan told him of the unpromising turn of the research. Without being asked, he went on, "How about this, then? Suppose I shoot you all the information about the R strain. That might help."

"So it might." Kaplan paused, continued, "I want you to understand, Dr. Delahanty, no matter how intriguing the possibilities are here, there's no guarantee I can find these beasts of yours acceptable."

"Well, of course." Delahanty sounded surprised. "You have to do what you think is right, Rabbi. I'm just glad you didn't laugh at me and hang up."

"You're lucky you didn't talk with my wife."

Delahanty laughed. "Am I? Do you have your floppy ready?"

"Just a second." The rabbi loaded a disk into the base of the phone unit. "All right, go ahead." There was a faint whir from the drive as the floppy recorded the data Delahanty was sending. When it was done, Kaplan said, "Thanks. I'll get back to you."

"I ought to be thanking you."

"Nonsense. I haven't had this much fun in a long time." After they said their goodbyes, Kaplan took the floppy over to the computer and played it back.

Most of it, he discovered, consisted of Genetic Enterprises advertising videos. If half what they said about the R strain was true, as soon as the first little porker turned thirty-five it was going to get elected President. Rhapsodies over how nutritious the meat was, however, did not matter to Kaplan. Ordinary pork was perfectly edible. The problem lay elsewhere.

The rabbi learned the R strain's digestive tract was modeled after that of cows, sheep, and goats, but was not created from their genetic material.

From the tone of the video, he gathered others had tried that approach and failed.

He was glad Genetic Enterprises had done something new; it was a minor point in favor of the R strain. Leviticus 19:19 said, "Thou shalt not let thy cattle gender with a diverse kind." In the *Shulkhan Arukh*, Kara extended that to working with a team of different animals, such as a horse and an ox, and said the two mules working together should be examined to ensure that both were the get either of a stallion and jenny or of a jack and mare: otherwise they were animals of diverse kind. Some authorities, in fact, noted Karo, reckoned one mule an animal of diverse kind and forbade its use. If the R strain had some of the genes, say, of a sheep, that argument could have been raised against it.

Kaplan waded through a series of charts and graphs extolling the R strain's ability to put on flesh quickly. Again, that was beside the point. Moreover, while it was important to farmers, the rabbi found it mind-numbing after a while. He hit the fast-forward button.

He jabbed the stop control. There stood Peter Delahanty. He hadn't changed in the year or so since Kaplan had seen him last: he was fair, just past thirty, good-looking in an abstracted way, very sincere. This had to be the press conference he had mentioned. Maybe, Kaplan thought hopefully, it would give a tidy summary of all the data with which he had been bombarded. Lionel was certainly cuter than a pie chart.

The questions Delahanty had gotten were interesting, and his answers did help clarify matters, but only from a dollars-and-cents standpoint. Kaplan listened for fifteen minutes or so. He was about to give up and turn off the disk when a reporter with a bushy gray mustache stood up and asked, "Will they interbreed with unmodified pigs?"

When Delahanty said no, Kaplan felt like Archimedes in his bath. For that matter, a naked, dripping man running through the streets shouting "Eureka!" would attract no more attention in Los Angeles than back in ancient Syracuse, unless the police decided he was on angel dust and shot him.

He called Genetic Enterprises again; by now he did not have to look up the number. "I have the determination," he said when Delahanty came on the line.

"And?"

"In my opinion, Jews may eat animals of the R strain, as they may any other beasts that have divided hooves and chew a cud."

"Do you really think so? Do you mind if I ask you why you say so?"

"I was hoping you would," Kaplan said truthfully; he had enough ego to want his reasoning appreciated. "The key is that, properly speaking, these R strain beasts are not pigs at all."

"No? What would you call 'em, then? They look like pigs, they oink like pigs, they taste like pigs—though I don't suppose you'd know about that. You told me you weren't going to find the R strain kosher just to be doing it; it seems to me that's what you've done. I don't want that, Rabbi Kaplan."

Kaplan almost burst out laughing. Of all the ridiculous situations in the world, for him to be explaining to an Irishman

why a pig wasn't a pig had to fall into the top ten.

He said, "I was going to say no until I heard you tell the press that the R strain and ordinary swine weren't fertile with each other."

"No, they're not," Delahanty agreed. He sounded doubtful, then suddenly excited. "Oh, I follow you, I think. One scientific justification for calling two populations distinct species is that they can't breed together. Is that it? Wouldn't it just make the R strain a different kind of pig, though?"

