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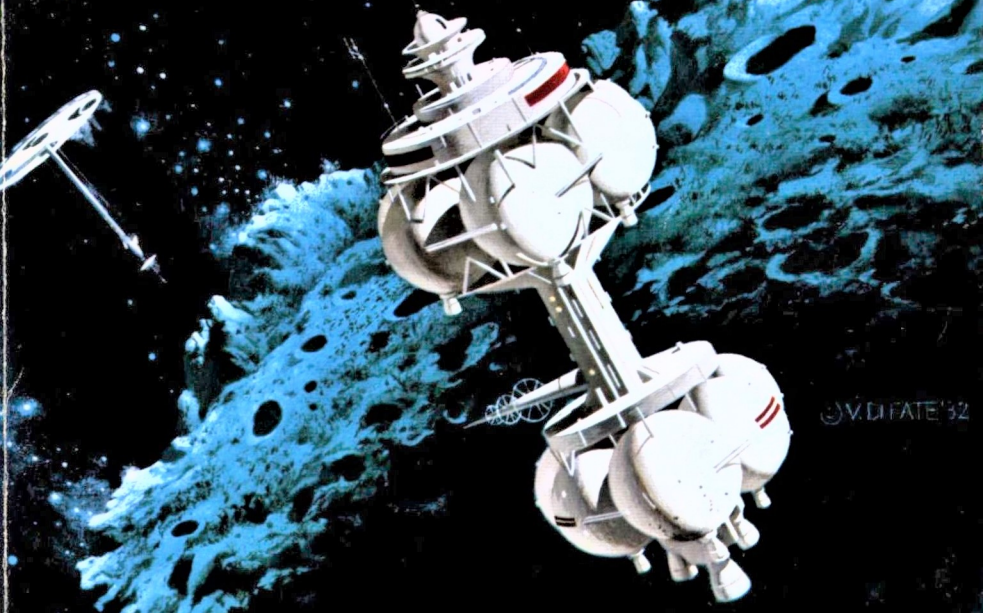

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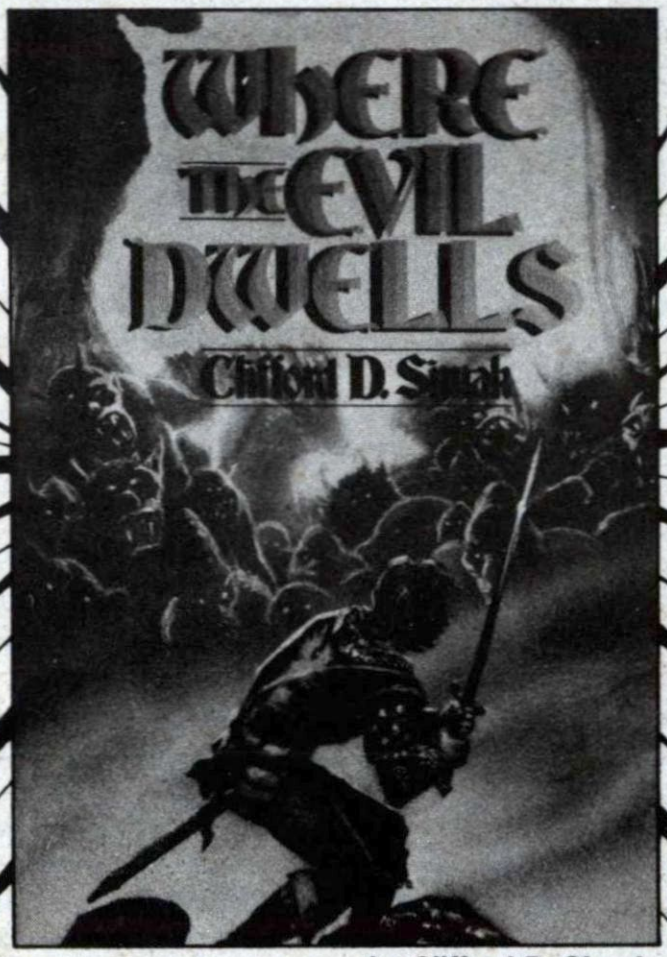

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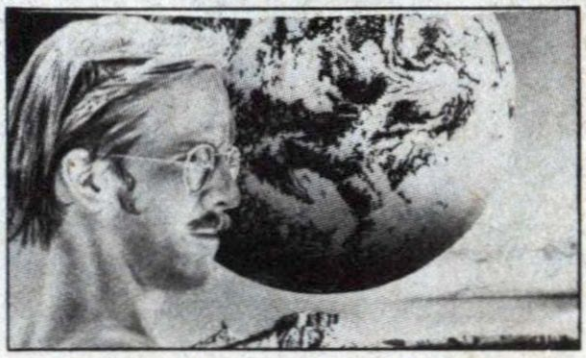

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Editorial by Stanley Schmidt

THE RELATIVITY OF EMERGENCY

By the time you read this, we'll be approaching the beginning of another winter; it will still be a comfortable distance away, but there will be reminders that it's coming.* *Last* winter (when this was written) was, in many places and in many respects, one of the more noteworthy in recent memory. A lot of places in North America had spells of record-breaking cold, with all the accompanying problems such as crop losses, engines that wouldn't start, frozen pipes, and snow and ice which made roads treacherous or even impassable. Though I haven't distributed a questionnaire to a good statistical sample, it seems to me that the level of complaint about the wintriness of last winter was pretty high all over (except around ski resorts).

That fact is rather interesting, if you think about it. I've learned that information gleaned from the news media must be interpreted warily, and it's sometimes helpful to supplement it with firsthand reports from known observers. During one short period last winter I talked to people in Minnesota and Georgia, and it seemed pretty clear that people in both places were experiencing comparable levels of inconvenience. Yet the conditions producing that inconvenience were very different. The parts of Georgia I was hearing about had a few inches of snow and temperatures between freezing and zero Fahrenheit. Minnesota had several *feet* of snow, much of which had arrived rather suddenly, and long runs of temperatures *way* below zero.

Yet the snow and cold emergencies in Georgia were no less real than those

**Yes, I know it's still summer. But if past years are any guide, the back-to-school sales have already started announcing themselves, and clearance sales on summer clothes. . . .*

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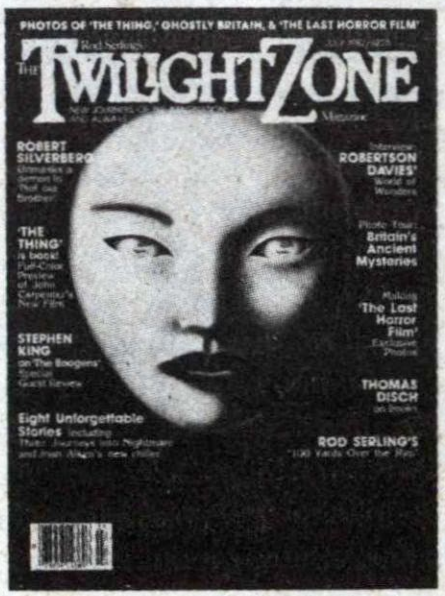
in Minnesota—and this is *not* to say that Minnesotans are "tougher" than Georgians. The severity of an emergency—whether a set of conditions is "critical" or "livable"—depends very largely on what you're used to and prepared for. Minnesota is used to cold and snow (though not quite that much). Cars there routinely carry lots of antifreeze, and highway maintenance departments are well equipped with snow removal equipment and surface treatment materials—because they need those things *every* winter. They still managed to have some problems because they got more than the usual that they had planned for. But they would have taken Georgia's problems right in stride; in Minnesota, I suspect, Georgia's harsh winter would have been shrugged off as "mild." But it was *not* mild in Georgia, because people there are accustomed to winters so much milder that they don't *own* much snow removal equipment and they don't budget much for salt and sand. When they're suddenly and unexpectedly faced with lots of snow to be cleared, there's not much to be done with the facilities on hand.

"Preparedness," of course, is a matter not only of equipment, but also of psychological attitude—and that can change fairly fast. In the middle latitudes where I've spent most of my time, I've noticed repeatedly that drivers and news media make a big fuss over the "extremely hazardous driving conditions" produced by a modest snowfall in November or December. By February, the same people will accept and cope with an identical storm with little fanfare.

Man evolved in the tropics, where food was readily available all year and insulation was seldom a matter of life and death. Technology—from fire and furs to air conditioning and airplanes—gradually enabled him to spread to a wider and wider range of previously uninhabitable places. Each stage of adaptation changed the limits of "routine." Millions of people now live in an area around New York City which could not sustain anywhere near that many without extensive technological support. These people live in a climate which would kill people without fire and warm clothing, and many of them commute every day over distances which would have been major expeditions for their not-very-distant ancestors. The process of adaptation to new environments has come a long way, and is continuing in places like Antarctica, the ocean bottoms, space, and other planets.

Of course, it works the other way, too. A technology which is perfectly adapted to one set of conditions may be disastrous under another—even under conditions which would be more survivable with *minimal* technology. Imagine, for example, a civilization in which last winter's extreme Minnesota conditions are the year-round norm. Such a situation might exist in the upper latitudes of a planet with little axial tilt in an orbit relatively far from its sun. Given adequate energy resources, human or humanoid civilization could flourish there, with a highly mobile population using snowmobiles as routinely as we use cars. Wheeled vehicles would be as scarce as snowmobiles in Florida. A prolonged warm spell which melted

Rod Serling's THE TWILIGHT ZONE Magazine



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the snow cover and introduced idyllic subtropical conditions might not wipe out *life* (directly), but it would certainly cripple *civilization*—because this civilization depends heavily on snowmobiles, and snowmobiles don't run well on bare ground. And if the dependence extends to the transport of food, life might well be threatened, at least for city dwellers.

Given this relativity of such concepts as "livable" and "emergency," we who speculate on faraway places may tend to be a little too hasty in deciding what sorts of planets are habitable. A species evolved on a planet more mild-mannered than ours might be even more so. (Remember Christopher Anvil's story, "The Gentle Earth"?) The key question about imaginable planets may not be *can* they be inhabited (either by native life forms or by human colonists), but *how* can they be inhabited? What would it take to sustain life and/or civilization there? What are the problems and *how could they be solved?*

Because the chances are, in a wider range of cases than we often assume, it can be done. And if it can be done, the chances are good that somebody, somewhere, has done it—or will do it.

A planet with weather too violent for civilization? Chronically disturbed weather, with extremes more extreme than those on Earth, might be expected on any planet with an axial tilt significantly greater than 23½ degrees. If the tilt is large enough, our terms "tropic" and "arctic" and "temperate" lose their accustomed meanings. You get regions combining the worst features of *both* tropic and arctic zones, alternately freezing through months of "Midnight Sun" and baking under months of tropic-high sun; large temperature gradients churn up violent currents in atmosphere and oceans—always. It doesn't sound appetizing, to us. But would it really be off limits to civilization? Or

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might its inhabitants just learn things we've barely imagined about how to build strong structures, to utilize wind power, to make things like ships which either can't capsize or go right on functioning if they do? Might they find Minnesota's climate as bland and monotonous as some American northerners find that of Florida or Arizona?

How about a planet where seismic and volcanic activity remained strong and widespread longer than they've done on Earth—a planet where earthquakes and volcanic eruptions were not remote possibilities or occasional disasters, but normal things to be lived with on a year-to-year basis, as we live with summer thunderstorms and six-inch snowfalls? Is civilization impossible in such a place? Or would it simply learn ways to hold itself steady on a bed of ever-shifting rock and to tap the plentiful supply of geothermal energy? What ways would it find, and what kind of social structure would grow up around them?

And what kind of opponent would such a culture be if we ever found ourselves in conflict with it?

It's worth remembering that most of us now live in places that our distant ancestors might have dismissed as uninhabitable. Most of our ancestors—even comparatively *recent* ones—lived their entire normal lives under conditions that we would consider "emergency." They managed. We have come to take long lives and low infant mortality and high personal mobility for granted; not even kings could expect them until recently. We can keep straight faces while applying the word "emergency" to con-

ditions which make coast-to-coast travel take two days instead of one—a trip which would have taken my great-grandparents many months of arduous labor, if they survived to finish it at all. But the system which has allowed us these luxuries is an artificial structure with fragile parts and linkages, and is therefore a potential liability as well as an asset. Conditions could change, for a wide variety of reasons. We could someday have to learn again to live with a different definition of "emergency."

It wouldn't be a bad idea for those of us in the business of imagining to spend some of our time looking for "impossible" situations—and figuring out how they could be rendered "possible" by those who had no alternative but to die.

Because to some, that alternative is not acceptable.

Meanwhile, we have another winter to look forward to—with high fuel bills and exhilarating ski slopes, icy roads and sugar-frosted forests, dead batteries and hot drinks by warm fires.

Enjoy! ■

● It took a century or so for an Englishman (to be more accurate, a Scot—Lord Acton) to recognize in this one sentence the flame of a quite new revolutionary doctrine: "...that to secure these rights, Governments are instituted among Men, *deriving their just powers from the consent of the governed.*"

Let us forget for the moment (what we make a habit of forgetting today) the implication that there may be unjust powers—responding to the injustice of life itself—in which the governed have no say. But the idea that if you felt you were being unjustly governed, you...had some "right" to resist or overthrow the government: this was a firebrand that was to blow up...the whole idea of empire. We have come to accept this right, and...we can make one fairly certain generalization about the cause of revolutions: when the people in power can neither keep the consent of the governed nor keep *down* the dissent of the governed, then there will be a blowup.

Alistair Cooke,
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Running & Fitness Day, October 9, 1982


Why would an ultrafast, deep-space ship like the Hoatzin be commandeered by an agency whose concerns were obviously agricultural?
Vincent Di Fate

Charles Sheffield

THE MANNA HUNT

We had been working hard for two months, preparing for the first long trip. Neither McAndrew nor I would admit to feeling excited, but every day I could see the pleasure and anticipation just bubbling up in him. I doubt that I was any harder to read.

It meant sixteen-hour work spells, day after day, checking every detail of the ship and mission. On an exploration that would take us away for four months of shipboard time and almost nine years of Earth-time, all the thinking had to be finished before we left the Institute.

Finally the launch date was only four days away.

That made the news of cancellation —when they plucked up the courage to tell us about it—hard to take.

I had been over on the *Hoatzin*, checking the condition of the big mass-plate at the front of the ship. It took longer than I expected. By the time I flew my inspection pod on its ten-thousand-kilometer hop back to the Penrose Institute we were well into the sleep period. I hadn't expected anyone in the dining hall when I slipped in to dial a late meal—and certainly I didn't expect to find Professor Limperis, the head of the Institute, in close conversation with McAndrew.

"Working late—" I said. Then I saw their faces. Even Limperis, coal-black as he was, looked drawn and a shade paler.

I sat down opposite them. "What's happened?"

McAndrew shrugged without answering and jerked his head towards Limperis.

"We've had a directive from U.S.F. Headquarters," said the older man. He seemed to be picking his words carefully. "Signed by Korata—right from the top. There was a meeting last week between the Food and Energy Council of Earth and the United Space Federation. They called me two hours ago. The Penrose Institute is instructed to support certain high-priority Council activities. This requires that we—"

"They've cancelled us, Jeanie," cut in McAndrew harshly. "The bastards. Without one word of discussion with anybody here. Our Alpha Centauri mission is dead—*finito*."

I gawped at Limperis. He nodded in an embarrassed way.

"Postponed, at least. With no new date set."

"They can't do that." I was beginning to feel my own anger rising. "The Institute doesn't answer to the Food and Energy Council; how the hell can they claim to order you around? This is an independent organization. Tell them to go away and play with themselves. You have the authority to do that, don't you?"

"Well . . . " Limperis looked even more embarrassed. "In *principle*, Captain Roker, it is as you say. I have the authority. But you know that's an oversimplification of the real world. We need political support as much as any other group—we rely partly on public funding. I like to pretend that we're pure research, answering to no one. In practice, we have our own political constituency in the councils. I tried to explain this just now"—McAndrew grunted and glowered down at the table— "to point out why I can't really fight it without losing an awful lot. Three of our big supporters, councillors who've done us

big favors in the past, called me ten minutes after we got the first word. They want to use their credit on this one. The Alpha Centauri mission is off. The council needs the use of the *Hoatzin* for other purposes."

"*No way.*" I leaned forward until our faces were only six inches apart. "That's our ship—we've slaved over it. If they think they can call in and take it away from me and Mac without even asking us, and leave us—"

"They want you, too, Jeanie." Limperis leaned back a bit. In my excitement I was spitting all over him. "Both of you. The orders are very clear. They want you and McAndrew *and* the ship."

"And what the hell for?"

"For a mission of their own." He looked baffled. "For a mission so secret they wouldn't tell me anything about it."

That was the first shock. The others dribbled in one by one as McAndrew and I made our way from the Penrose Institute to the headquarters of the Food and Energy Council.

The Institute had been parked out near Mars orbit. With the *Hoatzin* and its hundred-gee drive, or even with one of the prototypes like *Merganser* at fifty gee, we could have been to Earth in half a day. But Professor Limperis insisted that the McAndrew Drive should never be employed in the inner system, and McAndrew himself backed that decision completely. We were stuck with a slow boat and a ten-day journey.

Surprise Number One came soon after we powered away from the Institute. I had assumed that we would be running a confidential mission for the *Energy* Department of the full Food and Energy Council. I had worked on high-energy projects with McAndrew in the past, and I knew he was a real expert on the subject. But our travel documents instructed us to report to the *Food* Department. What did food programs need with a theoretical physicist, a spacecraft captain, and a high-acceleration ship?

Three days from Earth we were hit with another surprise. The information came in as a brief, impersonal directive that could be neither amplified nor questioned. I would not be the captain of the new mission. Despite the fact that I had more experience with the McAndrew Drive than anyone else in the system, a Food Department official would give me my orders. I became even angrier when, two days from Earth, we learned the rest of it. McAndrew and I would serve as "special advisors" reporting to a crew from the Food and Energy Council. We would have about as much decision-making authority on the mission as the robochef. I had descended from captain to cabinboy.

For me, maybe they could persuade themselves that it was a reasonable decision—some people have more deep space experience than I do (but not much more) and you could say that my talent is nothing more than tricks for staying alive and out of trouble. But McAndrew was another matter. According to his colleagues, he's the greatest combination of experimental and theoretical talent since Newton. His theories revolutionized our ideas on gravity and collapsed matter, and his practical tinkerings have converted abstract ideas to everyday use. To assign him a role as a simple information source sug-

gested an ignorance or an arrogance beyond my belief.

(All right, so I'm a McAndrew fan; I won't deny it. When I got to Earth I would have words with the bureaucrats of the Food Department.)