Admiring his quick wits, Kaplan quoted Leviticus 19:19: " 'Thou shalt not let thy cattle gender with a diverse kind.' The clear implication there, of course, is with a diverse kind of cattle. But the R strain can't gender at all with pigs. And if they can't gender with pigs, how can they be pigs, no matter what they look like?"

After a minute, Delahanty said, "You'd make a good Jesuit, Rabbi."

Kaplan grunted. Being a good Jew struck him as hard enough, without the added burden of lifelong chastity. Despite all his other strictures, Karo did not enjoin anything of that sort: in Chapter 150, he recommended cohabitation nightly for married men of strong constitution, twice a week for laborers working in the town where they lived, and once a week for those working in a different town. His injunctions included scholars, although Rabbi Eleazar said "that he used to have cohabitation with such awe and fear that it appeared to him as if a demon was forcing him to do it."

While Kaplan was musing on Karo's prescriptions, Delahanty said something he missed. "I'm sorry?" he said, embarrassed.

"I asked how serious you were about all this. Giving an opinion is easy, but do you mean it?"

"Of course I do," Kaplan said indignantly.

"Then—" Delahanty hesitated, went on, "Look, if you think I'm out of line, tell me and I'll shut up, and I certainly won't think any less of you. But I would like to ask . . . having said what you've said, would you eat meat from the R strain yourself?"

He should have guessed the question was coming, but it took him by surprise just the same. Suddenly and bitterly he understood how Ruth felt. Intellectually, he had convinced himself that the R strain was acceptable. Emotionally, Lionel, pink and plump and curly-tailed, was a pig, no two ways about it.

"Rabbi?" Delahanty said when he did not reply at once.

Having given the response he did, Kaplan saw he had no choice now. "I would eat it," he said. "I will eat it. By your phone code, Genetic Enterprises is in Westwood or somewhere close by. Give me your address; I can be there in a half hour. I don't care to make commercials for you, though, if you don't mind."

"I put you on the spot," Delahanty said. "I apologize; that was nasty of me. Don't let me make you do anything you wouldn't want to."

"You're not. Tell me that address now, please."

"Are you sure?"

"I'm sure," Kaplan said firmly. He wrote down the street number Delahanty

gave him, exchanged another minute or so of small talk, and hung up.

He threw on a battered corduroy jacket and was on his way down the hall when Ruth called, "Where are you going?" from the den.

Sheepishly (under the circumstances, he thought, not quite the right word), he explained. He stayed right where he was; at that moment, he didn't feel much like facing her.

"You told him his pigs were kosher," she said in a voice so flat he could make nothing of it.

"Yes, and this is what it got me." He heard her get up. "What are you doing?" he asked in some alarm.

"Getting a hat."

"What for?"

"So I can come with you, of course."

He was still gaping when she stepped into the hall. He finally found his tongue. "What are you coming with me for? You were the one who told me to say the R strain was *trafe* and have done with it. You can't want to go eat pork with me."

"But it's not pork, or that's what you told Delahanty."

"But to you it is."

"Who's the rabbi in this house?" she said, and laughed at his thunderstruck expression. "Besides," she added softly, "it'll be easier if you're not alone."

"Thank you," he said. That wasn't nearly strong enough. He went over and hugged her. "Have I told you any time lately I think you're wonderful?"

"Yes, but I never mind hearing it again. Come on; let's get this over with."

Traffic on the Santa Monica Freeway never moved fast. Old gasoline-fueled cars, alcohol-burners, and electrics crawled along together. Kaplan had just about decided to make his next car, somewhere in the indefinite future, an electric. With more and more fusion plants coming on line, they were definitely the coming thing. Smog was down, too; not out, but down.

They drove past billboards in Spanish, English, Korean, Japanese, and Hindi. Every decade, it seemed, some new group of immigrants settled in southern California in droves. Kaplan's neighborhood supermarket stocked nine different chutneys and seventeen curries.

With their superior climate, Westwood and Santa Monica had long dominated the L.A. area, leaving the old downtown to stagnation again after its rebirth in the 1970s. Skyscrapers flung long afternoon shadows across the San Diego Freeway as Kaplan and his wife swung north.

The parking garage in the building that housed the headquarters of Genetic Enterprises went down eleven levels underground. The elevator's surge was like a rocket lifting off, but it was not the only reason the rabbi's stomach had for lurching.

Genetic Enterprises kept its labs elsewhere in the city, where rents were lower. This was where the executives worked. When Kaplan opened the door to the receptionist's office, a delicious smell rolled over him like a wave. It was not really unfamiliar; one could not live in Los Angeles without coming across it now and then. But it had never had anything to do with him before.

Delahanty came out almost at once

to shake his hand. "Good to see you again," he said, politely adding, "A pleasure to meet you," when Kaplan introduced him to Ruth.

"Shall we get on with it?" she said harshly.

"Of course," Delahanty said. "Thank you for coming, both of you. I understand how difficult this must be for you."

You don't begin to, Kaplan thought, but he and his wife followed Delahanty back into his office. On the desk lay a meat-filled platter. "Blade-cut por—uh, chops," Delahanty said. "Here, let me heat them up for you." He popped them into a microwave oven, which obviously had been brought in for the occasion.

As the microwave hummed, Kaplan sighed inaudibly to himself. Perhaps even without meaning to, Delahanty had eliminated a possible last-ditch excuse to chicken out (another inappropriate phrase, the rabbi thought ruefully). He might have begged off by saying that the beast now reheating had not been slaughtered by a *shokhet*—any ritual butcher would have laughed himself silly at the notion of practicing his skill on a pig. But Kaplan did not insist that his beef and mutton come from the *shokhet*'s knife; he bought them at the supermarket. And so he could not honestly apply a standard to the R strain different from the one by which he judged other acceptable meat.

But he did avoid cuts from the hindquarters of the carcass. The section of meat through which the sciatic nerve passed was not kosher, in memory of the laming blow the angel of the Lord had inflicted on Jacob when they wrestled through the night. Blade-cut chops, though, came from far forward on the beast.

The reverie was done long before the microwave turned itself off. When it chimed, Delahanty took out the platter, produced some plastic cutlery from a desk drawer. "Would you like me to step out for a few minutes?" he asked.

"No, that's all right," Kaplan began, but Ruth broke in, "Yes, please."

"Of course," Delahanty said quietly, and shut the door behind him as he left.

The fantasy that flitted through Kaplan's mind this time was frankly paranoid: he wondered if this was all an elaborate practical joke to get him to eat forbidden food.

He and Ruth looked at the gently steaming chops, at each other. Gathering his pride, the rabbi said, "Me first," and picked up knife and fork. The meat was tougher, grainier than veal, which to his eye it most closely resembled. He speared it with his fork, brought it toward his mouth.

Chapter 92 of the *Shulkhan Arukh* dealt with laws concerning one dangerously ill, and one forced to transgress a precept. Karo wrote, "If one who is dangerously ill requires meat, and only forbidden meat is obtainable, an animal should be slaughtered for his sake in order not to feed him with forbidden meat, as it is apprehended lest he will become aware of having been fed on forbidden meat and he will become nauseous thereby."

Kaplan had come across that passage before. Now he had no doubt it described something real. When a couple of hours of theoretical knowledge came

up against forty years of ingrained practice, distress was inevitable.

He clamped his jaw shut to hold down his gorge, then realized he could not eat that way. He took a deep breath, chewed, swallowed, set his jaw again.

"Well?" Ruth demanded. "How is it?"

He laughed, shakily. "You know, it's just like the time I ate bacon and eggs when I was a kid. I have no idea what it tasted like."

"Well, let's find out, shall we?" Ruth cut a large piece, chewed with deliberation. "Not bad," she said reflectively. "Nothing to write home about, but not bad."

The second bite, Kaplan found, came much easier than the first. This time he too was able to consider the flavor of the—of the R strain, he told himself firmly. "Different," he agreed.

They ate a chop apiece, not with any great speed or relish, but steadily. Looking at the meat still on the platter, Kaplan asked, "Still hungry?"

"Not especially."

"Neither am I. Even honestly believing that was acceptable food, it was harder than I ever thought it would be."

Ruth nodded. "You did very well."

"Thanks. So did you, and thanks for that, too." He hugged her again. "Shall we give Delahanty his office back, and show him the dreadful deed is done?"

"Just a second." She took a tissue from her pocket and brushed at his beard. "Now."

"Okay."

Not surprisingly, the head of Genetic Enterprises had been hovering just outside in the hallway. He hurried in, saw the bones on the platter. "Rabbi, Mrs. Kaplan, thank you very much," he said, shaking hands with them both.

"It's all right," Kaplan said. "You've given me one of the more, ah, interesting afternoons of my life, that I can tell you."

"I really didn't mean to pressure you," Delahanty said. But, like any scientist, he was curious by nature, and could not help asking, "How did you like it?"

"We got through it," Kaplan said.

Later, driving home, he wondered if he had been short with the man. Then he thought of twenty-five hundred years of history, of conquest and captivity under Babylon; persecution by the Greeks; savage and futile war against Rome; European ghettoes and Christian mobs; Dreyfus; the Holocaust, still too appalling for any sane mind to take in; round after round of war in the Middle East, and no end in sight. No end to Jews in sight either, though.