I needed to talk it out with somebody, but Mac was no use. He wasn't interested in arguments on non-technical subjects. Instead he retreated into his private world of tensors and twistors, and despite my own respectable background in gravitational and electrical engineering I couldn't follow him there. For most of the journey he sat slack-jawed on his bunk, perfectly content, gazing at the blank wall and performing the invisible mental gymnastics that had earned him his reputation.

That sort of thinking is beyond me. I spent my time brooding, and by the time we were led into the council's offices I was loaded for bear.

The Food Department enjoys a bigger staff and budget than anything else in System government, and the opulence of its fittings was quite a contrast to the spartan furnishings of the Institute. We were conducted through four luxurious outer offices, each with its own secretaries and screening procedure. Ample working space spoke of prestige and power. The room we finally came to held a conference table big enough for forty people.

A woman was seated alone at the massive desk. I looked at her elegant dress, beautifully made-up eyes and carefully coiffured hair, and I suddenly felt scruffy and out-of-place. Mac and I were dressed for space work, in one-piece beige coveralls and loafers. My hair had been cropped to a few centimeters long. His thin, straggly mop as usual dipped untidily over his high forehead. Neither of us was wearing a touch of make-up.

"Professor McAndrew?" She stood up and smiled at us. I glowered back at her. "And Captain Roker, I assume. I must apologize for treating you in such cavalier fashion. You have had a long trip here, and no adequate explanation."

Good disarming waffle, the sort you get from an experienced politician or the highest level of bureaucrat, but her smile was broad and friendly. She came forward and held out a pudgy hand. As I took it I made a closer inspection of her appearance: thirty-five years old, maybe, and a bit overweight. Perhaps this messy situation wasn't her fault. I restrained my scowl and muttered conventional words of greeting.

She gestured us to sit down.

"I am Anna Lisa Griss," she went on. "Head of Programs for the Food Department. Welcome to Headquarters. Other staff members will join us in a few minutes, but first I want to point out the need for secrecy. What you will learn here cannot be mentioned to anyone outside this room without my permission. I will come to the point at once. Look at this."

She exuded an air of complete control. As she was speaking, the lights dimmed and an image became visible on the screen at the far end of the room. It showed a column of calendar years, and alongside it two other columns of figures.

"Total system food reserves, present and projected," said Griss. "Look at the trend—it's a log scale—then look

particularly at the behavior thirty years from now."

I was still trying to assimilate the first few numbers when McAndrew grunted and put his hand up to his face.

"That's ridiculous," he said. "You're showing a factor of two drop in less than three decades. What's the basis for that projection?"

If she felt surprise at his speed of response, she didn't show it. "We included population patterns, available acreages, plant yields, and capacity to manufacture synthetics. Would you like to see the details on any one of them?"

McAndrew shook his head. "Never mind the details. That's disaster and starvation flashing on your screen."

"It is. It's the reason that you are here." She brought the lights back up to what I regarded as a dim, conspiratorial level and dropped her voice to match. "You can imagine the effect if that projection became public knowledge. Even though we're talking about many years in the future, we'd see stockpiling—probably food wars."

"But if you're correct in your projections, you can't keep this a secret," I said. "People have a right to know so they can work on solutions."

McAndrew frowned at me, while Anna Lisa Griss gave me a quick probing glance (no smile now) and raised her dark eyebrows. The man's easy, her look said, but this one needs persuading.

"The problem is clear enough," she agreed. "It has been known to my group for almost a decade. As for solutions, we have looked at all of them. Involving the general public would provide no new insights."

I didn't like her superior manner, but in spite of my irritation I was becoming interested. "It has to be a supply-side answer," I said. "The population growth won't budge."

"Obviously." She smiled again, a bit too broadly, and sneaked a look at her watch. "But think about that supply side. We'd like to increase the planted acreage, of course. But how? We're using every spare inch, unless we can move the lunar agricultural experiments to massive production—and nobody feels optimistic about that. Plant yields are as high as they will go—we're seeing bad effects of plant overbreeding already. No hope there. So what's left?"

Before we could chance an answer or she could provide one, the door behind us opened. A skinny man with plastered-down grey hair entered and stood deferentially at the threshold.

"Come in, Bayes." Anna Lisa Griss looked again at her watch. "You're late."

"Sorry." He remained at the door, hesitating.

"I began without you. Come in and sit down." She turned to face us without offering introductions. "There was one area still to be examined: alternative supplies of organic materials that might easily be converted to food. Six years ago, everyone thought that was a hopeless avenue. Now, with the Griss-Lanhoff Theory"—I could hear the capital letters in her voice as she proclaimed the name—"we have new hope."

I was watching Bayes's face as she spoke. His lips tightened when Anna Lisa Griss pronounced the name of the theory, but he remained silent.

McAndrew cleared his throat.

"I'm afraid that I'm not as well up on the literature of food production as I ought to be," he said. "Lanhoff's a familiar name. If it's the same person, I knew him fairly well ten years ago, when he was working on porphyrin syntheses. What's he doing now?"

"We don't know. Maybe you can help us to find out." She leaned forward and looked at us intently. "Lanhoff has disappeared—out in the Halo, testing our theory. Two weeks ago I learned that you have available a high-acceleration ship with an inertialess drive." (I saw McAndrew wince and curse to himself—twice a day he has to explain to somebody that it's not inertialess.) "We need the use of that, for a mission of the highest priority. We have to find out what happened to Lanhoff's project. Three days from now we must be on our way to the Halo."

It said something for the lack of efficiency of the Food Department that they would drag McAndrew and me all the way to Earth for a meeting, then shuttle us back to the Penrose Institute and the *Hoatzin* on a government-owned ship less than four hours after we arrived. Anna Lisa Griss would follow to the Institute in another and even fancier vessel, but Bayes went with us to continue the briefing on the way. Without his boss around he lost his intimidated look and became a much cheerier person.

"Let's start with Lanhoff's ideas," he said. "Though after listening to Anna back in her office it's apparently going to be called the Griss-Lanhoff Theory, at least while Lanhoff's not on the scene. I'll keep it short, but I'm not sure where to begin. In the Halo, I guess. Professor McAndrew, do you know anything about the Halo?" He cackled with laughter at his joke.

Griss had asked McAndrew that same question when she was giving us our first briefing. I had watched Bayes's eyes bulge with astonishment. I felt the same way myself. McAndrew probably knew more about the Halo and the outer parts of the extended solar system than anyone, living or dead—he had developed the entire theory that predicted the existence of the kernel ring, the broad belt of Kerr-Newman black holes that girdles the ecliptic at four hundred a.u., ten times the distance of Pluto, and he had travelled out there himself, in the first test of the McAndrew balanced drive. I assumed that any scientist worth the name would know all about McAndrew and his work, but apparently Anna Lisa Griss proved me wrong.

McAndrew laughed. He and Will Bayes had needed only ten minutes alone together to discover a mutual fascination with bad jokes, and they were getting along famously. I thought ahead to a long trip with the two of them and shuddered at the prospect.

"Lanhoff wandered into our offices six or seven years back," went on Bayes after he had had a good giggle at his own wit. "He'd been analyzing the results of Halo remote chemistry probes. Didn't you do some of that yourself, a few years ago?"

McAndrew rubbed at his sandy, receding hairline. "Och, just a little bit. I wanted to find power kernels, not low-density fragments, but as part of the survey we sneaked in a look at some other stuff as well. Most of the Oort

cloud's so poorly surveyed, you know, it's a crime not to explore it whenever you have the chance. But I never looked out more than a few hundred a.u.—it was before we had the drive, and probes were too expensive. I'm sure Lanhoff had all my results to work with when he started."

"He certainly knew your work," said Bayes. "And he remembered you well. You made quite an impression on him. He's an organic chemist, and he had been looking at all the data on the Halo, and plotting body chemical composition as a function of distance from the Sun. He has a special algorithm that allows him to look at the fractional composition of each object—I think it came from Minga's team. You probably don't remember Minga; he never published much himself. I met him once or twice, way back . . . no, maybe I'm thinking of Rooney. You know, he was the one who did the high-energy work, I think it was for the Emerald Project, wasn't it? Yes, I think so. . . ."

It's probably a kindness if I edit Will Bayes's briefing of McAndrew and me. He tried hard enough, but everything he said reminded him of something else, and that something-else had to be explained too, and all the people involved in it reminded him of other people, and what they had done. Regression, *ad infinitum*.

We didn't mind too much, with a two-day journey before we were back at the Institute, but I must say I thought a bit more kindly of Anna Griss before the trip was over. Staff meetings with Bayes must be hell.

Boiling Will's verbiage down to a minimum, it was a simple story: Lanhoff had done a systematic chemical analysis of the cometary Halo, from its beginnings not far past the orbit of Pluto, all the way to the fading outer edge nearly half a lightyear away, where the Sun's gravitational hold is so weak that the frozen bodies drift around in orbits with periods of millions of years.

That's the Oort cloud, a great ball of loosely held matter centered on the Sun. There are several hundred billion comets out there, ranging from near-planet-sized monsters a few hundred kilometers across to snowballs no bigger than your fist. Chapman's Rule applies as well to the cometary Halo as it does to the asteroid belt: for every object of given diameter, there are ten objects with one-third of that diameter.

The Halo has been described and studied since the middle of the twentieth century, but Lanhoff's interests were different. He divided the solar vicinity into regions, of different distances and inclinations to the plane of the ecliptic, and he looked at the percentage of different organic materials within each orbital regime. Naturally, with a trillion objects to work with he could only look at a tiny sample of the total, but even so the analysis took him eight years. And he found something new and surprising. In a part of the halo about 3200 a.u. from the Sun, running out to maybe 4000 a.u., the complexity of chemical compounds increases enormously. Instead of simple organic molecules like cyanogen, formaldehyde, and methane, his program told him he was finding higher compounds and complex polymers—macromolecules like polysaccharide chains.

"Like what?" At that point in the

discussion I had interrupted Will Bayes's ramblings. Organic chemistry is low on the list of educational priorities for controlling a spacecraft.

"Organic polymers," said McAndrew thoughtfully. He had been frowning hard as Bayes talked of the chemical composition. "Chains of glucose molecules, to make starches and cellulose." He turned back to Bayes. "Did Lanhoff find any evidence of porphyrins, or nitrogen compounds like purines and pyrimidines?"

Bayes blinked. "You seem to know all about this already. Did Anna already brief you? Lanhoff's work is all supposed to be a big secret."

I had some sympathy for him. Briefing McAndrew is an unrewarding experience. At the end of it he seems to know everything you know and be able to apply it better. Now he was shaking his head and looking puzzled.

"She didn't mention any of this to us. But I knew most of it years ago. Not the particular place in the Halo where we might find complex organic materials, but at least the fact that they might be there. It's not a new theory at all. Hoyle suggested it more than a hundred years ago. I just don't understand why there's anything secret about it. A finding like this one ought to be available to anyone."

"There's a reason. Wait until you know Anna Griss a bit better and you'll understand." Bayes was looking outside for his first glimpse of the *Hoatzin*, which was now only a couple of hundred kilometers away. "She's the hardest worker I know, but she's super-ambitious. She wants to run the whole council someday—tomorrow, if she had her way. When Lanhoff came to her with his proposal, the first thing she did was hit it with a classified label."

"Didn't anyone argue with her?" I said.

"No. Try it. It's not something you'll want to do more than once. There were a few mutterings, that was all. Anna offered some positive incentives, too. She thinks this will make her famous, and push everybody in the department ten rungs up the management ladder."

"Just because we've got a bit more information about the composition of the Halo? Not much chance of that." McAndrew snorted his disbelief.

"No." Bayes was still peering out of the port. "Lanhoff persuaded her that he had the only answer to the System food problem. All he needed was money and a ship, and U.S.F. permission to make some orbit changes to a few bodies out in the Halo. Good God!" He turned back from the scope. "There's the oddest-looking ship out there. Surely we're not proposing to chase after Lanhoff in that thing?"

Lanhoff's suggestion sounded reasonable until you sat down to think about it. Out in the Halo, off where the Sun was nothing more than an extra-bright star, mountains of matter drift through space, moving to the tug of a faint gravitational current. Most of them are frozen or rocky fragments, water-ice and ammonia-ice bonding metals and silicates. But swarms of them, in a toroidal region three hundred billion miles from Earth, are made of more complex organic molecules. If Lanhoff were correct, we would find an endless supply of useful compounds there—all the pre-

biotic materials from which foodstuffs are easily made. They needed only warmth and a supply of the right enzymes to serve as catalytic agents. Cellulose, polypeptides, carotenoids, and porphyrins could be transformed to sugars, starches, proteins, and edible fats. The food supply of the whole system would be assured for a million years.

Now sit down and think about it again. How do you seed a hundred million worlds and turn them to giant candymountains, when the nearest of them is so far away? How do you heat them; how do you get them back where they will be useable?

If you are Arne Lanhoff, none of those questions will deter you. The enzymes you need are available in small amounts in the inner system; once a body has been seeded and heat is available from a fusion reactor, enzyme production can proceed at an explosive pace. It will suffice to begin with just a few hundred thousand tons of the right enzymes, and make the rest where the supply of raw materials is assured. The types of enzymes needed to split polymer chains are well known, but the only sort of ship that can carry this much load is a boost-and-coast vessel with a maximum short-duration acceleration of only two-tenths of a gee. So be it. Plan on a trip out to the Halo that will take a couple of years, and allow another year or two to trundle around from one cometary body to the next, seeding and performing necessary orbital adjustments. The continuous-thrust engines that will be attached to each body add another two million tons to the ship's initial payload. So be it. Fusion heaters to warm the frozen interiors will add a million more. Don't worry about it. For a project of this size and importance, the Food and Energy Council will find the money and equipment.

McAndrew had shaken his head when Will Bayes described the plan to place the seeded bodies into radial orbits, thrusting in toward the Sun. "Man, do you realize we'll be trying to catch a billion tons travelling at two thousand kilometers a second?"

"Arne Lanhoff knew that before he left. He was planning just enough drive to bring them to the inner system in twenty years. By that time they'll be warmed and transformed in context." Bayes smiled contentedly. "He felt sure that you'd find ways to catch them and slow them. It's the sort of thing your group finds challenging."

"Challenging! He's insane." But two minutes later McAndrew was miles away, working on this new puzzle.

The ship that had left the Inner System four years ago did so with no fanfares or publicity. The *Star Harvester* was a massive set of linked cargo spheres with electromagnetic coupling. Each section had an independent drive unit powered by its own kernel. It was quite similar to the assembly that I used to pilot on the Earth-Titan run, and I was glad to know that I'd have no trouble handling it if the need arose.

That need might well arise. The Food Department had received regular communications from the *Star Harvester* crew during the long trip out—two years Earth-time, and the ship was too slow to make it noticeably shorter in shipboard time. Lanhoff had finally reached his first suitable target, a fifteen-kilometer chunk of ice and organics. He had

officially named the body *Cornucopia*, planted the enzyme package, the fusion furnace, and the drive, and then started it on the long drop in towards the Sun. Without the drive it would fall for millennia. With a little continuous-thrust assistance *Cornucopia* would be crossing the orbit of Jupiter sixteen years from now. By that time it would be a fertile mass of the raw materials of nutrition, enough to feed the system for five years.

"No problems. Complete success in all phases," read Arne Lanhoff's message as they moved on to the next selected target, a mere five hundred million miles away.

The mission had operated perfectly for another five targets—each one named, processed, and directed toward the inner system. *Ambrosia; Harvest Festival; Persephone; Food of the Gods;* and *Demeter*.

Then the pattern was broken. The seventh target had been reached ninety days ago. After an initial message announcing contact with the body *Manna*, a huge organic fragment sixty kilometers in length and incredibly rich in complex compounds, *Star Harvester* became inexplicably silent. A message of inquiry beamed to it from Oberon Station fled off on its nineteen-day journey, and an automatic signal of message receipt finally returned. But no message originated in the ship's transmission equipment. Arne Lanhoff and his crew of four had vanished into the void, three hundred billion miles from home.

Our troubles didn't wait until we were out in the Halo. As soon as Anna Lisa Griss arrived on board the *Hoatzin*, only six hours before our scheduled departure time, we had a problem. She looked around the living quarters disbelievingly.

"You mean we're supposed to stay in this little space—all of us? It can't be more than three meters across."

"Three and a half." I paused in my runthrough of firing sequence checks. "We left information about that with you before we came here—didn't you look at it?"

"I looked at the size of the ship, and the column for the living quarters was hundreds of meters long. Why can't we use all of it?"

I sighed. She had the authority to commandeer the *Hoatzin*, but had never bothered to learn the first thing about how it operated.

"The living-capsule moves up and down that column," I said. "Nearer or closer to the mass disk, depending on the ship's acceleration. We can put the supplies outside the capsule area, but if we want to live in a one-gee environment we're stuck with this part—it's not bad, plenty of space for four people."

"But what about my staff?" She gestured at the five people who had followed her into the *Hoatzin*. I realized for the first time that they might be more than mere carriers of luggage.

"Sorry." I tried to sound it. "This ship is rated for a four-person crew, maximum."

"Change it." She gave me the full force of her imperial manner. I suddenly understood why Will Bayes chose not to argue with her.

I stared back at her without blinking.

"I can't. I didn't make that rule—check with the U.S.F. back at Lunar

Base if you like, but they'll confirm what I'm telling you."

She took her lower lip between her teeth, turned her head to survey the cabin, and finally nodded. "I believe you. Damnation. But if there is a four-man limit we still have a problem. I need Bayes and I want my own pilot. And I need McAndrew. You'll have to stay behind."

She didn't look at me this time. I took a deep breath. I didn't want to do it, but if we were going to bang heads we might as well get it over with—now was as good a time as any.

"I suggest that you discuss this with McAndrew," I said. "Better talk to your pilot, too, while you're at it. I think you'll find that Mac will refuse to go along without me—just as I wouldn't go without him. This is not a conventional vessel. Ask your own pilot how many hours of experience he has with the McAndrew Drive. Mac and I have essential experience and skills for the successful performance of this mission. Take your pick. Both, or neither."

My voice sounded trembly. Instead of replying she turned to head for the steps to the lower level of the living-capsule.

"Prepare us for departure," she said over her shoulder as she went. Her voice was so calm that I was shocked by my own tension. "I will talk to Bayes. He must assume additional duties on this project." She turned again when just her head and shoulders were visible. "Did you ever consider taking a job down on Earth? You have abilities that are wasted out here in the middle of nowhere."

I swivelled my chair to face the console screen and wondered what sort of victory I had won—if any. Anna Lisa Griss was wise in the ways of political infighting, while I was a raw novice. But I was damned if I'd give up my place on this trip without a struggle. The ship was easy to handle, but I'd never admit that to Anna Griss.

Will Bayes came in to stand beside me while I was still having trouble getting my attention back to the status reports.

"Now you've done it," he said. "What did you say to her? I've never seen her in such a weird mood. I can't read her at all. She just told Mauchly and the rest of her staff to get back to headquarters—no explanation. And I've been given double duty for the duration."

I ran the trajectory parameters out onto the screen, jabbing viciously at the buttons. Then I gave him a quick sideways glance. "I had to make a choice. Which would you rather have: Anna Lisa Griss in a peculiar mood, or a ship run by people who don't know the McAndrew Drive from a laser-sail?"

He grunted and stared gloomily at the screen. "It's not an easy decision. You've never seen Anna when she's really annoyed. I have. Let me tell you, it's not something I want to go through again." He leaned forward. "Hey, Jeanie. Surely that's not the plot of our flight out you've got there on the display."

"It certainly is." I rotated axes so that all coordinates were in ecliptic spherical polars and stored the result. "Don't you like it?"

"But it looks so *simple*." He moved his finger along the screen. "I mean,

it's just a straight line. Not a real trajectory at all. What about the Sun's gravitational field? And you're not making any allowance for the movement of *Manna* while we're flying out there."

"I know." I loaded the flight profile to main memory, and as I did so the knot in my stomach seemed to loosen. "That's why I'll be piloting this ship, Will, rather than one of your buddies. We'll be accelerating away from the Sun at a hundred gee, agreed? Did you know that the Sun's acceleration on us here near Mars orbit is only one three-hundred-thousandth of that? It has tiny effects on our motion."

"But what about *Manna*'s movement in its orbit while we're on the way there? You've ignored that as well."

"For two reasons. First, *Manna* is so far out that it's not moving very fast in its orbit—only half a kilometer a second. More important, we don't know how far Lanhoff's team went in processing *Manna*. Is the body in its original orbit, or did they start it moving in toward the Sun?"

"I've no idea."

"Nor have I. The only thing we can do is fly out there and find out."

I looked at the clock. Time to get moving. "Better say your goodbyes," I went on. "There'll be plenty of chances for us to talk to each other in the next couple of weeks. Probably too many. Two hours from now we'll be on our way. Then we'll be deaf to outside signals until we're out in the Halo and turn off the drive."

"Is that so?" He looked intrigued. "But what about orders that come—"

"Bayes!" Anna Griss was calling softly from below.

Will was gone before I could swivel my chair.

I don't envy the life of the Downsiders, ten billion of them crawling over each other looking for a little breathing space. But there are certain experiences available on Earth and nowhere else in the solar system.

For instance, I'm told that during the great circular storms that sweep from the Earth tropics to the northern latitudes, there is an area at the very center—the "eye of the hurricane" as the Downsiders call it—where the wind drops to perfect stillness and the sky overhead turns to deep blue. That's something I'd like to see, just once.

The eye of the hurricane. That was the area of the living-capsule surrounding McAndrew during the *Hoatzin*'s flight out to rendezvous with *Manna*.

With me, Anna Griss was in constant battle.

"What are you talking about, no messages?" she said. "I have to be in daily contact with headquarters."

"Then I'll have to switch off the drive," I explained. "We can't get signals through the plasma shell."

"But that will slow us down! I told headquarters that we'd only be away for one month—and it's a two-week trip each way even if we keep the drive on all the time."

We were standing by the robochef and I was programming the next meal. It took a few seconds for her last statement to penetrate.

"You told headquarters *what?* That we'll only be away for a month?"

"That's right. Three days should be long enough to find out what's happen-

ing to *Star Harvester*. You said that yourself, and McAndrew agreed."

I turned to face her, noticing again the care she took to make her appearance as well-groomed and attractive as possible.

"Three days should be long enough, sure it should. But you'll be away for a lot more than a month. The trip is two weeks each way *in shipboard time*. It's twenty-five days each way in Earth time. There's no possible way you can get back home in a month."

Her face flushed red and her eyes glowed—she looked more attractive than ever. "How can that happen?"

"I don't know, but it's standard physics. Ask McAndrew." (I knew well enough, but I'd had more than I wanted of this conversation).

It was like that all the time. We found it hard to agree on anything, and it became clear as soon as we were on the way that Anna Griss was used to delegating and not to doing. Poor old Will Bayes did triple duty. Luckily there was not too much that *could* be done without a communications link to Earth—except shout at Will and keep him on the run.

Yet McAndrew—I thought at first I was imagining it—McAndrew was the eye of the hurricane. When she was within two yards of him, Anna Griss became all sweetness and light. She humbly asked him questions about the drive and about time dilation; she deferred to his opinions on everything from diet to Dostoevsky; and she hung first on his word and then on his arm, blinking her eyelashes at him.

It was sickening.

And McAndrew—the great lout—he lapped it up.

"What's she *doing?*" I said to Bayes when the other two were out of earshot. "She's making a fool of herself."

He winked at me. "You think so, and I think so—but does he think so? Before we left she told me to get a full dossier about him and bring it on this trip. She's been reading it, too. You have to know Anna. What she wants, she gets. Wouldn't look bad for her personal records, would it, to have a five-year cohab contract with the most famous scientist in the system?"

"Don't be silly. She doesn't even like him."

"She does, you know." He stepped closer and lowered his voice. "I know Anna. She has appetites. She wants him, and I think she'd like a cohab contract."

I snorted. "With Mac? That's ridiculous! He belongs to—to science." And I fully believed it, until one morning I found myself applying a pheromonal amplifier behind my ears, and dressing in a new lime-green uniform that fitted a lot closer than my standard garb.

And McAndrew—the great lout—he never noticed or said one word.

While this was going on, we were hurtling outward away from the Sun. With our acceleration at a hundred gee, the living-capsule was snuggled in close to the mass-plate. The plate's gravitational attraction just about balanced the body force on us produced by the ship's acceleration, leaving us in a comfortable and relaxing half-gee environment. The tidal forces caused by the gravity gradient were noticeable only if you looked for them. McAndrew's vacuum drive worked flawlessly, as usual, tapping the zero point energy—"sucking the mar-

row out of spacetime," as one of Mac's colleagues put it.

"I don't understand," I'd once said to him. "It gets energy out of nothing."

McAndrew looked at me reproachfully. "That's what they used to say in 1910, when mad scientists thought you might get energy from the nucleus of an atom. Jeanie, I thought better of you."

All right, I was squelched—but I didn't understand the drive one bit better.

At the halfway mark we rotated the ship to begin deceleration and I cut the drive while we did it. Anna Griss had an opportunity to send her backlog of messages, and finally gave Will Bayes a few hours of peace. I was amused to see that her communications gave the impression that she was running everything on the *Hoatzin*. Her increased absence from headquarters she attributed to delays on the trip. If the level of scientific expertise in the Food Department matched her own she would probably get away with it.

For me, this should have been the best part of the mission, the reason that I would remain in space and never look for a Downside job. With the drive off we flew starward in perfect silence. I stayed by the port, watching the wheel of heaven as the ship turned.

The *Hoatzin* was within five percent of lightspeed. As we performed our end-over-end maneuver, the colors of the starscape Doppler-shifted slowly from red to blue. I caught a last glimpse of Sol and its attendants before the mass-plate shielded them from view. Jupiter was visible through the optical telescope, a tiny point of light a fifth of a degree away from the Sun's dazzling disk. Earth was gone. Its reflected photons had been lost on their hundred-and-fifty-billion-mile outward journey.

I turned the telescope ahead in a hopeless search for *Manna*. It was a speck in the star-sea, as far ahead of us as the Sun was behind. We would not detect its presence for another two weeks. I looked for it anyway. Then the shield came on to protect us from the sleet of hard radiation and particles caused by our light-chasing velocity. The stars blinked out. I could pay attention again to events inside the *Hoatzin*.

With little else to occupy her attention, Anna delegated her chores to Will Bayes and concentrated everything on charming McAndrew. Will and I received the disdain and the dog work. I sat on my anger and bided my time.

As for Mac, he had disappeared again inside his head. We had loaded a library of references on Lanhoff and the organic materials of the Halo into the computer before we left the Institute. He spent many hours absorbing that information and processing it in the curiously structured personal computer he carries inside his skull.

I knew better than to interrupt him. After just a couple of futile attempts to divert him, Anna learned the same lesson. No doubt about it: she was quick. No scientist, but when it came to handling people she did instinctively what I had taken years to learn. Instead of social chit-chat, she studied the same data that McAndrew had been analyzing and asked him questions about it.

"I can see why there ought to be a lot of pre-biotic organic stuff out in the

Halo," she said, during one of our planned exercise sessions. She was dressed in a tight blue leotard and pedaling hard at the stationary cycle. "But I never did follow Lanhoff's argument that there may be primitive life there, too. Surely the temperature's too cold."

It was still the "Griss-Lanhoff" Theory for official records, but with us Anna had dropped her pretense of detailed knowledge of Lanhoff's ideas. She had been the driving force to carry his ideas to practical evaluation. We all knew it; for the moment that was enough for her. I had no doubt that we would see another change when we arrived back in the inner system.

McAndrew was idly lifting and lowering a weighted bar. He hated exercise, but he grudgingly went along with general U.S.F. orders for spaceborne personnel.

"It is cold in the Halo," he said. "Just a few degrees above absolute zero, in most of the bodies. But it may not be *too* cold."

"It's much too cold for us."

"Certainly. That's Lanhoff's point. We know only about the enzymes found on Earth. They allow chemical reactions to proceed in a certain temperature regime. Why shouldn't there be other life-supporting enzymes that can operate at far lower temperatures?"

Anna stopped pedaling, and I paused in my toe-touching.

"Even at the temperatures here in the Halo?" she said.

"I think so." McAndrew paused in his leisurely bar-lifting. "Lanhoff argues that with plenty of complex organic molecules and with a hundred billion separate bodies available, a lot of things might develop in four billion years. He expected to find life somewhere out here—primitive life, probably, but recognizable to us. He was prepared to find it, and the *Star Harvester* was equipped to bring back samples."

We dropped the subject there, but it went running on in my mind while Anna took McAndrew off to program an elaborate meal. I could hear her giggling from the next room, while visions of a Halo civilization ran wild through my brain. Life had appeared there, evolved to intelligence. The Halo society had been disturbed by the arrival of our exploring ship. Lanhoff was a prisoner. His ship had been destroyed. The Inner System and the Halo would go to war. . . .

All complete rubbish. I knew that even as I fantasized, and McAndrew pointed out why when we discussed it later.

"We got the way we are, Jeanie, because life on Earth is one long fight for limited resources. Our bloody-mindedness all started out as food battles, three billion years ago. The Halo isn't like that—*everything* will be part of the food supply. How much evolving would we have done if it rained soup every day and the mountains of Earth had been made of cheese? We'd still be single-celled organisms, happy as clams."

It sounded plausible. McAndrew was so bright that you tended not to question him after a while. But an hour or two later I was worrying again. It occurred to me that Mac was a physicist—when it came to biology he was way outside his field. And *something* had happened to Lanhoff and his ship. What could it have been?

I didn't mention it again, but I worried and fretted, while McAndrew and Anna Griss talked and laughed in the sleeping area and Will Bayes sat next to me in the control area, miserable with his own thoughts. He was so dominated by Anna that I often lost sight of him as an independent person when she was around. Now I found out what made him tick—security.

Poor Will. Looking for security, he had joined the safest, most stable organization in Earth's government: the Food Department. That was the place for a solid, Earthbound, risk-free job. He had no desire for adventure, no wish to travel more than a mile from his little apartment. He had been in space only once before, as part of a meeting between the council and the United Space Federation. Now he was embarked on a mission so far from home that he might survive even if the Sun went nova.

How had it happened? He didn't know. It didn't occur to him to blame Anna. He sat about, uncertain and unhappy. I kept him company, my own worry bump throbbing randomly until at last it was time to throttle the drive and begin final search and rendezvous. *Manna* should be less than ten million kilometers ahead of us.

"QUERY DISTANCE FOR STAR HARVESTER APPROACH? DEFAULT VALUE: ZERO."

Our computer began talking to us while we were still scanning ahead for first visual contact. No matter what had happened to the vessel's crew, *Star Havester*'s guidance and control system was still working. Automatic communication for identification and position-matching had begun between the two ships as soon as drive interference was low enough to permit signal transfer.

"Fifty thousand kilometers." I didn't want an immediate rendezvous. "Manual control."

"FIFTY THOUSAND KILOMETERS. CONTROL TRANSFERRED."

"We'll see nothing from that distance." Anna was impatiently watching the hi-mag viewing screen. "We're wasting time. Take us in closer."

We could now see the rough-cut oblong of *Manna* on the imaging radar. A bright cluster of point reflections at one end had to be the *Star Harvester*'s assembly of sections. I suddenly had a new feel for the size of the body we were approaching. Lanhoff's ship was of the largest class in the U.S.F. fleet. Next to *Manna* it looked like specks of dust.

"Didn't you hear me?" Anna spoke more loudly. "I don't want a view from a million miles away—take us in closer. That's an order."

I turned to face her. "I think we should be cautious until we know what's going on. We can do a lot of overall checking from this distance. It's safer."

"And it wastes time." Her voice was impatient. "I'm the senior officer on this ship. Now, do as I say, and let's get in closer."

"Sorry." I couldn't delay this moment any longer. "You're the senior officer while we're in free flight, I agree. But when we're in a rendezvous mode with another ship, the pilot automatically has senior decision authority. Check the manuals. I have final say on our movements until we're on the way back to Earth."

There was a long pause while we sat eyeball to eyeball. Anna's face took on a touch of higher color on the cheeks. McAndrew and Will Bayes held an uncomfortable silence.

"You've had this in mind all along, haven't you?" Anna said softly. Her voice was as cold as Charon. "Damn you, you counted on this. You're going to waste everybody's time while you play at being the boss."

She went through to the other communications department, and I heard the rapid tapping of keys. I didn't know if she was making an entry into the log, or merely calling out the section of the manual that defines the transfer of authority to the pilot during approach and rendezvous. I didn't care. Super-caution has always paid off for me in the past. Why change a winning hand, even for Anna Griss? I concentrated my attention on the incoming data streams.

Half an hour later Anna came back and sat down without speaking. I was uncomfortably aware of her critical attention over my shoulder. I gestured to the central display screen, where the second series of remotely sensed observations from *Manna* were now appearing. The computer automatically checked everything for anomalies. One new set was displayed in flashing red for our attention.

"That's why I didn't want to rush. I don't think we've been wasting time at all. Mac, look at those radioactivity readings. What do you think of them?"

The computer had done its preliminary analysis, taking the ratio of radioactivity measurements from *Manna* to typical Halo bodies and to the general local background. McAndrew frowned at the smoothed values for a few seconds, then nodded.

"Uh-huh. They're high. About six hundred times as big as I would expect."

I took a deep breath. "So I think we know what happened to Lanhoff. One of the fusion units must have run wild when they were installing it. See now why I'm cautious, folks?"

Anna Griss looked stunned. "Then the crew all got a fatal overdose of radiation?"

"Looks like it." I had proved my point, but not in a way that gave me any satisfaction. I felt sick inside. When a fusion plant blows, there's no hope for the crew.

"No, Jeanie." McAndrew was frowning and rubbing at his sandy hairline. "You're jumping to conclusions. I said the radioactivity was six hundred times as big as it should be, and it is. But it's still low—you could live in it for years, and it wouldn't do you much harm. If a fusion plant had gone, the reading from *Manna* would be a hundred thousand times what we're measuring."

"But what else could give us abnormally high values?"

"I've no idea." He looked at me apologetically. "And we'll never know from this distance. Seems to me that Anna's right. We may have to get in a lot closer for a good look if we really want to find out."

Perhaps the idea that Lanhoff and his crew were almost certainly dead was hitting Anna hard for the first time. At any rate, there was no triumph in her expression as she watched me ease us gingerly forward until we were only ten thousand kilometers from the planetoid.

We went slowly, all our sensor input channels wide open. I set the control system to hold us at a constant distance from the surface of *Manna*.

"That's as far as I'm willing to take us," I said. "We're a long way from home, and I won't risk our only way of getting back. Any closer look will have to be done with the transfer pod. Mac, I've not had time to watch the inputs. Is there anything about the ship or about *Manna* that's looking out of line?"

He had been muttering to himself over by a display screen. Now he frowned and pressed a sequence of control keys.

"Maybe. While you were busy I did a complete data transfer from *Star Harvester*'s computer to ours. Lanhoff and his crew stopped feeding in new inputs a hundred and fifteen days ago—that's when the signals to Oberon Station cut off—but the automatic sensors kept right on recording. See, here's the very first radioactivity reading from *Manna* when they arrived, and there's one taken just a few minutes ago. Look at 'em. Identical. And now look at this. This is the thermal profile of a cross-section through *Manna*'s center."

A multi-colored blob filled the screen. It was a set of concentric ellipses, color-coded to run from a dark red in its center portion to a violet on the outer boundary.

"Different colors represent different temperatures." McAndrew touched a button, and a dark ellipse appeared around the red and orange portions at the center of the image. "I've just put in the contour for zero degrees Celsius. See? Significant, eh?"

"See what?" said Anna. She was sitting close to McAndrew, their shoulders touching.

"The inside—inside the curve. It's warmer than the melting-point of ice. If *Manna* has a water-ice core, it must be liquid. There's a couple of kilometers of frozen surface, then that liquid interior."

"But we're out in the Halo," I protested. "We're billions of miles from a source of heat. Unless—did Lanhoff already put one of his fusion plants in there?"

"No." McAndrew shook his head. His eyes were sparkling. "The temperature distribution inside was like this before Lanhoff arrived. You're right, Jeanie, it looks impossible—but there it is. *Manna* is three hundred degrees warmer than it has any right to be."

There was a long silence. Finally Will Bayes cleared his throat.

"All right, I'll be the dummy. How can that happen?"

McAndrew gave a little bark of excitement. "Man, if I had a definite answer to that I wouldn't hold out on you. But I can make a good guess. There has to be a natural internal source of heat, something like uranium or thorium deep inside. That's consistent with the high radioactivity value, too." He turned to me. "Jeanie, you have to get us over there, so we can take a good look at the inside."

I hesitated. "Will it be safe?" I said at last. "If it's uranium and water—you can make a nuclear reactor from them."

"Yes—if you try really hard. But it wouldn't happen in nature. Be reasonable, Jeanie."

He was looking at me expectantly, while Anna sat silent. She liked to see

him putting the pressure on me for a change.

I shook my head. "If you want to go over there and explore, I won't try to stop you. But my job is the safety of this ship. I'm staying right here."

Logic was all on my side. But even as I spoke I felt that I was giving the coward's answer.

From a distance of fifty kilometers, *Manna* already filled the sky ahead, a black bulk against the star field. *Star Harvester* hung as a cluster of glittering spheres near one end of the planetoid. It steadily grew in size on the screen as the pod moved in, one of its television cameras sending a crisp image back to my observing post on the *Hoatzin*. I could see the dozen sections and the narrow connectors between them, hollow tubes that were flexible now but electromagnetically stiffened when the drive went on.