Without much thought, he had managed to sum up the history of a people in four words. That wasn't bad.

He changed lanes. ■

● The number of people who agree or disagree with you has absolutely no bearing on whether you're *right*. The universe has a way of deciding that for itself.

Kelvin Throop III

brass tacks

Dear Dr. Schmidt,

I have just completed reading Ben Bova's guest editorial, "Freedom from Fear" in the November 1984 issue. To quote, "very high-power lasers and other energy weapons of pinpoint accuracy, *directed by very smart computers*, are beginning to give the defense its chance . . ." (italics mine).

Just a little over a week ago we had the thrill of watching our space shuttle finally be able to take off, go through many exciting procedures, and safely land. But, because of the many *smart computer* problems, this was not the first try to get her up there. I'm all in favor of space exploration and the wonderful uses humanity can garner from space. But to rely on those smart computers for our defense seems to be madness of the first order, even if as Mr. Bova says "the mushrooms may have to bloom again, and it will take a nuclear engagement of some sort to make the nations realize . . ." I have more fear of Mr. Bova's brand of freedom from fear than from the status quo. He seems to be saying, "Hey, guys, let's try just a little bit of a nuclear war and see if that won't teach us all a lesson. Then will you all be good?"

Thank you, Mr. Bova, but no thanks! Even your little nuclear war is a little too much.

GRACE S. SHER

Chicago, IL

I don't think Mr. Bova was advocating *any sort of nuclear engagement, or saying that it would be a* good *way to make nations take the problem seriously enough to do something about it, or even that the option he described was the only thing that might be done about it. But people being people, I can easily (though sadly) imagine that history may show that that was what it took to get the message across.*

Dear Stan,

I found Ben Bova's editorial on ballistic missile defense ("BMD," or, as it is now often termed, "Strategic Defense Initiative") in the November issue interesting and provocative, but I think it might be useful to inject some real-world considerations into his speculations.

I am sure Ben recognizes that there are still many technical questions about whether such a missile defense system can be made to work, and whether or not such a defense could be easily circumvented by relatively simple countermeasures, or shot down by antisatellite weapons. I do concede that creating a total defense is so highly desirable an objective that if there is even a small chance of achieving it, we should attempt to do so. However, in addition to technical criteria (will it work?) any ballistic missile defense system must also satisfy several elementary considerations:

(1) The cost per shot of the defense must be less than the cost of the missiles shot at (and peferably much less).

(2) The system must be very close to perfect. Shooting down 90% of the incoming missiles is *not* good enough.

In addition, one more criterion is extremely desirable:

(3) The system must not itself employ nuclear explosives.

The first criterion is rather straightforward, although it seems to be ignored surprisingly often by advocates of BMD, who often state that a defense system should be built "regardless of cost." If it costs more to shoot down a missile than to build another missile, a defense system can always be defeated by simply building more missiles. Such a defense is not only useless, since the enemy can always build more missiles than you can shoot down, but actually destabilizing, since it leads to proliferation of more and more weapons.

How does this compare with currently proposed missile defense systems? The Soviet strategic missile force totals about 2400 missiles, with 7000 warheads,[1] counting both land and submarine based missiles. Estimates for defense cost[2] range from about 200 billion to over 500 billion dollars (not inclusive of R&D cost), which means a cost per kill of between eighty and two hundred million dollars. The cost of a missile depends on what type you are considering. Estimates of the cost of a simple next-generation US missile, the "midgetman,"[3] range from ten to seventy million dollars each (like the defense costs, these depend on whether you believe the estimates of proponents or opponents). Even the *lowest* defense cost estimate is too high to defeat the *highest* cost missile. Bova states that a defense would be worthwile "even if the system costs a trillion dollars." That is not the case.

One might be tempted to think that the cost to kill an additional missile may be much lower once the system has been paid for, since the same "battle station" could presumably kill many missiles. However, in general there will be little or no excess capacity available in the case of a massive attack; the defense system will be shooting as fast as it can. If the enemy builds additional missiles, the defense will be forced to build additional defensive stations to shoot them down. It is unlikely that economy of scale will be significantly better for defense than for offense.

The second criterion is that the system must be very nearly leakproof. While a 100% effective defense may be described as a defensive weapon, a 90% effective defense is an *offensive* weapon. In terms of protecting against an offen-

sive first strike, a 90% effective shield is not good enough; ten percent of even the current Soviet arsenal is over seven hundred warheads, more than enough to devastate the target country. But what if the side with the 90% effective shield makes a preemptive strike against the missile silos of the presumed enemy? The shield is probably effective enough to guard against the missiles that remain. A partial shield only works if the shielded side strikes first! Worse, it is an incentive for the *unshielded* side to strike first, since they will be in a "use it or lose it" situation. A partial shield, far from being better than nothing, is destabilizing in the worst way.

Most defense systems proposed are "layered" defenses, where missiles that pass through the first defense are targeted by the next. While such a layering system increases the reliability of defense, it markedly increases the cost.

The third desideratum, that the defense should itself use no nuclear explosives, has two justifications. First, a defense using nuclear warheads is unlikely ever to pass the political process. However, there is a more important reason. For a defense system to work, it must have an extremely fast reaction time. For submarine launched missiles, there are only fifteen minutes between launch and impact, and the easiest time to destroy one is in the first *three minutes* after launch.[4,5] This is certainly not enough time to receive authorization from the President; it is probably insufficient time for any human decision at all. Despite increased confidence modern computers, it is not a wise decision to have nuclear weapons detonated without any human decision at all.

While it is clear that such a defense would be desirable, it is not at all clear that any of the currently proposed systems would do the job. I quote James Fletcher: "Enormous hurdles remain . . . such a system could not be built today . . . it depends on technological systems and capabilities yet to be developed." (keep in mind that this quote is from a report *favorable* to defense.) In conclusion, it is unlikely that defense will be available before the year 2000 at the very soonest. Bova expresses a magnificent dream—and a worthy hope—but hopes and dreams should not be confused with working technology.

These considerations apply only to area defense, that is, the idea of protecting the population from a nuclear attack. There is another concept, *hardpoint* defense, namely protecting only missile silos. This type of defense is much easier, since there are comparatively few points to defend. Rather than eliminate the concept of MAD, hardpoint defense seeks to protect the ability to retaliate against any preemptive strike. In some sense, then, it is exactly the opposite of total defense. Hardpoint defense may be stabilizing, and be worth implementing, but is quite different from Reagan's declared strategic defense initiative.

The issue of ballistic missile defense is complex, and there is no clearly right solution. It is difficult to find unbiased, detailed discussions of the complex issues involved. Useful information can be found in *Physics Today*, *Technology Review*, and *Scientific American*. Intelligent, provocative discussion (albeit with a declared pro-disarmament bias) can be found in *The Bulletin of the Atomic Scientists*. Last, a new journal, *Issues in Science and Technology* published by the National Academy of Sciences, promises to be a good source of relatively unbiased analysis.

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GEOFFREY A. LANDIS

To the readers of *Analog*:

I am currently engaged in a major research project, the purpose of which is to investigate the various "peace systems" as they appear in science fiction stories. Because the enormous volume of publications in science fiction literature would make it practically impossible for one person to read every publication in this field, I am asking assistance from the readers of *Analog*. I would appreciate letters sent to me containing the following information: name of author, title of publication, publisher, and date of publication which, in the view of the respondent, contains a so-called "peace system" summarized in a few paragraphs. In this context, my research is limited to the following criteria: 1. It must be a peace system devised *by humans for humans*. 2. It can be a peace system devised between humans and aliens (in this context aliens can be any kind of combination of human-like creatures). 3. The place of the story can be the Earth or any other planet or star. 4. The systems can be terrestrial, galactic, universal, etc.

Any reader who wishes to assist me in my research work should write directly to me at the following address:

PROFESSOR WILLIAM O. PETERFI
Social Science Division
University of Minnesota
Morris, MN 56267

Dear Stan:

The December 1984 issue of *Analog* was enhanced by the fantasy, "Elemental," by Geoffrey A. Landis. It's a highly entertaining piece that by rights should have been published in *Unknown Worlds*, though, alas, that magazine is no longer being published.

Although symbolic operations of magic enable any one of several models to be used in order to achieve a desired goal, Landis's story has a few aspects that could be called technical errors. A pentacle used as a ward, for instance, does not create a movable field: it creates a static condition at a locus (correctly handled elsewhere in the story). If Ramsey Washington had created a kameaic talisman, he'd have been able to have a portable field.

While for purposes of the story, everyone is supposed to be able to manipulate magical forces (". . . peasants trying to improve their crops" . . . "Thousands . . . maybe millions . . .") there's a hierarchy rigid enough so that it can be determined that only *seven* people in the entire world are "qualified to work with the Earth Elemental . . ." Actually, Randall Garrett is correct in pointing out that having the Talent is a requirement, and that's genetic: if everybody could perform magic, there would by rights (rites?) be hundreds or thousands expert enough to handle the elemental. Particularly after more than 2,000 years of practice (the *Handbook of Thaumaturgy*, a printed book, was in at least its 2,053rd edition—Ramsey's edition was a "battered secondhand hardcopy of the . . . 2052nd edition." Given the

engineering technologies involved, such as motorboats and internal-combustion autos, I'd suspect no more than the 52nd edition).