"Approaching outermost cargo sphere," said McAndrew. I could see him on the screen that showed the inside of the pod, and a third image showed and recorded for me the pod control settings exactly as he saw them himself.

"Everything still appears perfectly normal," he went on. "We'll make our entry of *Star Harvester* through the control section. What is it, Anna?"

He turned to where she was monitoring another sensor, one for which I was not receiving coverage.

"Cut in Unit Four," I said quickly.

At my command the computers sent the image Anna and Will were watching to fill the center screen. I saw a long shaft that extended from a cargo hold of *Star Harvester* and drove down to penetrate the rough surface of *Manna*. The camera tracked its length, switching to deep radar frequencies to generate an image where the shaft plunged below the planetoid's surface.

"Is that a drilling shaft?" I asked. "It looks as though they were getting ready to put a fusion plant in the middle of *Manna*."

"Wouldn't make sense." McAndrew spoke in an abstracted grunt, and I saw him rubbing at the balding spot on the back of his head. "Lanhoff knew quite well that *Manna* has a liquid core—he had the same computer base to look at as we do. With that core he didn't need a fusion plant at all. The interior would be warm enough already for his enzymes to thrive."

"Was he looking for radioactive material?" I asked, but I could answer that question myself. "It wouldn't make sense. He could locate them the same way we did, from remote measurement. So why would he drill into the core?"

"I'll tell you why," said Anna suddenly. "That's the way Arne always was. Anytime he saw something that he didn't understand he wanted to investigate—he couldn't resist it. I'll bet he drilled to the core to take a closer look at something he'd detected in there—something he couldn't examine closely enough from outside."

The pod had been creeping in nearer and nearer to the hatches on the control section. I suddenly realized that once the three of them went inside I would be blind.

"Mac! As soon as you get in there, turn on all the monitors and tell the computer to send the signals back to me here on the *Hoatzin*." I raised my voice.

"And one of you has to stay in the control section if you go down to the surface. *D'you hear me?*"

He nodded vaguely, but he was already moving towards the hatch. Anna followed him. The last thing I saw before the camera could no longer keep them in view was Will Bayes's face as he turned to take a last worried look around the pod.

Deserted, but in perfect working order; that was the conclusion after a thorough examination of the control section of *Star Harvester*.

I had followed on the remote monitors as the other three made their inspection, step by step, and I could not fault them for lack of caution.

"We'll not find Lanhoff and his crew here," said McAndrew finally, when they were back in the main control room. "They must have gone down into the interior of *Manna*. Look at this."

A computer-generated profile of the shaft leading down from the ship to the surface appeared on the screen in front of me. It penetrated the frozen outer crust and terminated in an airlock leading to the liquid core. In the graphics display the broad shaft looked like a hair-thin needle piercing an egg. I was astonished again by the size of the planetoid. Its liquid core held half a million cubic kilometers of liquid. Maybe we would never find Lanhoff and the other crew members.

"We know they went down there," went on McAndrew, as though he was reading my thoughts. He held up a big clear container full of a cloudy yellow fluid. "See? They brought back samples. I'll send you the analysis, but I can tell you now that the results are just what Lanhoff predicted."

"It's high-level organic materials," added Anna. She was looking at me in triumph. "I told you we had to come here to find anything useful. This is just as we expected, but even more concentrated than I hoped. We've found a mother lode. The whole inside of *Manna* is like a rich soup—one of us could probably drink it for dinner and feel well-fed."

Will Bayes was staring at it dubiously, as though he expected Anna to tell him to go ahead and take a swig. "There's things living in it," he said.

My old fears came running back. "Mac, be careful how you handle that. If there are organisms there . . . "

"Just single-celled ones." McAndrew was excited. "Lanhoff thought he might find primitive life here, and he was quite right about that."

"And it's DNA-based," added Anna. "The same as we are."

I looked more closely at the yellow broth. "So the old theories must be right? Life came to Earth from outside."

"That's the real significance of what they found on *Manna*," said McAndrew. "Life didn't originate on Earth. It began out here in the Halo, or somewhere even farther out, and drifted in to Earth—maybe in the head of a comet, or as smaller meteorites. But see the difference; down on Earth we've had pressures to make us evolve away from a single-cell form. Here, there's heat from the radioactive materials in the middle of the planetoid, and there's food galore. There's no reason for evolution as we know it. That's why I don't share your worries, Jeanie, about going down

to the interior. There's no evolutionary reason for predators on *Manna*. We won't find sharks and tigers here. It's the Garden of Eden."

Anna nodded her agreement and squeezed his arm. They were both so excited, I wondered if I were the irrational one. I stared at the screen and shook my head.

"So what happened to Lanhoff and his crew?" I said.

There was a long, uneasy silence.

"Quite right, Jeanie," said McAndrew at last. "We still have no answer to that. But we're going to find one. Will can stay here, and Anna and I will go down there now."

"No." My pulse began to race. "I won't allow it. It's too dangerous."

"We don't agree," said Anna softly. "You heard McAndrew; he says we should look down there—and we'll go in our suits, so we'll be well protected."

Fools rush in where angels fear to tread. Anna Griss knew how to survive in an Earthbound bureaucratic free-for-all, but she was a long way from her home ground. And if she was relying on Mac's instincts to save their skins . . .

"*No.*" My voice cracked. "Didn't you hear me? I absolutely forbid it. That's an order."

"Is it?" Anna didn't raise her voice. "But you see, we're not in the spacecraft rendezvous mode now, Captain Roker. The *Star Harvester* is tethered to the planetoid. That means I command here, not you." She turned to McAndrew. "Come on, let's make sure we're fully prepared. We don't want to take any risks."

Before I could speak again she reached forward to the monitor. I suddenly found that I was looking into a blank screen.

It took me a long five minutes to patch in a substitute communications link between the computers of the *Hoatzin* and the *Star Harvester*.

When the auxiliary screen came alive I saw Will Bayes fiddling with the control bank.

"Where are they, Will?"

He turned quickly. "They're on the way down to the surface. Jeanie, I couldn't stop them. I said they shouldn't go, but Anna wouldn't take any notice of me. And she had Mac convinced, too."

I knew McAndrew—he hadn't taken any convincing at all. Show him an interesting intellectual problem, and preservation of life and limb came a poor second to curiosity.

"Don't worry about that, Will. Link me to the computer on board the transfer pod."

"What are you going to do?"

"Go after them. Maybe Mac is right, and they'll be fine, and in no danger. But I want to be the rearguard and trail along behind them, just in case."

Will probably could have flown the pod to pick me up in an emergency, and I knew that the computer could have done it with a single rendezvous command from me. But Will and the computer would have followed the book on permissible rates of acceleration and docking distances. I took remote control of the pod myself, overrode the computer, broke every rule in the manual, and had the pod docked at the *Hoatzin* in less than fifteen minutes. Going back

to the *Star Harvester* we beat that time by a hundred seconds.

Will was waiting at the main lock with his suit on. "Something has gone wrong," he said. "They told me they would send a signal every ten minutes, but it's been over twenty since the last one. I was going to go down and see what's happening."

"Did you see any weapons on board when you were looking over the ship earlier?" I asked.

"Weapons?" Will frowned. "No. Lanhoff had no reason to carry anything like that. Wait a minute, though, what about a construction laser? That can be pretty dangerous, and there are plenty of those in Section Six."

"Get one." I was preparing the transfer pod for a rapid departure from *Star Harvester* if we needed it. One time in a thousand, a precaution like that pays off.

"I'll get two."

Will was off along the tube between the sections before I could argue with him. I didn't want him with me in the middle of *Manna*—I wanted him available to help me out if I ran into trouble myself.

What was I expecting? I had no idea, but I felt a lot better when I had my suit firmly closed and a portable construction laser tucked under one arm. Will and I went together to the entrance of the long tunnel that led down to the interior of *Manna*.

"Right. No farther for you." I looked at the peculiar way he was holding the laser, and wondered what would happen if he had to use it. "You stay here, at the head of the shaft. I'll send you a signal every ten minutes."

"That's what Anna said." His words echoed after me as I dropped away down the broad shaft.

The illumination came only from the light on my suit. Seen from the inside, the shaft out of the cargo hold dropped away in front of me like a dark, endless tunnel. *Manna*'s gravity was negligible, so there were none of the Earth dangers of an accelerated fall. But I had to take care to remain clear of the side of the tunnel—it narrowed as we went deeper into the planetoid's crust. I drifted out to the center of the shaft, turned on the coupling between the suit's conducting circuits and the pulsed field in the tunnel wall, and made a swift, noiseless descent.

The three-kilometer downward swoop took less than a minute. All the way to the airlock at the bottom I watched carefully for any sign that McAndrew and Anna had met trouble there. Everything was normal.

The drilling mechanism at the end of the shaft was still in position. Normally the shaft could extend itself through hard, frozen ice at a hundred feet an hour. When they came to the liquid interior, however, Lanhoff had arrested the progress of the drill and installed the airlock. It was a cylindrical double chamber about six meters across, with a movable metal wall separating the two halves.

I cycled through the first part of the lock, closed the wall, and went forward to the second barrier. I hesitated in front of it. The wall was damp with a viscous fluid. The airlock had been used recently. Anna and McAndrew had passed through here to the liquid core of the

planetoid. If I wished to find them I must do the same.

Was there a port? I wanted to take a good look at the interior of *Manna* before I was willing even to consider going through into it.

The only transparent area was a tiny section a few inches across, where a small panel had been removed and replaced by a thin sheet of clear plastic. Lanhoff must have arranged it this way, to make an observation point before he would risk a venture beyond the lock. Despite the curiosity referred to by Anna, it suggested that he was a cautious man—and it seemed to increase the odds against me. I was diving blind, and in a hurry.

I drifted across and put the faceplate of my suit flat against the transparent plate. The only illumination in the interior was coming from my suit, and because it had to shine through the port I was confused by back-scattered light. I held my hand to shield my eyes and peered in.

My first impression was of a snowstorm. Great drifting white flakes swam lazily across the field of view. As I adjusted to the odd lighting, the objects resolved themselves to white, feathery snowballs, ranging in size from a grape to a closed fist. The outer parts were in constant vibration, providing a soft-edged, uncertain shimmer as they moved through the pale yellow fluid of *Manna*'s interior.

Even as I watched, the number and density of the white objects was increasing. The snowfall became a blizzard. And floating far away from me, almost at the limit of vision, I saw two great white shapes. They were travesties of the human form, bloated and blurred outlines like giant snowmen. Every second they grew bigger, as more and more snowballs approached and adhered to their surfaces. They were swelling steadily, rounding to become perfect spheres.

I shivered in my suit. Alien. The figures looked totally alien, but I knew what I had found. At their centers, unable to see, move, or send messages, were McAndrew and Anna.

How could I rescue them? They were in no danger for the first few minutes, but the snowballs would muffle the escape of heat from the suits. Unless the clinging balls were cleared away, Anna and McAndrew would soon die a blind and stifling death.

My first instinct was to open the lock and plunge through to the interior. Another look at the feathery snowballs changed my mind about that. They were thicker than ever, drifting up from the deep interior of the planetoid. If I went out there they would have me covered in less than a minute. The laser that I had brought with me was useless. If I used it in water, it would waste its energy turning a small volume close to me to steam. And I had no other weapon with me.

Return to the *Star Harvester,* and look for inspiration there? It might be too late for McAndrew and Anna.

I went across to the side of the lock. There was a dual set of controls for the drilling shaft there, installed so that drilling progress could be monitored and modified on the spot. If I started the drill, the fluid ahead would offer little resistance. The tunnel would extend further into the liquid, far enough to en-

close the area where the two misshapen spheres were floating. So if I opened the lock first, then activated the drill . . .

The timing would be crucial. Once the lock was open, liquid would be drawn into the evacuated area around me. Then I would have to operate the drill unit so that the open lock moved to enclose the two swollen masses of snowballs, close the lock again, and pump the liquid out. But if I was too slow, the blizzard of snow would close in on me, too, and I would be as helpless as McAndrew and Anna.

Delay wouldn't help. I pressed the level that opened the lock, moved to the side of the chamber, and started the drill extender.

Liquid rushed in through the opening aperture. I struggled to move forward against its pressure, fighting my way back to the lock control.

There was a swirling tide of white all around me. Feathered balls hit my suit and stuck to it, coating the faceplate in an opaque layer. Within thirty seconds I could not see anything, and my arms and legs were sluggish in their movements as I clung to the lock lever.

I had not anticipated that I would become blind so quickly. Were McAndrew and Anna already swept into the chamber by the advancing drill and the opened lock? I had no way of knowing. I waited as long as I dared, then heaved at the lever. My arm moved slowly, hampered by the mass of snowspheres clinging to it. I felt the control close, and sensed the muffled roar of the pump. I tried to thrash my arms, to shake off the layers that clogged their movement. It was useless. Soon I was unable to move at all. I was in darkness. If the snowballs could tolerate vacuum, McAndrew and Anna and I would go the same way as Lanhoff; we'd be trapped inside our suits, our communication units useless, until the heat built up to kill us.

It was a long, long wait (only ten minutes, according to the communications link on board the ship—it felt like days). Suddenly there was a lightening of the darkness in front of my faceplate. I could move my arms again. The feather balls were falling off me and being pumped out through the airlock.

I turned around, peering through the one clear spot on my faceplate. There were two spherical blobs with me in the chamber, and they were gradually taking on human shapes. After another five minutes I could see parts of their suits.

"Anna! Mac! Turn around."

They clumsily rotated to face me. I saw them staring out of the faceplates, white-faced but undeniably alive.

"Come on. Let's get out of here."

"Wait." McAndrew was taking a bag from the side of his suit, opening it, and scooping up samples of liquid and snowballs. I decided that he was terminally crazy.

"Don't fool with that, Mac—let's get out of here."

What was the danger now? I didn't know, and I wasn't going to wait to find out. I reached out, grabbed his arm, and began to haul him back through to the other chamber. We were still sloshing in a chaos of fluid and floating feather balls.

Anna grabbed at my arm, so I was towing both of them. I could hear her teeth chattering.

"God," she said. "I thought we were

dead. I knew it, it was just like being dead, no sound, nothing to see, not able to move."

"I know the feeling," I grunted—they were a weighty pair. "How did you get caught? I mean, why didn't you get back into the airlock as soon as the snowballs arrived?"

We were scooting back up the tunnel as fast as we could, McAndrew still clinging to his bucket of specimens.

"We didn't see any danger." Anna was gradually getting control of herself, and her grip on my arm had loosened. "When we first came through the lock there were maybe half a dozen of those fuzzballs in sight. McAndrew said we ought to get a specimen before we left, because they were a more complex lifeform than any that Lanhoff had reported. And then they started to arrive in millions, from all directions. Our suits were covered before we could get away—we didn't have a chance."

"But what are they—and what were they doing?" I said.

We had reached the top of the tunnel and entered the cargo sphere. There was no sign of Will Bayes—it occurred to me that I hadn't sent him a single signal of any kind since I left. He must be frantic. I hit the switch that would fill the chamber with air. For some reason I was keener to get out of that suit than I had ever been.

McAndrew placed his container on the floor and we all began to work our way free, starting with the helmets.

"What were they doing? Now that's a good question," he said. "While we were stuck in the middle of them down there, I had time to give it some thought."

Well, that sounded right. When McAndrew stops thinking, he'll be dead.

"Lanhoff and I made a big goof," he went on. "And for him it was a fatal one. We both argued that the food supply here was so plentiful that there'd be no pressure to evolve. But we forgot a basic fact. An organism needs more than food to survive."

"What else? You mean moisture?" I had my suit off, and air had never tasted so good.

"Moisture, sure. But as well as that it needs warmth. Here on *Manna,* the evolutionary pressure is to get near a heat source. If you're out too far from the center, you become part of the frozen outer layer. Those snowballs normally live down near the middle, getting as close as they can to the radioactive fragments that provide the warmth."

Anna was out of her suit. Now that we were safe, she was making a tremendous effort to gain her self-possession. Her shivering had stopped and she was even patting at her damp and tangled hair. She peered curiously down at the container of feathered snowballs. They were still moving slowly around in the yellow liquid.

"The radioactivity must speed up their rate of evolution, too," she said. "And I was thinking they wanted to *eat* us."

"I doubt that we're very appetizing, compared with their free soup," said McAndrew. "No, if there hadn't been so many of them they'd have been harmless enough. But when we came along, they sensed the heat given off by our suits, and they tried to cuddle up to us.

They didn't want to eat us; all they were after was a place by the fireside."

Anna nodded. "This is going to create a sensation when we get back to Earth. We'll have to take a lot of specimens back with us."

She was reaching down towards the open container. One of the snowballs had fully opened and was a delicate white mass of feathery cilia. She put out her forefinger as though she intended to touch it.

"*Don't do that!*" I shouted.

Maybe she was not even considering any such thing, but my loud command made her stiffen. She looked up at me angrily.

"You saved us, Captain Roker, and I appreciate that. But don't forget who is in charge of this expedition. And don't try to order me around—ever."

"Don't be a fool," I said. "I wasn't ordering you around—I was speaking for your own good. Don't you have any idea what might be dangerous?"

My own tone must have betrayed my impatience and anger. Anna stiffened, and her color went from white to red.

"McAndrew has pointed out that these lifeforms would have been quite harmless if there had not been so many of them," she said. And then she reached forward into the container and deliberately touched the expanded snowball with her forefinger. She looked up at me. "Satisfied? They're perfectly harmless."

Then she screamed. The ball was clinging to her finger as she withdrew it, and the cilia had enveloped it as far as the second joint.

"It won't come off!" She began shaking her hand desperately. "It hurts."

I swung my helmet hard at her finger, and the edge caught the ball near its middle. It was jarred loose and flew across the chamber. Anna stood and looked ruefully at her hand. The finger was reddened and swollen.

"Damnation. It stings like hell." She turned accusingly to McAndrew and held forward her injured hand. "You fool. You told me they're harmless, and now look at my finger. This is your fault."

We all stared at her hand. The swelling on her forefinger seemed to be getting bigger and redder.

McAndrew had been standing there with a startled and perplexed expression on his face. Before I could stop him he picked up the laser that I had laid on the floor, aimed it at Anna, and pressed the switch. There was a crackle from the wall behind Anna, and the smoke of burned tissue. Her arm had been neatly severed above the elbow, and the wound cauterized with a single sweep of the instrument.

Anna looked at the stump with bulging eyes, groaned, and started to fall sideways to the floor.

"Mac!" I grabbed for the laser. "What the hell are you doing?"

His face was pale. "Come on," he said. "Let's get her to the robodoc. This isn't too serious—she'll have to wait to regenerate it until we get home and find a biofeedback machine, but we can't help that."

"But why did you do it?"

"I made one bad mistake, back there outside the air lock." We were hurrying back through the ship, supporting Anna between us.

"I don't want to make another one,"

he went on. "Lanhoff's notes on the single-celled organisms inside *Manna* pointed out that they didn't have a sexual method of reproduction, but they have something that resembles the plasmids down on Earth—they swap sections of DNA with each other, to get the mixing of offspring characteristics. I wondered about that when I read it, because it suggests a mechanism for speeding up an evolutionary process. But I skipped on past it, because I was so sure there would be no evolutionary pressures at work inside *Manna*."

We were almost at the control section of *Star Harvester*. Unless Will had gone mad and flown off in the transfer pod, we were only twenty minutes away from the *Hoatzin*'s robodoc. Anna was coming out of her faint, and groaning a little.

"Mac, I still don't see it. Why does the evolution method of the creatures inside *Manna* mean you had to burn off Anna's arm?"

"If they do swap tissue regularly, their immune reaction systems have to recognize and tolerate the exchange. But we're not made like that—Anna's immune reaction system might mop up the materials that the snowball transferred to her bloodstream, but more likely the stuff would have killed her. I daren't take the chance."

We had come to the hatch that led to the transfer pod. Will Bayes stood there. For a fraction of a second he looked relieved, then he took in the whole scene. We were all pale and panting. I was dragging Anna along while she lay in a near-faint with only a stump of a right arm; and McAndrew, wild-eyed and lunatic, was bounding along behind us, still brandishing the laser.

Will backed away in horror, his hands held in front of him.

"Come on, man, don't just stand there," said McAndrew. "Get out of the way. We've got to get Anna over to our ship and let the doc have a go at her. The sooner the better."

Will took a hesitant step to one side. "She's not dead, then?"

"Of course she's not dead—she'll be good as new once she's been through a regeneration treatment. We'll have to keep her sedated for the trip back, but she'll be all right."

I went to the controls of the pod, ready to take us back to the *Hoatzin*. It hadn't occurred to me that Anna would be quieted down now for the return trip, but I wouldn't be the one to complain.

"You mean we're actually going home?" asked Will. His tone suggested that he had never expected to see Earth again.

"Just for a while." McAndrew had settled Anna as comfortably as he could, and now he was looking disconsolately around him for the bucket of lifeform samples that we had left behind in the control section of *Star Harvester*.

"We'll be back, Will, don't you worry," he said. "Anna was quite right: when Lanhoff found *Manna* he stumbled across a real treasure trove. We've hardly scratched the surface. As soon as we can get organized, there'll be another party from the Food Department. And I'm sure we'll all be here with it."

My attention was mainly on the controls, so I'm not sure that I heard Will's low mumble correctly. But I think he was saying something about a transfer to the Energy Department. ■

Joel A. Davis

EXPLORING THE ASTEROIDS

Asteroid mining may soon move from speculation to reality —but before we can mine, we have to prospect.

One of the first serious suggestions for exploiting asteroidal resources appeared in an article written by the late Dandridge M. Cole back in 1960.[1] More than 20 years later the prospect of mining, capturing, or colonizing a[illegible]id still seems audacious. It may seem so —but it isn't. Several recent studies[2-4] suggest that asteroid mining or capturing may be feasible projects before the turn of the century, with a monetary investment comparable to the Apollo program and using current or near-current technology.

However, the economical exploitation of asteroidal resources is based on a big assumption: that the resources we want *are actually there*.

Everything we currently know about asteroids comes from Earth-based observations or studies of meteorites thought to come from certain asteroids. In many ways our knowledge of asteroids is comparable to our pre-1965 understanding of Mars, before Mariner 4 made its photographic flyby of the Red Planet. While ground-based instrumentation is several orders of magnitude better now than it was in the early 1960s, it's a fact that—as an example—almost none of the 2,300-plus named asteroids even can be resolved to a disk with our highest-power telescopes.

(That will change in 1985 with the orbiting of the Space Telescope; yet still we'll only be imaging the surfaces of asteroids and gathering data that's limited in scope.)

To actually mount an asteroid-mining operation on presently available information would be a bit like asking the Kennecott Corporation to dig a full-

fledged open pit copper mine in a location that's never been explored with a geologist's hammer.

Just as we photographed and probed the lunar surface with unmanned robots before landing two humans there, so we must examine a number of asteroids up close: first with robot spacecraft and later, if necessary, with human explorers. As we accumulate large amounts of high-quality data on the surface and interior composition of asteroids, we will move closer to making realistic plans for exploiting the resources of these fascinating and (perhaps) valuable chunks of rock.

Current Knowledge

Asteroids, to start with, are not a homogeneous group of objects. They can be classified by rough (and somewhat speculative) composition and by spatial location.

Dynamical studies of the entry paths of certain meteorites have led researchers to believe they are associated with some asteroids. Going with this assumption (and it is not an unreasonable one), it's been possible to set up a rough compositional classification of asteroids by comparing their reflectance spectra with that of meteorites. Thus we can talk of C (carbonaceous), S (silicaceous or stony), M (metallic), and U (the ubiquitous "unknown") bodies. The C-type asteroids may have substantial amounts of volatile compounds such as water, carbon, and organic molecules. S and M asteroids are not kinky; they may contain sizeable amounts of iron, iron-nickel, and perhaps other metallic elements and compounds.

It's easier to classify asteroids by where they are in the solar system. Doing it that way, they fall into three main classes: the Main Belt asteroids, orbiting between 2.17 and 3.3 AU from the sun between Mars and Jupiter; the Trojan asteroids, occupying the L-4 and L-5 Sun-Jupiter Lagrangian points; and the Earth Approach Objects (EAOs), which occupy orbits that approach or cross that of Earth.

No one's yet found, by the way, any asteroids in the Sun-Earth Lagrangian points, though searches have been made.[5] There are also a few oddballs around; best known is (2060) Chiron, which orbits between Uranus and Saturn. (When a newly discovered asteroid has been observed often enough for its orbit to be plotted, the International Astronomical Union gives it an official number, and its discoverer gives it an official name. Chiron is the 2,060th such asteroid, and discoverer Charles Kowal named it after the centaur in Greek mythology who was the teacher of Hercules.) It could be the first known member of a whole new class of asteroids (the Minor Belt? the Far Belt?).

We know of more than 2,400 asteroids; perhaps 100,000 or more are bright enough to be discovered photographically and they range in size from 1,025 km. ((1) Ceres) down to objects most properly called flying mountains.

Most main belt asteroids are pretty well confined to the plane of the ecliptic. The average orbital inclination is 9.7 degrees and the average eccentricity is 0.15. The immense gravity field of Jupiter does tend to smear things up a bit at the outer edges of the belt. A com-

TABLE I

DATA ON SELECTED ASTEROIDS*

Name	Type	Diam. (km)**	q(AU)	Q(AU)	A(AU)	e	I(°)	Period (yrs)	Discovered
1 Ceres	MB/C	1025.0	2.55	2.98	2.77	.076	10.598	4.60	1801
2 Pallas	MB/U	583.0	2.11	3.42	2.77	.232	34.880	4.61	1802
3 Juno	MB/S	249.0	1.98	3.35	2.67	.255	13.002	4.36	1804
4 Vesta	MB/U	555.0	2.15	2.57	2.36	.089	7.144	3.63	1807
433 Eros	EAO/C	20.0	1.13	1.78	1.46	.223	10.828	1.76	1898
1566 Icarus	EAO/U	1.9	0.19	1.97	1.08	.826	22.945	1.12	1949
1943 Anteros	EAO/?	?	1.06	1.80	1.43	.256	8.700	1.71	1973
2062 Aten	EAO/S	1.1	0.79	1.14	0.97	.182	18.935	0.95	1976

*Type: MB = Main Belt, EAO = Earth Approach Object, C = Carbonaceous, S = Silicaceous/Stony, U = Unclassifiable, ? = not classified; q = perihelion; Q = aphelion; A = semimajor axis; e = eccentricity; I = orbital inclination. Data from following sources: Bender, Bowell, Pilcher, TRIAD files in *Asteroids*, T. Gehrels, ed. University of Arizona Pr., 1979; "Table 3. Minor Planets," *Anchor Dictionary of Astronomy*, V. Illingworth, ed., Doubleday, 1979; J. Niehoff, "Round-trip mission requirements for asteroids 1976 AA and 1973 EC," *Icarus* 31, 430-438 (1977).

**Diameters for asteroids 1-4 vary, even in the TRIAD files. E.g., 1 Ceres diameter given in two different places as 1016 km and 1025 km. I've used Bowell's figures.

positional difference may also exist, depending on location. Asteroids in the inner belt tend to be M or S bodies; those in the outer belt are more likely to be C-type asteroids.

The Trojans, in orbits that form "clouds" around the Sun-Jupiter Lagrangian points, show some evidence of being covered with organic, kerogen-like compounds. They are a long way off, though, and asteroids just as interesting and potentially valuable lie a lot closer to us. We'll explore the Trojans some day, but it won't be in this century.

The most intriguing objects—and the ones worthy of an early closeup look—are the Earth Approach Objects, or EAOs. Asteroid expert Dr. George Wetherill has persuasively put forward the rationale for *in situ* examination of EAOs in a recent paper in *Icarus*:

". . . It is becoming increasingly clear that an understanding of the Earth-approaching interplanetary objects is central to major problems in planetary science. It is almost certain that these bodies are at present the principal cause of 1- to 100-km-diameter craters on the Moon and the terrestrial planets with the possible exception of Mars. It is very probable that this has been the case for the last 3×10^9 years or more. . . . A large proportion of the meteorites (may be) recent fragments of these bodies. . . . There are good reasons to believe that at least many of these objects represent the nonvolatile portions of the nucleus of 'extinct' comets. . . . Certain of these bodies have been identified as recently accessible sources of raw materials for space construction and manufacturing."[6]

Earth Approach Objects can be divided into three main groups: Aten objects, Apollo objects, and Amor objects. We can also speak of Mars-crossers and Mars-grazers.

Aten objects have orbits whose semimajor axes are less than 1 AU and which overlap Earth's orbit at their aphelia. A hundred such objects likely exist, according to EAO expert Dr. Eleanor Helin;[7] we know of three—(2062) Aten, (2100) Ra-Shalom and (2340) Hathor.

Apollo objects have semimajor axes equal to or more than 1 AU and perihelia equal to or less than 1.017 AU (Earth's aphelion distance). Apollo orbits overlap Earth's at their perihelia. We know of 23 Apollo objects; (1566) Icarus and (1862) Apollo are the best-known. From 400 to 1,000 Apollo objects may be out there, whizzing past.

Amor objects have perihelia greater than 1.017 AU and less than 1.3 AU. Of the 20 or so known Amor objects, (1943) Anteros is the most interesting in terms of robot exploration. Likely there are 1,000 to 2,000 Amor objects circling the sun between Earth and Mars.

The names "Mars-crossers" and "Mars-grazers" are self-explanatory. Helin estimates about 5,000 to 15,000 such objects may exist. Table I (page 46) lists more data.

EAOs may not be "real" asteroids; as Wetherill said, they could well be the dead husks of comets. The only way to really confirm that is to (1) do a close-up examination of a couple of live comets, and (2) do the same for some EAOs.

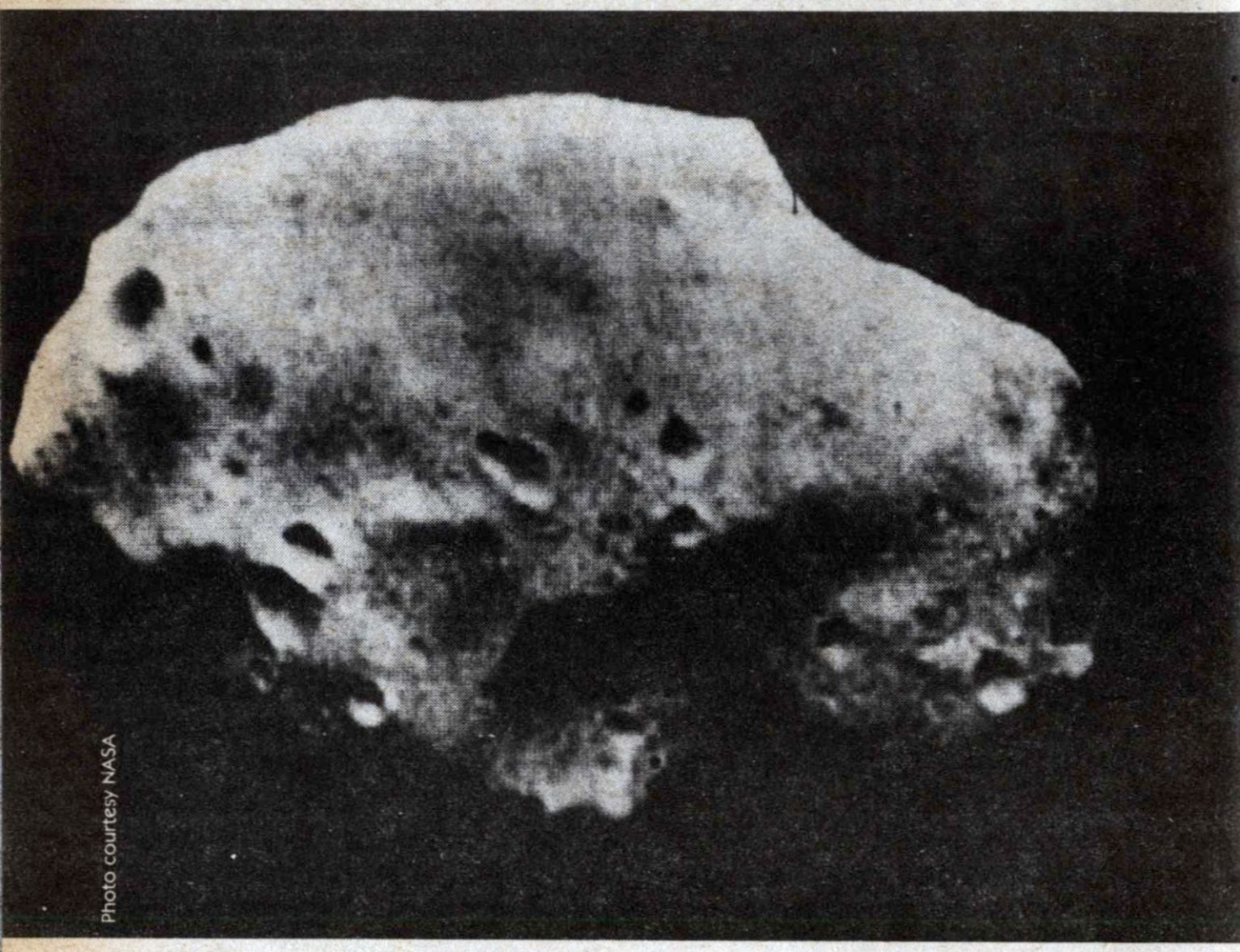

Figure 1. Is this what an Earth Approach Object would look like from an approaching probe? This photo of Phobos, Mars's larger moon, was taken by Mariner 9 from a distance of 5,540 km. Many astronomers believe Phobos is a large Mars-cross captured by the Red Planet.

That's one reason for rendezvous and sample-return missions to these objects; the possible enormous economic benefits accruing from mining them, should they turn out to be the gold mines some believe they are, is another. EAOs may be the key to understanding the origin of the solar system; and they may represent the greatest threat to the human species, and much other life on this planet, since the invention of nuclear weapons.

Helin and Eugene Shoemaker have estimated the collision rate for EAOs with Earth as being on the order of from three to four every million years. EAOs are quite small—the largest known, the still-unnamed 1978 SB, is around 10.4 km in diameter with an estimated volume of 590 km^3. The others are all

smaller, with (2062) Aten probably less than a kilometer in diameter.

What would happen if a 10-kilometer-diameter asteroid, or comet head, hit Earth? The first description of the consequences of such a strike from outer space appeared in the pages of this magazine 16 years ago, in a terrifying article called "Giant Meteor Impact." (J. E. Enever, *Analog*, March 1966.) The real thing might have happened 65 million years ago; several scientists say they've found evidence an asteroid impact wiped out the dinosaurs and a large fraction of other Earth life. Larry Niven and Jerry Pournelle described the results of such an event on human civilization in their novel *Lucifer's Hammer*.

Suffice it to say we wouldn't like it to happen, and we'd like to be able to know ahead of time if it were; a few well-placed nuclear explosions several years ahead of impact would be enough to change the object's orbit to one safer for us. The more we know about the existence, numbers, orbits, and compositions of EAOs, the safer we are. It's as simple as that.

Most of the same reasons for learning more about EAOs apply to the asteroids of the inner main belt. High in metals and silicaceous compounds, they may not initially be economically competitive with lunar or Earth-approach mining operations, but they're worth looking at anyway.

It never pays to have all your valuable eggs in one basket. The United States has that problem with its supply of oil, chrome, and cobalt. The human race has the same problem—one planet is not enough when the universe throws big rocks at you. It also makes no sense to depend solely on lunar mining for extraterrestrial sources of metals and material for space construction. The moon is big, close, and an easy target for a bomb aboard a "runaway" shuttle. The inner belt is none of these. Further, once the pipeline from the inner belt to Earth orbit is open, material can be delivered as swiftly as from the moon. The first load might take several years to arrive, but subsequent shipments could easily be at intervals of weeks or days.

Earth-approach objects include some S-type bodies, but most seem to be C-type, carbonaceous. They're just as valuable in their own way to an extraterrestrial construction economy. The volatiles (especially water and organic compounds) and silicaceous material are essential. So, too, are the metals from the inner belt.

It's clear: we must eventually take the measure of both inner belt asteroids and Earth-approach objects. Both for the money and for the peace of mind.

Getting There

Picking an asteroid to explore is not a matter of drawing a name out of a hat. Actually exploring the asteroid you do pick is also not a simple task.

First, we're looking for asteroids with orbits that have low inclinations and low eccentricities. Main belt objects average out at 9.7 degrees inclination and 0.15 eccentricity. The numbers are worse for EAOs. One Apollo asteroid, the famous (1566) Icarus, has an inclination of 22.9 degrees to the ecliptic and an eccentricity of .826. (So do some main belters:

(2) Pallas has an inclination of almost 35 degrees!)

High inclinations and/or eccentricities mean higher delta-v's for spacecraft ("delta-v" is the term used to mean the velocity change made by a spacecraft when it changes its course or trajectory), and that means more fuel. That, in turn, means either a bigger probe or one with less instrumentation. Conversely, a low delta-v means a cheaper trip with more science payload for the same amount of fuel. "Cheap" is going to be the watchword for planetary exploration for some time to come, like it or not.

It would be fun, and scientifically valuable, to send a probe to Icarus. It came within 0.04 AU of Earth in 1968 (a close call if there ever was one!) and has a perihelion *inside the orbit of Mercury*. It must be a fascinating object—but the delta-v requirements for a probe to Icarus are huge, 15 to 30 kps. Icarus will have to wait.