However, the story was a fantasy, and a good one, too. So one shouldn't quibble over technical details, including those of magic. Too bad there isn't an active *Unknown Worlds* to publish such a story in.

STEPHEN A. KALLIS, JR. ThD.

Maybe if enough people wrote to express an interest. . . . (Which is, I'm told, approximately how the original Unknown *came to be.)*

Dear Stan,

Mitch Geller's letter in the December '84 *Analog* is inaccurate in the use of the word "luxury." According to him, a planner like Nicholas van Rijn is a "luxury" in a survivalist scenario. Well, van Rijn would be a "luxury" in about the same way that automobiles or electric power is a "luxury." That is, under the circumstances it is possible to get along without it, even for extended periods of time, but a community that has one will probably get along better than one that doesn't. The main value of such a planner is that, with the police and courts gone, he keeps the citizens from shooting each other and organizes them against those who *would* shoot them.

Also, I disagree most emphatically with Mr. Thomas Day. He says that "Surely it is common knowledge . . . that our government has earned a poor record in the human rights, world peace, and fair development of the world's resources department." Concerning the first two points: Garbage. With the possible exceptions of some of the countries in Europe, the United States has the best human rights record in the world. Ask the people in the Gulag Archipelago. Ask the firing-squad victims in Iran. Ask the prisoners in the prisons of Brazil. In fact, ask just about anywhere else. As for world peace, the U.S.'s main contribution to world peace is to be half of what keeps the U.S.S.R. from overruning the rest of the world. (The other half is the People's Republic of China—and *they* are checked by us as well.) And if you believe that the U.S. is checked by Russia and China, why don't we overrun part of Canada, Mexico, or Latin America every 15 years?

As for the third department, the "fair development of the world's resources" —I don't believe in fairness. Fairness means dividing up everything equally, e.g., kindergarten snacks policy or socialism. I do believe in *justice*. Justice means giving every man or organization what it earns. The men and organizations of the United States have produced more *per capita* than any other nation on Earth (with the exceptions of several small nations in the Middle East, according to Dr. Herbert Block's *The Planetary Product*, as quoted in the 1983 Hammond Almanac), and so justice dictates giving them more of the world's resources *per capita*. (Or, more accurately, giving them the money with which they purchase these resources.)

BOB CARRICO

Dear Stan,

Catching up on my *Analog*s, I just read John Gribbin's short story, "Double Planet" (September '84). It's nicely written and makes its point well. However, I do feel compelled to write with a few cavils. You are free to use them privately, or in the magazine.

First off, from the story protagonist's point of view there could not have been any "rendezvous" with Halley's Comet "back in 1986." The present international effort involves four small FLYBY

probes that will streak past Halley at tens of kilometers per second. In space-navigation parlance, "rendezvous" means actually matching orbits with the target, a far more difficult undertaking! (Proposals for a Halley rendezvous probe involved launching, years in advance, a solar-sail or solar-electric driven craft to loop about the sun many times before finally meeting the comet.)

True, Halley's 162 degree retrograde orbit makes this particularly difficult. But even if we allow the comet in Gribbin's story to be flying exactly in the ecliptic, and assume a carom past Jupiter stole lots of orbital energy, those astronauts would be in space an awful long time trying to catch that beast!

To be able to even get there, on as little warning as they had in the story, would demand very hefty technology. But then, once they arrive, the characters must actually "nudge" the comet nucleus—and begin after the double planet of Earth + Moon was already visible to the naked eye. This is HARD! Gribbin's comet is a monster, perhaps 100 times normal in size. You MIGHT divert such a behemoth, but only over a long period of push, push, push. . . .

Finally, I'm afraid Gribbin's intelligent discusion of atmospheric loss rates assumes a lot, like that gaseous equilibrium has been reached. It neglects the effects of solar ultraviolet, and the fact that the Moon's surface is naked to the solar wind.

But the critical point is right at collision. If the comet strikes faster than the speed of sound in Lunar rock, nearly all of the falling material will be blown right back into space. All those lovely volatiles will be lost unless luck is with them and the targeting is done exactly right.

All of this is not to detract from the nifty overall idea. (I have to think it's nifty. A related concept is part of my own comet story!) John is to be congratulated for spinning an entertaining and informative yarn.