A lot more promising is the famous Amor object (433) Eros. Even with an inclination of 10.8 degrees and an eccentricity of .223, its delta-v to rendezvous is just over 9 kps—not bad. Aten object (2340) Hathor has an inclination of only 6.27 degrees; that's good. Its eccentricity of 0.424 is not so good. (2062) Aten has low eccentricity (0.237) and a high inclination (18.9 degrees). Amor object (1943) Anteros is perhaps the best of all, with an orbital eccentricity of about 0.26 and an inclination of only nine degrees to the ecliptic. Table II (page 59) lists other good candidates.

Besides having a low eccentricity and orbital inclination, the ideal asteroid target should be close enough to Earth to provide a reasonable trip time. Remember, we're not exploring asteroids *only* for the science; there's a lot of money and perhaps the future of the human race riding on these robot examinations. Six years may be fine for a Pioneer 11 trip from Earth to Saturn via Jupiter. That may be a little long for governments and corporations planning for profits.

(Voyager 1 took only three years to get to Saturn; that, however, was a flyby. A rendezvous-and-probe, or a sample-return from Titan, would take longer and/or lots more energy.)

Most of the asteroids we want to take a look at are close enough to make one-year round trips feasible. More likely they'll run from two to five years, and five years is probably the upper time limit for the missions we want to run.

The Trojan asteroids look intriguing; what *is* that stuff that covers their surface? The problem is they're too far away, in Jupiter's orbit, to make a sample-return mission feasible any time soon. On the other hand, rendezvous and sample-return missions to asteroids like (2062) Aten and (1943) Anteros come in time periods from one to three years. It's even possible to do multiple-flyby missions to main belt asteroids in periods of from two to three years.

Once we get there, what do we do? In most cases we do not just fly by, taking pictures *à la* Mariner 4 or Voyager. True, we can gather enormous quantities of data that way, both with cameras and other remote sensing instruments. What we really want, however, is a "geologist's hammer" approach to asteroid exploration: ren-

dezvous with penetrators or landers, or a sample-return.

So here are some instruments our asteroid probes should carry.

ORBITER: (1) special electronic cameras called CCDs (Charge-Coupled Devices), which are TV cameras that use a target screen of thousands of special semiconductors instead of a normal vidicon tube to detect incoming electromagnetic radiation. CCD cameras are much more sensitive than normal TV cameras; these would have a number of different filters and wide- and narrow-angle lenses; (2) x-ray and gamma-ray fluorescence instruments, which will provide definitive chemical analyses of major element abundances and particularly important minor or trace elements—hydrogen, oxygen, carbon, aluminum, silicon, titanium, iron, uranium, and thorium; (3) a mapping spectrometer; (4) a multispectral radiometer; (5) a radar altimeter; (6) fields and particles package; (7) micrometeoroid detector.

LANDER: (1) a multispectral camera for close-up imaging; (2) an alpha-proton x-ray fluorescence instrument for total chemical analysis of the surface, including all minor elements; (3) seismometer; (4) magnetometer.

PENETRATORS: If used instead of or in combination with landers, each would carry instruments to measure seismic activity, heatflow, and subsurface chemistry. The forebody, with most of the instrumentation, would be connected to the afterbody (left on the surface) by a trailing umbilical. The afterbody would contain a camera and telemetry electronics. A small Radioisotopic Thermal Generator (RTG), a form of nuclear power plant using plutonium, would be in the forebody and would provide power.

SAMPLE-RETURN: Some of the instruments carried by a lander, for example a CCD camera and alpha-proton-x-ray fluorescence package, would be advisable on the lander/sample gatherer. In addition, it will carry a corer/scooper to obtain surface and subsurface samples totaling one kilogram in mass. Either the entire lander would be equipped to make the return journey, or a separate return stage would do it.

Those are the parameters for where we want to go and what instruments we'll carry. What follows is a series of missions we could launch to the asteroids, some as soon as five years from now. The first two were originally detailed by John Niehoff of Science Applications, Inc., Schaumburg, Ill., [8-10] and are missions to the EAOs Aten and Anteros. The main belt missions were proposed by Niehoff; also by a team of European scientists for ESA (European Space Agency) missions to be launched on the new—and now operational—Ariane expendable launcher.

Asteroid Mission: Aten

Eleanor Helin and Eugene Shoemaker discovered (2062) Aten in 1973 during their Palomar Planet-Crossing Asteroid Survey. It's the first known asteroid with a semimajor axis less than that of Earth. The orbital characteristics and other information for Aten are listed in Table I (page 46).

The next favorable launch window to Aten is between 1991 and 1993, giving

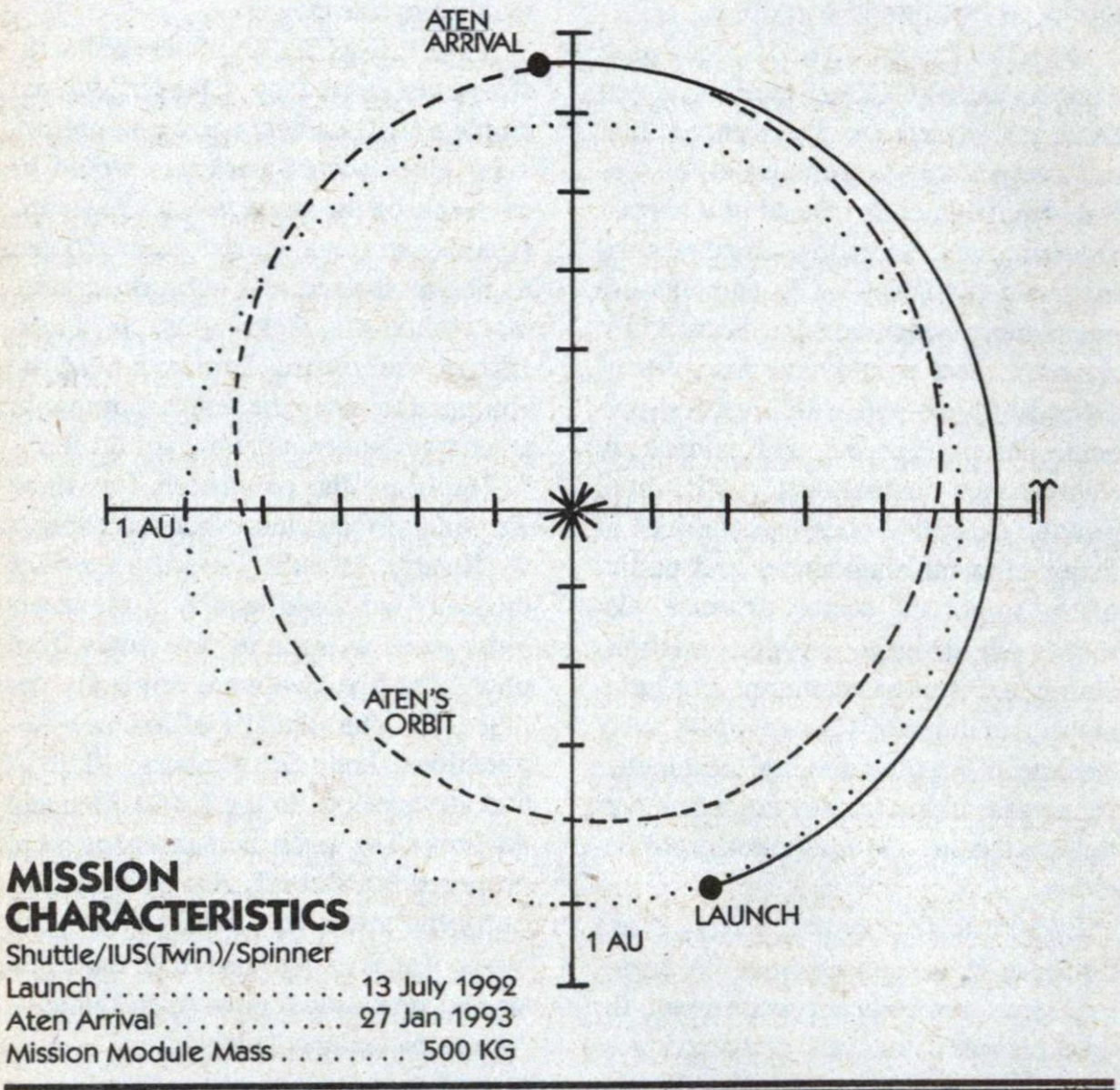

Figure 2. Diagram of Aten Rendezvous Mission. Dotted line is Earth's orbit; dashed line, Aten's orbit. Solid line is trajectory of ARP to Aten rendezvous at the asteroid's aphelion. (From Niehoff, 1978, ref. 8.)

us plenty of time to develop a spacecraft and mission plan. By the beginning of the next decade the space shuttle will be a tried and true launch vehicle and the current problems with advanced upper stages for planetary mission vehicles will (it is hoped) be long solved.

(And if NASA doesn't solve it, ESA may do it for them, with Ariane.)

The problem with an Aten mission is the asteroid's somewhat high orbital inclination of 18.9 degrees. That means a rather high delta-v to get the probe out of the Earth's orbital plane and into

Aten's, and puts some constraints on the type of mission we can fly. A straight ballistic flyby would be the easiest, but it produces not much more than a series of quick snapshots as the probe zooms past Aten. A sample-return would be great, but the delta-v for such a mission is prohibitive—easily over 7.7 kps *after* Earth-escape.

However, a rendezvous-and-lander mission *does* have an acceptable delta-v after the probe escapes Earth gravity. Delta-v following Earth-escape is just a little over 3.2 kps. That includes outbound midcourse maneuvers, rendezvous impulse, and station-keeping energy requirements. A "park-and-poke" mission is the way to go.

The Aten Rendezvous Probe, or ARP, would be launched in July of 1992 using a single shuttle, plus upper stages like IUS-twins and a spinning upper stage (or their equivalent; perhaps a souped-up Centaur or a totally new Space Tug-type upper stage).

Flight time to Aten is 198 days. ARP would arrive at Aten in late December 1992 or early January 1993, depending on the precise launch date. At no time would the probe be more than 22.5 million km from earth. Figure 1 shows a graphic of the Aten mission.

ARP would have a total weight (or more properly, *mass*) of 500 kg, about twice that of the Pioneers that went to Jupiter and Saturn, about 300 kg less than the Voyagers. The main bus would mass about 340 kg. Two landers would mass 80 kg each. If penetrators were used instead of or in combination with a lander, they'd mass about 40 kg each.

We've already mentioned the kinds of science instruments an asteroid probe would carry, and ARP would have a full complement—100 kg total, with 81 kg in the main bus and about 18 kg in the landers or penetrators.

(Two penetrators could be substituted for one lander with no real change in the mass of the ARP.)

The main bus/orbiter gets power from solar panels (about 90 watts would be needed to drive the instrumentation). The landers/penetrators get power from RTGs, radioisotopic thermoelectric generators similar to those used on Voyager. Three watts will do the job for the instrumentation.

Aten is very small, probably 0.9 km in "diameter." It has a very small gravitational field, too. Rendezvousing with Aten will not mean orbiting it (though it certainly could be done); likely it will be more like station-keeping, flying in formation with the asteroid. To image features an order of magnitude smaller than Aten's diameter (100 meters) at a resolution of 2 arc-seconds (the *current* limiting effective resolution of spacecraft cameras) the ARP will have to be at least 1000 km from Aten. Closer is better. It needn't orbit the object to get total imaging coverage; likely Aten rotates, and that will carry all its surface past the cameras and other instruments.

It may come as a surprise, but there is very little about the ARP and its instruments that is all that exotic. Most of the scientific instruments either have been flown before or have been studied in detail for now-cancelled missions like the Lunar Polar Orbiter. The only "new" technology would be penetrators—and those have been tested by NASA/Ames

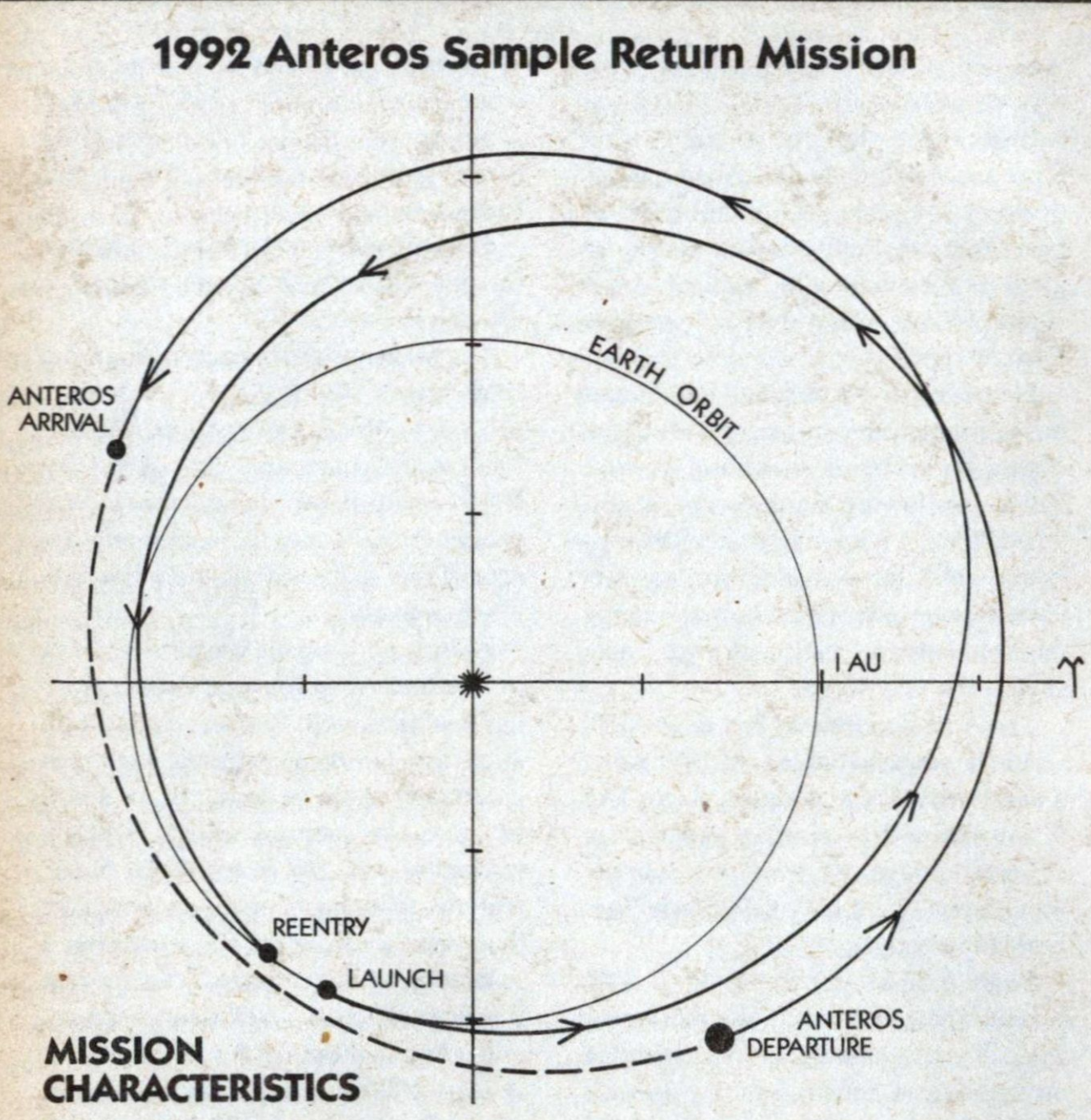

Figure 3. Diagram of Anteros Sample Probe Mission. Inner circle is Earth's orbit; dashed line, Anteros's orbit. Arrows show ASP trajectory to arrival at, then departure from, Anteros. (From Niehoff, 1978, ref. 8.)

Research Center and the Department of Defense.

Asteroid Mission: Anteros

(1943) Anteros is an Amor-class asteroid more properly called a Mars-crosser; its aphelion lies beyond that of Mars, at the inner edge of the main belt

(see Table I; asteroid (7) Iris has a perihelion of 1.87 AU, close in distance —though not location—to Anteros's aphelion).

Launch windows to Anteros open up every 2.4 years. The asteroid's low orbital inclination makes it a very good target for exploration. In fact, it has the lowest delta-v for exploration missions of all currently known asteroids. Its eccentricity of 0.256 is not the best—it's 70 percent more than Aten's—and it limits the times for certain kinds of missions. A fast one-year sample-return shot is always possible, but with extremely high energy requirements. On the other hand, a low-energy sample-return mission can be carried out only once every 12 years. The next available launch window for such a mission is in 1992. And that's not all that bad. As with the Aten mission (in fact, as with *any* planetary exploration mission), we'll need the lead time.

So: the Anteros Sample Probe, or ASP, would be launched from Earth orbit in May of 1992 using a simple shuttle/twin-IUS vehicle. Its outbound coast will get it to Anteros by August 1993, 15 months later. The probe will decelerate, approach Anteros over a period of several days, and conduct a photoreconnaissance of the object.

We don't know too much about Anteros other than its orbital elements. We don't even know its diameter at this point. The cameras and other instruments aboard the ASP will glean information about the asteroid, look for a place to land, and get a sample.

After landing, the probe will stay on Anteros for 177 days or so—a long time, but necessary. The ASP must wait for Anteros to move to a point in its orbit for an optimal return trajectory to Earth. That happens on Feb. 14, 1994. The ASP plus sample will launch from Anteros and coast back to Earth entry on May 14, 1995. Earth entry speed: 12.7 kps. Total mission time: three years.

The total ASP mass, including propellants, will be about 1700 kg, the same as Voyager-plus-Earth-escape-propellants. The bus will be about 250 kg; the science payload for encounter with Anteros, around 150 kg. The lander will mass 350 kg; Earth entry capsule: 29 kg plus a 1-kg Anteros sample for a total mass of 30 kg.

ASP's post-Earth-escape delta-v is actually less than the Aten mission's: 2.731 kps total post-escape delta-v. The biggest single increment is 1.566 kps for departure from Anteros for Earth intercept.

In one sense, the ASP is more sophisticated than anything the U.S. has ever done, since we have never carried out a sample-return mission. However, the Russians have done lunar sample-returns successfully, and the Viking landers, with their sophisticated scoopers, were pretty complex.

In point of fact, both the Aten and Anteros missions are of about the same level of complexity as the planned Galileo orbiter/probe to Jupiter, now scheduled for launch in 1985 or 1986 (maybe . . .).

We can bring home a sample of an Earth Approach Object in eleven years. We can have a genuine two-pound piece of asteroid in our hands in time for the

19th anniversary of the Viking Mars landing—and before the third anniversary of the Aten rendezvous.