By the way, I also very much enjoyed Marcia Martin's and Eric Vinicoff's moving short, "Winter Snow," also Michael Flynn's "Slan Libh."

DAVID BRIN ■

BIOLOG

(continued from page 129)

dioactive fallout. But the real bombshell to readers and future writers alike was a three-page delineation of the Heinlein "Future History" in which all the stories bearing his name were to be set. Since that day, nearly every SF writer has at least one future history series of his own.

Recognition of Robert's two-pronged contribution to SF came immediately, and he was Guest of Honor of the Third World Science Fiction Convention at Denver in 1941. Along with John Campbell, he is the only one to be a guest three times, in 1961 at Seattle and again in 1976 at Kansas City. After bringing slick writing into science fiction, he brought SF into the slicks with a series of Future History stories in *The Saturday Evening Post*, starting with the February 8, 1947 issue.

In a very real sense, Robert started the transformation of "mainstream" literature into science fiction, since SF is now so very popular. Indeed, huge book advances now make it uneconomic for many writers, including Robert, to appear any longer in magazines. The glory days of the slicks are now long gone, though *ASF* still continues as popular as ever, with readers practically life-long subscribers and *their* children often devoted subscribers, too.

All in all, Robert Heinlein built better than anyone ever expected with such stories as "—and He Built a Crooked House" (Feb., 1941). Since I read this story in a reprint anthology years later as a teenager, I don't think a day has passed without wondering where that house got to. Where science fiction has got to is pretty plain: it's all around us with Heinlein-inspired writing techniques and plot ideas. It's in the magazine you're holding right now. ■

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a calendar of analog upcoming events

1 June
ORCON 11 (central Florida SF conference) at Howard Johnson's Executive Center Hotel, Orlando, Fla. Guest of Honor—Andre Norton, Artist Guests of Honor—Kelly and Polly Freas, Fan Guests of Honor—June Hutchison and Joanie Stanco. Registration—$3.50 in advance, $4.50 at the door. Info: ESS@EFF Prod., Box 4514, Winter Park FL 32793.

3-6 June
Robots 9 Conference and Exposition at Detroit, Mich. Info: RI/SME Public Relations, 1 SME Drive, Box 930, Dearborn MI 48121. 313-271-1500.

7-9 June
HATCON 3 (Connecticut SF conference) at Ramada Inn, Danbury, Conn. Guest of Honor—Ian & Betty Ballantine. Registration—$25 until 1 April, $30 to 1 June, $35 at the door (limited to 350). Info: Connecticut SF Society, Kennedy Poyser, 108 Park Avenue, Danbury CT 06810. 203-743-1872.

14-16 June
LASTCON T'REE (Albany area SF conference) at Americana Inn, Albany, N.Y. Guest of Honor—Christopher Stasheff, Art Guest of Honor—Jack Gaughan. Masquerade, computers, video, hucksters, art, etc. Registration—$16 until 1 June, $18 at the door. Info: LASTSFA, Box 13002, Albany NY 12212.

21-23 June
DEEPSOUTHCON 23 (Southern regional SF conference) at Carriage Inn, Huntsville, Ala. Guest of Honor—Marion Zimmer Bradley, MC—Marta Randall, Artist Guest of Honor—Barclay Shaw, Fan Guest of Honor—Bob Sampson. Registration—$16 until 15 May, $20 thereafter. Info: DSC 23, Box 4857, Huntsville AL 35815.

21-23 June
SHADOWCON IX at Quality Inn at Los Angeles International Airport, Los Angeles, Calif. Guests of Honor—Fred Saberhagen, Robert McCammon. Registration—$20 until 15 May, $25 at the door. Carnival of Souls, Masquerade, etc. Info: ShadowCon, 8610A West Cermak Road, North Riverside IL 60546.

27-30 June
National SF Research Association meeting (academic) at Kent State University, Kent, Ohio. Registration—$40. Info: Donald Hassler, English Department, Kent State University, Kent OH 44242. 216-673-9164.

22-26 August
AUSSIECON II (43rd World Science Fiction Convention) at Southern Cross Hotel, Melbourne, Victoria, Australia. Guest of Honor—Gene Wolfe, Fan Guest of Honor—Ted White. Registration—$30 supporting; $60 attending (more at the door). 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: Aussiecon Two, GPO Box 2253U, Melbourne, VIC 3001, Australia (use airmail); Fred Patten, 11863 West Jefferson Blvd. #1, Culver City CA 90230 (membership info); jan howard finder, Box 428, Latham NY 12100.

30 August-2 September
NASFiC 1985 (North American SF Convention, officially The First Occasional Lone Star SF Convention & Chili Cook-off) at the Hyatt Regency Austin and Palmer Auditorium, Austin, Texas. Guest of Honor—Jack Vance, Artist Guest of Honor—Richard Powers, Fan Guest of Honor—Joanne Burger, TM—Chad Oliver. Registration—attending $35 until 31 December 1984, then $45; supporting—$15. Info: NASFiC, Box 9612, Austin TX 78766.

—Anthony Lewis

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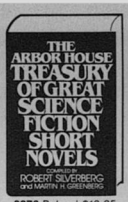

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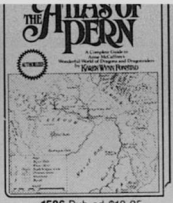

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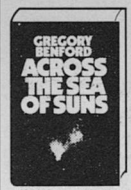

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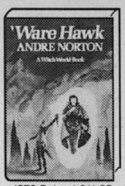

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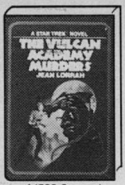

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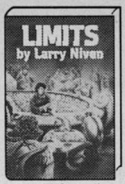

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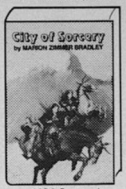

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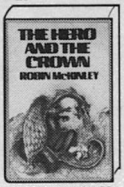

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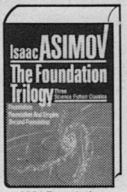

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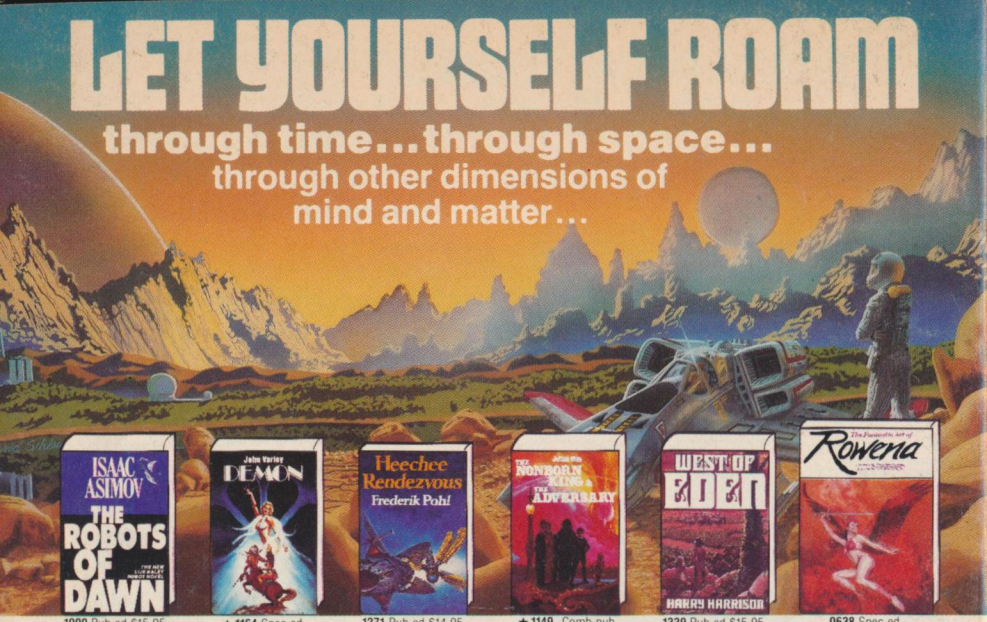

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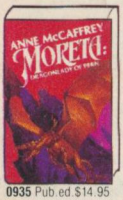

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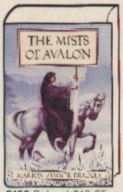

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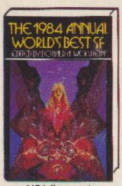

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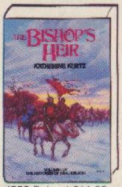

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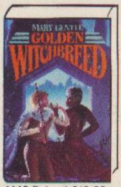

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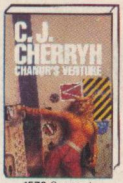

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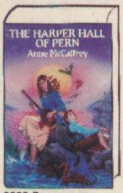

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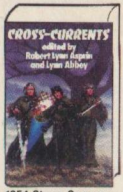

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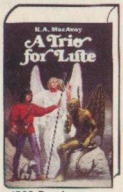

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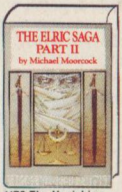

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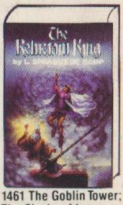

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