Asteroid Mission: The Main Belt

In some ways a main belt mission is both the easiest and the hardest to do. Main belt asteroids are farther from Earth than EAOs, which means trip times can be longer. On the other hand, there are *so many* of them. That makes multiple flybys and rendezvous nearly as easy as a single-shot mission. Flybys are quicker and take less delta-v; but they don't produce a lot of good data unless the probe makes very slow passes. Rendezvous missions take a lot longer and more delta-v; but they produce a great deal of data, especially if hard lander or penetrator probes are used. It all depends on what you want. So let's take a look at examples of both.

First, what asteroids do we want to look at? At the top of almost every list of multiple flyby missions is (4) Vesta. This 555-km body is unique in the asteroid belt. Earth-based observations indicate it's covered with basalt-like material, and that suggests global chemical-geological differentiation. Is Vesta a primordial asteroid—one of the parent bodies that had time to generate internal heat and differentiate like the larger terrestrial planets, but escaped the shattering fate of the other primordials? Is Vesta indeed the source of meteorites called achondrites? Is it still geologically active? A flyby might, and a rendezvous-and-probe could, begin providing answers to the mysteries of Vesta.

Nearly as high on our list are some M-type (metallic) asteroids, like (16) Psyche. More than 200 km in diameter, Psyche seems to be a huge metal-rich object. Is it the core of some now-shattered primordial asteroid? That question could be answered, and we might also learn more about the precise chemical composition of the intriguing—and possibly valuable—M-type asteroids.

We'll also want to look at some large C-type asteroids, like (1) Ceres, the largest dark C-type (and largest asteroid, period, at 1,025 km diameter) body known.

Of course, if we get a chance we'll look at anything else interesting that comes our way, including S-types and unclassifieds. People who've studied multiple flyby missions to the main belt have found that, once you determine the flight path parameters to an initially chosen target, literally thousands of possible missions emerge.

Example one: Using an advanced Ariane booster, a 692-kg probe (spacecraft mass, 395 kg) launched June 18, 1986, will do flyby encounters of (1798) Watts (197 days post-launch), (1772) Gagarin (397 days), Vesta (479 days), and our old friend Anteros (866 days, or 2.37 years post-launch). Total post-launch delta-v: 1.4 kps. Average flyby velocity: 6.825 kps.

Another flyby example: An Ariane-launched probe massing 580 kg total (spacecraft, 290 kg, Pioneer-equivalent), leaving Earth on June 3, 1988, will encounter (253) Mathilde, (1091) Spirea, (621) Werdandi, Ceres, and asteroid 1924/69BA. First encounter occurs 197 days post-launch; Ceres encounter is 544 days post-launch. The

entire mission lasts two years. Post-launch delta-v: 1.7 kps; average flyby velocity is also 6.8 kps, with the Ceres flyby at 5.7 kps, only 1.1 kps more than the Vesta flyby speed in example one.

The European scientists who drew up these (and other) scenarios believe the probe could carry about 50 kg of scientific instrumentation. They suggest a high-resolution CCD camera could get 20-meter resolution on images.

The closer we get to an asteroid and the slower we fly past it, the better resolution we get, and the better chance exists for other remote observations, such as chemical analyses with x- and gamma-ray instrumentation. However, that also means using more energy to slow the spacecraft down for a leisurely flyby. Eventually we reach the point when it's better, in terms of fuel expenditure, to forget about flybys and go to out-and-out rendezvous missions — orbits or station-keeping.

Now we're talking about something completely different from what we've discussed so far. For main belt rendezvous missions it's more fuel-efficient to forget about space-storable chemical fuels and ballistic flight paths and instead go to a probe with an ion drive—a powerplant much like the recently cancelled SEPS drive for the proposed U.S. Halley Comet rendezvous probe.

A Halley rendezvous is now out of the question for NASA; the 'lead-time' window for such a mission is long past. SEPS, though, is not completely dead and gone. Prototypes have been built, and two are in orbit, still working on experimental satellites. It is still possible to build and use a 60-kilowatt SEPS for a 1987 multi-asteroid rendezvous mission.

The mission would be as follows: A 500-kg mission module, with five 75-kg surface probes, would be launched on October 3, 1987 (the day before the 30th anniversary of Sputnik 1; how's that for timing!), using a shuttle/IUS-twin/60-kw ion drive. The ion drive would spiral the probe out on a non-ballistic path reaching Vesta (target Numero Uno) on May 14, 1989. The probe would station-keep at Vesta for three months, dropping a hard lander to the surface and relaying data back to Earth: chemistry, magnetism, seismic events, and lots and lots of pictures. Complete global coverage of Vesta down to whatever resolution we can get away with (how close do you want to approach Vesta?).

After three months the probe departs and spirals out on its ion drive to the next target, reaching (67) Asia about two years later. Same procedure; then on to a rendezvous with (377) Campania in February 1993. Then on to Target Numero Dos: Psyche, the big metallic mass that could be the iron core of a shattered asteroid (and if it is, what a bonanza!). The probe reaches Psyche on October 7, 1994, four days before this author's 46th birthday (reasonably good timing). Yours truly gets a nice birthday present and covers the event live from Mission Control for *Analog*.

We can end the mission at Psyche; or we can send the probe on to a fifth target, (179) Klytaemnestra, with arrival on May 31, 1996.

Total mission time: 8.7 years, with

asteroid encounters happening on the average of every 20 to 21 months.

After the 1990s

These missions constitute the *beginning* of our exploration of the asteroids. They will lay the groundwork for the commercial exploitation of both Earth Approach Objects and main belt objects. Mission costs will probably run between $300 to $600 million (depending on the complexity of the mission: flybys are cheapest, sample-returns the most expensive; one-target missions more expensive overall than multiple-target missions, which return more data per buck). Those costs will, of course, not be a lump sum, but spread out over the lifetime (five to ten years) of each mission. A $600-million asteroid exploration mission, with costs spread out over ten years, would cost each American about 26 cents per year. The "crass" economic return from these missions could well be staggering.

What next? What will we do after the 1990s? Manned asteroid missions. Asteroid mining operations. The capture of a small Earth Approach Object that will be towed into Earth orbit for mining operations. Perhaps even more.

The late Dandridge M. Cole wrote about it in 1964 in his seminal book, *Islands In Space*. Take an asteroid some 30 km long and 15 km in diameter. Hollow it out (i.e., mine it from the *inside out*, going in from the ends). Cap the ends, fill the inside with Earth atmosphere, topsoil, rivers, and lakes. Use a solar mirror to reflect sunlight down the long axis.

And then move in.

If this sounds like an O'Neill colony, you're right. If it sounds like Larry Niven's "Confinement Asteroid," or New New York in Joe Haldeman's new novel *Worlds*, right again. Great minds often move in the same direction.

And the direction is *out*.

To the asteroids. ■

ABOUT THE AUTHOR

Joel Davis (who is not a clone of the president and publisher of Davis Publications) is a freelance science writer and frequent contributor to *OMNI, Astronomy, Science & Mechanics*, and other periodicals. Formerly science editor of the *Spokane Community Press* and contributing editor for *Star & Sky*, Mr. Davis lives in Olympia, Washington.

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TABLE II

DELTA-V FIGURES FOR SELECTED ASTEROID MISSIONS

Asteroid	Orbital Type	Launch Date	Mission	Post-Launch Delta-V To Rendezvous
Watts	Main Belt	6/18/86	Flyby	1.4 kps
Gagarin	Main Belt			
Vesta	Main Belt			
Mathilde	Main Belt	6/3/88	Flyby	1.7 kps
Spirea	Main Belt			
Werdandi	Main Belt			
Ceres	Main Belt			
1924/69BA	Main Belt			
Aten	Aten	7/13/92	Rendezvous	3.2 kps
Anteros	Amor	8/20/93	Sample Return	2.7 kps

Based on data from Refs. 8-11.

TABLE III

PAYLOADS FOR ASTEROID RENDEZVOUS

Main Bus (Mass = 340 kg)	
Instrument	*Mass*
1500-mm CCD camera (800 × 800), multispectral (8 filters) 250-mm CCD camera (800 × 800), multispectral	20 kg
X-ray fluorescence	2 kg
Gamma-ray	17 kg
Mapping spectrometer	10 kg
Multispectral radiometer	7 kg
Radar altimeter	12 kg
Fields and particles package	10 kg
Micrometeoroid detector	3 kg
Tracking	—
TOTAL INSTRUMENT MASS	81 kg
Lander (Mass = 80 kg)	
Facsimile Camera	1.5 kg
Alpha-backscatter/proton/x-ray fluorescence	2.0 kg
Seismometer	2.0 kg
Magnetometer	0.6 kg
TOTAL INSTRUMENT MASS	6.1 kg
TOTAL MASS OF RENDEZVOUS PROBE: Main bus structure, solar panels, comdish, etc., 259 kg; + main bus instruments, 81 kg; + two landers (80 kg × 2), 160 kg = 500 kg.	

Data from Table 2, Fanale, *Asteroids: An Exploration Assessment.* NASA Conference Publication 2053. NASA, 1978. p. 202.

The Alternate View

CREATIVE EVOLUTION?

G. Harry Stine

A controversy has been raging for more than a century between the Darwinian evolution theory advocates and those who believe that some superior entity brought forth all the life on Earth in a short spasm of creativity a few thousand years ago. This controversy has been brought into modern focus by the recent legal battles in Arkansas and Louisiana, where more emotion than logical thought has prevailed.

Regardless of which side a person chooses to take, one must possess a degree of faith or belief in the validity of the data supporting either position.

The "creationists" rely on the written word of a single document, unknown thousands of years old, that is the translation of other documents from other languages which are even older and which, in turn, were based on often-told and retold verbal stories and accounts whose origin is lost in antiquity when mankind was an infant species. There is no way to verify the beliefs; one must simply accept them.

The "evolutionists" also rely on belief. But their reliance is in the veracity of other human beings who have recorded and reported findings from the laboratory and the field. Many other persons have repeated the experiments or visited the field sites to confirm the original findings. One must therefore believe the verification reports or suffer from severe paranoia. Basically, if one wishes to take the time and effort to duplicate the laboratory and/or field work, one may independently confirm the findings.

Darwin drew quite rational inductive conclusions from the data he collected in the last century. It led him to a theory that life on Earth evolved—i.e., changed slowly—from simpler to more complex organic systems on the basis of continual environmental pressures. The organic systems that manage to survive long enough to breed progeny are thus perpetuated; those that do not become extinct.

During the intervening years, the "whys" involved in Darwin's propositions have been investigated, and new theories and data brought forward. It's been discovered that alterations in the composition and structure of the DNA molecule and genetic material can be brought about by chemical or electromagnetic energy. Most of the resulting mutations are lethal, but a minuscule percentage are subtly different from their parent(s). This takes a long time and a large number of organisms.

The Universe (read also as "Nature," "Mother Nature," "The Environment," or even "God") appears to thrive on quantity, with a methodology that appears to be wasteful. The individual organism matters not, nor does

family or species. Only life itself seems to be at stake on this planet. With such enormous numbers of organisms, probability and random choice can be quite effective in producing evolutionary change over periods of time relatively long in comparison to that during which human scientists have observed and contemplated the situation.

However, new data is now in hand that may require a major modification of Darwinian evolution theory, perhaps bringing it closer to the creationist beliefs. The big question is *not* whether creation or evolution is the truth, but whether or not people will be willing to change their minds in the face of this new data. In view of the historical resistance to change exhibited by scientists with regard to data suggesting the need for revisions to the theories of relativity, this may take time.

One of the big problems with evolution theory is the requirement for the creation of complex organic molecules by random chance. Given the primordial soup of the pre-life Earth with its reducing carbon-dioxide atmosphere (probably similar to that of Venus and Mars today), experimenters—starting with Miller in 1952—created critical amino acids in the laboratory by subjecting various mixtures of inorganic chemicals to electrical discharges. Therefore, the amino acids necessary to form the building blocks of DNA and various enzymes could have been created by random chance. But when it comes to the 2,000 or so enzymes that appear to be critical for the existence of terrestrial life, the odds against the proper arrangement occuring by random chance becomes enormous. If only 15 sites per enzyme must be filled by particular amino acids, the probability of achieving the proper set by random chance is one in $10^{40\,000}$, which is ten with forty thousand zeroes after it—more zeroes than there are letters in this entire "Alternate View" article. This number exceeds by many orders of magnitude the number of all the atoms in the entire observable universe. As Isaac Asimov has pointed out in this magazine ("Hemoglobin and the Universe"), there hasn't been enough matter or time since the beginning of the Universe for the critical hemoglobin molecule to have been formed by random chance.

This apparent, extremely low probability of random chance causing the formation of the basic building blocks of organic life brings up a fascinating speculation that may be considered as a synthesis of evolution and creation, or "creative evolution" if you will.

Some manner of creative force must have not only functioned *before* and *at* the moment of creation of the Universe, but also *since then* in the deliberate creation of *not* the complex living organisms but the basic complex organic molecules of which such complex systems are built.

Is there any data to support this speculation?

Sir Fred Hoyle and Nelin and Dayal Wickramasinghe have developed a panspermia theory and produced some data based upon the possible composition of interstellar dust. Nelin Wickramasinghe showed theoretically that a polymer molecule built from formaldehyde components could explain some of the infrared absorption characteristics seen in astronomical observations. One of

Wickramasinghe's students determined the infrared absorption properties of dessicated microorganisms—*E. coli*, *Lactobacilli*, blue-green algae, and yeast cells. The I-R absorption characteristics or "thumb print" of each of them was the same. Then Dayal Wickramasinghe observed the I-R flux from the astronomical source GC-IRS 7 using high spectral resolution over a wider bandwidth than ever before. This light had to pass through about 30,000 light years of interstellar dust. When the brothers Wickramasinghe compared their separate data, the two I-R absorption curves matched 100%!

There are bacteria in interstellar space.

More data confirms this. Some carbonaceous chondrite meteorites contain structures resembling fossil microbes. Very special contamination-proof techniques have been used to identify 17 amino acids within a carbonaceous chondrite called the Murchison meteorite, and H.D. Pflug has reported finding "definite existence of bacterial and fungal microfossils" in the same meteorite. NASA balloon experiments have detected living bacteria in the Earth's upper atmosphere.

Arrhenius's panspermia concept may have some validity to it after all.

There has always been a major theological and philosophical paradox concerning whether God or the Creator (or use your own favorite name for the phenomenon) created a perfect Universe and therefore, being perfect, didn't have to be involved with it any more; or whether God created the Universe, then had to stick around to correct discrepancies and keep it working. It may not be a paradox. This Supreme Being may have done *both*. After all, the incredible heat and radiation flux of the primordial fireball wouldn't permit life to exist. When the fireball and the Universe cooled down enough, life apparently couldn't come about by random chance and had to be created throughout interstellar space. The organic chemicals and bacteria then rained down from space onto planets. Once seeded on a planet, life could then evolve on Darwinian principles *with the additional factor* that microorganisms of various sorts continued to fall upon the planet, adding "panspermic mutation" to the Darwinian mutations occurring because of chemical and electromagnetic forces.

Sometimes an alternate view is useful in creating a new synthesis of existing data that appear from some viewpoints to be antagonistic or paradoxical. Alfred Koestler defines the act of creation as the bisociative synthesis of random matrices. And that's just what we've been talking about.

In the long run, it may not be necessary at all to make a choice between creation and evolution. It could well be that both contain elements of truth. But these elements may never be found if advocates of either demand that a one-or-the-other choice be made.

After all, I know of no aspect of any area of science that denies or refutes the existence of a superior entity or creator.

Or perhaps we should instead sit around debating how many angels can dance on the head of a pin? ■

● Arm the law, not the litigants.

Norman Angell

Gary McDonald

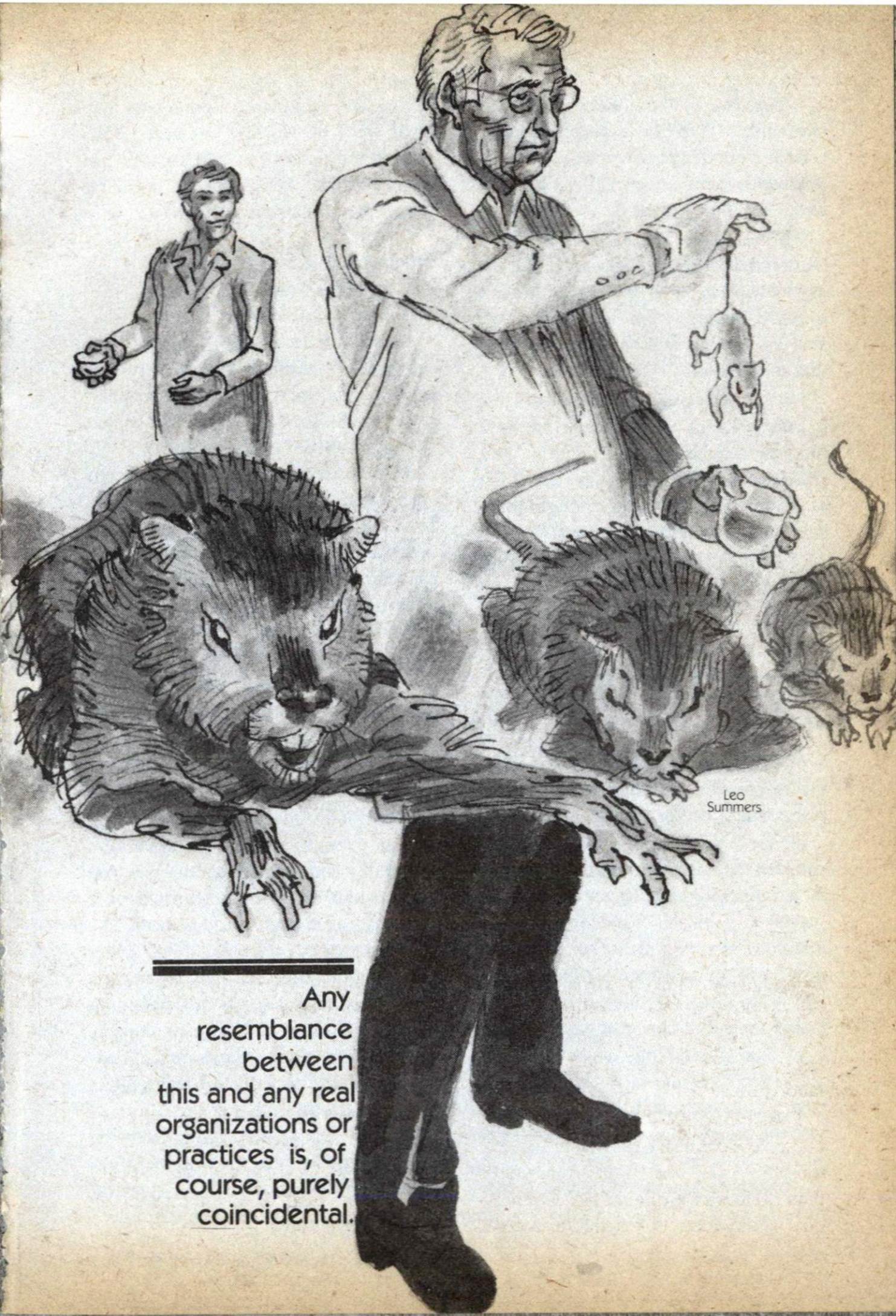
THE UNFOOD

Doctor Stark. The title still sounded too big for me. But here I was, out of Harvard with a Ph.D. in biochemistry, starting a career in the FDA's testing laboratories.

I sat rather stiffly by Dr. Leblanc's cluttered steel desk. He was a real doctor, an M.D., and twenty years older than I. He was as relaxed as I was nervous; if anything, my agitation seemed to help him to relax. A radio on his desk was playing rock music at a barely audible level, but it reminded me of nights when I was kept awake as an undergraduate, and it made me feel worse.

"Are you all settled in Rockville yet, George?" he was asking me.

"More or less, Dr. Leblanc," I said. "I've got most of my things in the apartment by now."



Any resemblance between this and any real organizations or practices is, of course, purely coincidental.

"You can call me Rick," he said cheerfully. "We like to keep things informal around here. I'm sure you'll like it around here—none of those infernal Massachusetts winters."

He picked up a newspaper from his cluttered desk, exposing a nameplate to my view. What was on the plate wasn't a name, though, but the word TANSTAASL. I pointed to it and asked, "Isn't that misspelled?"

Dr. Leblanc laughed. "No, that's just a little joke of mine. There are free lunches to be had today, but what that stands for is 'There ain't no such thing as a safe lunch.' That really ought to be the motto of the FDA, don't you think?"

"Well, there are certainly some safe—"

"No, George, nothing's really safe. Some things are just less dangerous than others, and you have to eat *something*." He opened a drawer and pulled out a roll of mints. "Have some?"

"Not right now, thanks." I was starting to feel that working with Dr. Leblanc would be something of a strain.

He took a mint off the end of the roll and inserted it into his mouth, then went on talking without letting it impede his speech very much. "Take this stuff, for instance. It's got more sugar than I need, and it could hurt my teeth. So I live with that. Anything you eat has things in it that can hurt you. People have died of drinking too much plain old water. Our job is to find out just how unsafe the lunches are, and make sure the more dangerous ones don't get out."

"I suppose you could look at it that way," I said.

"In fact, that makes a good lead into what we'll be working on here." He opened the newspaper and showed me a short article. Wrinkling his nose, he said, "Read that."

The Unfood?

BIG MARKET SEEN FOR
"NOTHING MUNCHIES"

Morrow Chemical of Philadelphia may be just a minor chemical supply house today. But they're hoping to make it big in the food industry with a new delicacy called "Nothing Munchies."

What makes this treat different from anything else, says President John Morrow, is that it has NO nutritional properties at all. Even diet soft drinks have saccharin or other sweeteners in them, entering the bloodstream and just possibly causing health problems. But Nothing Munchies break down completely in the stomach, leaving nothing at all to be absorbed—yet they leave you feeling full for hours.

"This is going to drive the FDA bananas," says Morrow. "It's the perfect dietetic food. It does absolutely nothing to you, even if you pour it down a rat's throat day and night. The only way you can get hurt by Nothing Munchies is if a carload of it lands on your head."

Consumer advocate Randolph Zener has a slightly different view of the merits of what he calls "the ultimate junk food." "Even if it's safe, it's dangerous," Zener said in an interview. "People will snack on this stuff and neglect proper nutrition."

Morrow has applied for a patent on the synthetic formula for Nothing Munchies, but it must await FDA approval before it appears on the shelves.

"Morrow's throwing it right in our faces," Dr. Leblanc said with barely concealed anger. "But we'll see how safe that stuff really is. I'm putting you in charge of the tests on it."

I sat up abruptly. I had thought my first assignment would be something safe and obscure until my superiors got some confidence in me. But this was obviously a product that millions of people might be consuming in a few months. My stomach knotted itself as I thought of how many lives would depend on the accuracy of the tests we were about to conduct. This realization made me put aside the unpleasant feelings I had been starting to have about Dr. Leblanc.

"That's quite a confidence you're putting in me, D—doing something like that for my first job." It seemed especially wrong at the moment to address him in a familiar way, but I didn't want him correcting me for calling him "Doctor."

"We think you deserve it. Your professors said you're already an expert at running a lab. And we'll give you lots of help, of course. Now here's what we have in information on the Gloop." As he went to a shelf to get a notebook, I realized he wasn't as tall as I had thought; it was his rank and manner that made him seem to tower over me.

He rattled off the chemical name of the sole ingredient of Nothing Munchies. "And, of course, 'Gloop' serves as a fine acronym for that. According to Morrow's claim, Gloop breaks down completely in the digestive system, producing compounds that are utterly unreactive and unabsorbed, along with some water and CO_2. The only thing you can get out of it is stomach gas. So that's the first thing we want to see. If it turns out that anything else gets into the bloodstream of animals that eat Gloop, we can say he's a liar and put the ball back in his court."

I spent most of the next couple of days just learning my way around the lab. Most of the techs were a bit of a disappointment to work with after having sharp undergrads to do coolie work, but a certain Alice was able to make up for the mistakes of the others, and even for my own foundering.

Working with Dr. Leblanc continued to be a strain. I'm still not sure whether it was his obvious hope that something deadly would turn up in whatever he tested, or his way of twisting phrases, or maybe just the subliminal effect of his AM radio, but I tensed up every time I saw him. And every time I tensed up, he would become even more relaxed and twist even more phrases.

But it was more important to me that this was my first job and the start of a career. After I had been here a year or so I might be in a position to look for a more congenial situation, but right now the onus was on me to prove myself.

The first test I ran was to taste some Gloop. It came in a pale tan bar that chewed like a dry cake. It had a hot and tangy taste, and a flavor artist could easily have doctored it to taste like pepperoni. The samples Morrow gave us had no artificial flavor or color, of course, but I could see that Nothing Munchies could easily catch on with proper packaging.

We got the real tests going by the end of the second day. It took the rats a little

while to decide the stuff we had put into their cages was food, but once they did, they devoured it eagerly. We ran blood tests, stomach content tests, and autopsies. At one point we thought we had detected a high sugar content in the test animals, but Alice found out that someone had made a mistake copying a figure.

It wasn't too long before I started to understand what I was doing, and the tests started to go smoother. I even managed not to grimace when Dr. Leblanc would request more Gloop from supplies by asking for "Unfood to feed them all, unfood to find them."

After two weeks we had to admit that Morrow's claim was accurate. None of the breakdown products of Gloop showed up anywhere beyond the digestive tract, and a day after eating there wasn't a trace even there. In fact, the products turned out to be highly stable polymers that just weren't going to do anything to rats or people. The only effect on the bloodstream was a barely detectable trace of ethyl alcohol—less than you'd get by opening a bottle of beer and drawing a deep breath.

Dr. Leblanc and I discussed the results in his office, away from the laboratory smells of formaldehyde and ether. "It looks okay so far, George," he said, mint in his mouth, "but we have to be sure. If we make a mistake and say it's OK to eat Gloop when there's some insidious danger in it, all those lives are on our hands. And besides that, I really don't like Morrow." He handed me his newspaper, already opened and with a headline circled in red.

DEBATE ON
"NOTHING MUNCHIES" CONTINUES

Randolph Zener yesterday renewed his assault on Morrow Chemical's forthcoming product, "Nothing Munchies." Speaking before the annual meeting of the Coalition for Better Nutrition in Atlantic City, he said, "It's bad enough that Morrow is planning to cram his junk down the throats of Americans. But he's even planning to export it to countries with worse nutrition problems than ours. Will people in these countries start starving to death with their stomachs full? I don't think Morrow would care if they did."

Morrow responded in an interview by thanking Zener "for all the free publicity he's giving us. Unfortunately, we haven't figured out a way to make Nothing Munchies into a baby formula, or we could really give him something to scream about. There's still hope for him, though, if the FDA declares Nothing Munchies are a hazard to human life."

"How can anyone have that sort of gall?" Dr. Leblanc cried.

"Don't let it bother you, Rick," I said. "He's just having fun baiting Zener. And us too, I suppose."

"But he really ought to have more respect for us. Doesn't he think we're doing the public a service by protecting them from dangerous stuff, or doesn't he care?"

"There are people who resent the fact that we decide for them what's safe and what isn't. Maybe Morrow was once a cyclamate addict, and he's never forgiven the FDA because he can't get it any more."

"Maybe. I'd never try to guess what may come to Morrow. But there are still more tests we have to run. And it'll be a while before the cancer tests turn up any results. The next thing will be to check the internal organs of the animals to see if any tissue damage results from contact with Gloop while it's breaking down. That shouldn't take long."

It didn't. No test that we could devise showed any effect on the rats other than increases in water and carbon dioxide levels. There was no statistically significant difference in any test between the "Gloop group"—Dr. Leblanc's phrase, of course—and the control group. We soon abandoned the cancer tests, since none of the breakdown products of Gloop was a conceivable carcinogen.

The only harmful effect that Nothing Munchies had was on Dr. Leblanc's blood pressure; the longer we went without discerning any harmful effect, the more frustrated he grew.

Nonetheless, the complete lack of positive results kept us moving at record speed. After eight weeks we were ready to give Nothing Munchies a clean slate, but he still couldn't endure the prospect. "There *has* to be something dangerous about Gloop," he said. "It isn't right that something can go through a digestive system and not have *any* effect."

By now he had a collection of a dozen clippings on Morrow and Nothing Munchies. He pointed to them angrily and said, "Damn Morrow, and damn Morrow, and damn Morrow! You've got to find something wrong about Gloop!"

"But suppose there isn't anything wrong, Dr. Leblanc?" I asked.

He picked up the TANSTAASL plate on his desk and waved it at me. "There has to be. We just haven't figured it out yet! It's a food made by an idiot, full of munching and crunching, nutrifying nothing!"

In an effort to calm him, I facetiously suggested, "We could feed rats nothing but Gloop and watch them starve to death. Would that be good enough?"

His hand stopped in mid-air, still holding the plate. "You may have something there," he said slowly. "Not anything that crude, of course." He put the plate down and looked through the clippings that were lying on his desk. "Of course!" he said. "Why didn't I pay some attention to Zener instead of just getting upset over Morrow's ravings?"

For half a minute the only sound was the occasional footsteps going by and the low-volume wail of an alleged singer on Dr. Leblanc's radio. Then he said, softly but eagerly, "All right, George, here's what we'll do. Put the rats where they can get all the Gloop they want. Also let them have real food—but force them to cross a mild electric barrier to get to it. Just enough of a shock so they wouldn't cross it just for the exercise, but they would if they got hungry enough. Then we'll see whether they go after the food or contentedly starve on Gloop. If they starve, then clearly Zener is right, and Gloop is too dangerous to put on the market."

I stared at him in astonishment. "You're kidding, of course," I said, forcing my voice to stay even.

"Not at all," he said, smiling. "Look at it this way. Gloop has no nutritional value at all. People really could eat it and neglect real food. And our job is

to protect people from consuming dangerous things."

"But you could say the same thing about diet soda," I protested. "And we certainly can't ban that just on the basis of it not having any nutrients."

"We're not banning anything ourselves, George. That's the job of the bureaucrats far above us. We just make tests and recommendations. If they ban it, that's their decision. Ours is not to reason why, ours is but to make rats—"

"Stop that!" I cried in agony. He looked at me in mild surprise; I had never openly protested his literary perversions before. I took a couple of slow, deep breaths and then asked, "But what would you recommend to the commissioner if the rats do starve?"

"That Gloop be banned. But they can take that or leave it. All we did was run an honest test."

I stood up and looked at him, still barely able to believe he was serious. It might be a difficult world out there, but it couldn't be this bad. "Sit down, George," he said doubtfully.

"Why?" I asked beseechingly. He knew I wasn't referring to the question of my posture. I kept looking at him and finally admitted to myself that he really meant what he had said.

"Sit down," he said, this time more forcefully. He drew himself up, hands on the arms of his chair, and said, "Are you going to run that test, or will I have to find someone else?"

I sighed; he just didn't make a convincing dictator. "You'll have to find someone else, Dr. Leblanc," I said. "I'm leaving."

He nearly choked on his mint as I walked out of the office.

Ten minutes after the personnel officer learned who I was, I was talking to Morrow himself. His office was an old-fashioned one with a large oak desk almost as cluttered as Dr. Leblanc's. He was thirty-six years old and as extravagant in his speech and gestures as he was in print. "You worked for the FDA?" he burst out. "On Nothing Munchies? And you expect me to hire you?"

"I don't expect anything," I answered. I felt a bit of the nervousness I had felt on my earlier interviews and on my first meeting with Dr. Leblanc, but it no longer bothered me quite as much. "But my experience there shows that I know something about how to run a lab and conduct tests. And my leaving there shows that I know when a test is too silly to run."

He looked at me with what seemed to be amusement. "You may have some sense at that," he said. "I thought that was something they didn't teach on the banks of the Charles River. Or the Potomac, for that matter." He stood up, walked once around his office, then sat down again. "All right," he said calmly. "Let's assume for the moment that you do have sense. What exactly did you do while you were at the FDA?"

We talked for half an hour. After the first two minutes, Morrow dropped his extravagant manner and talked like a scientist—or at least the way I had always thought scientists ought to talk, probing for the facts and relishing them. At the end of the interview, I had the job of assistant to the Morrow development lab's chief biochemist.

Toward the end of the interview, I said, "I really am sorry about the fact that the FDA banned Nothing Munchies. I liked them myself."

"Don't worry about it," he said. "I figured something like that might happen, so we drew up an alternate marketing plan, which we're going to launch next week." He showed me the proof of an advertisement with a cartoon of a dead rat at the top. The text read:

STOP RATS
THE SAFE WAY!

Why use messy traps or dangerous poisons when you can get rid of rats *safely?* Get Morrow's Rat Munchies and *starve* rats to death! Put a supply of Rat Munchies where the rats can easily get at it, and they won't bother to go after anything else—and Rat Munchies contain no nutrition, so the little beasts will soon be bothering you no more!

Proven Effective and Non-Toxic by the FDA!!

I collapsed laughing onto the desk. What hope can a few poor bureaucrats have against a mind as devious as Morrow's? ■

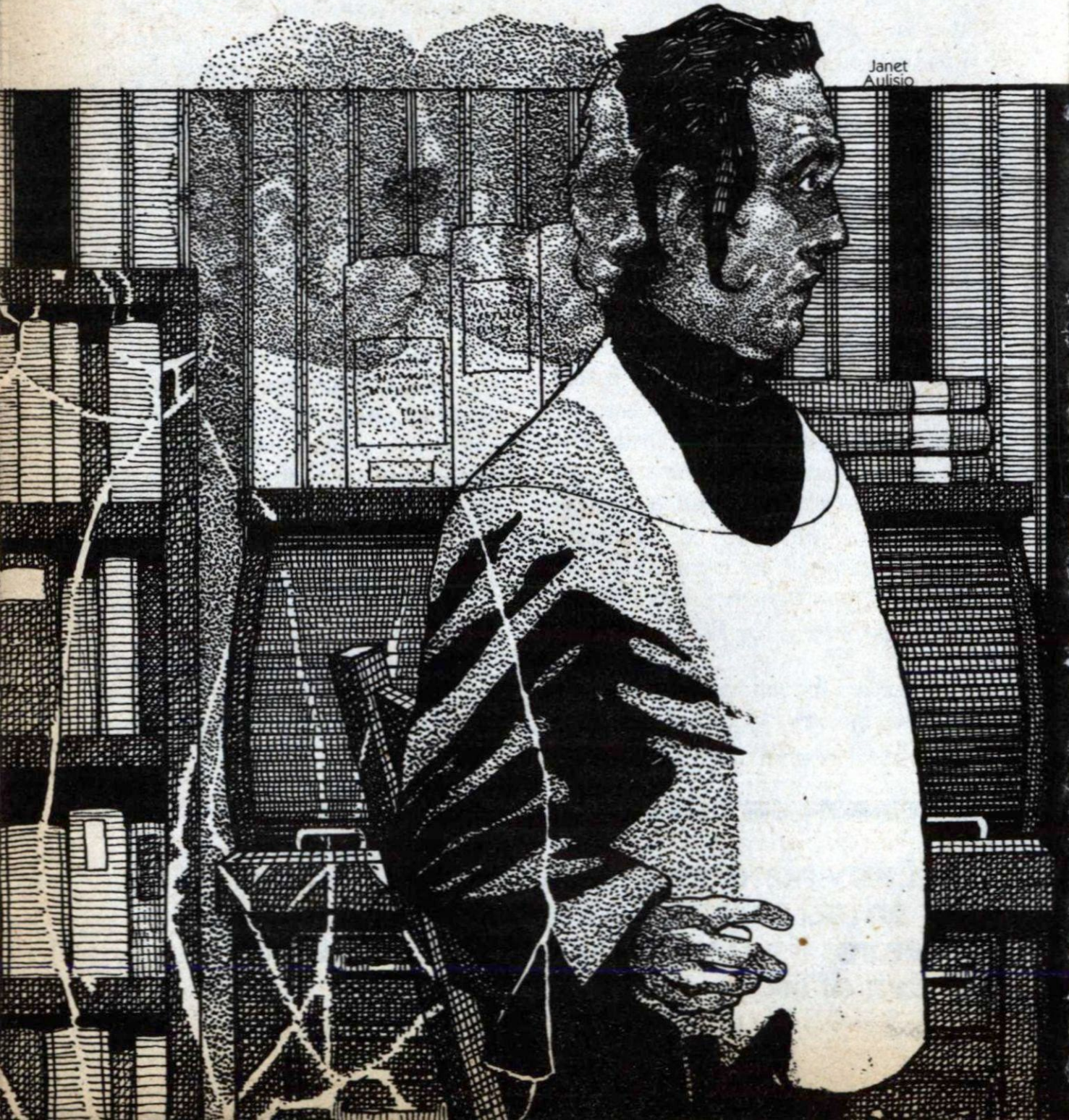
● Every human action goes back in some part to our animal origins; we should be cold and lonely creatures if we were cut off from that bloodstream of life.

Jacob Bronowski, *The Ascent of Man*

Ray Brown

LOOKING FOR THE CELESTIAL MASTER

If the essence of a human being is just information, then "matter transmission" is just the beginning of the possibilities. A body, after all, is just one form in which information can be stored....



Adept Bulgakov was reborn on Alpha Centauri IV still clutching the note, staring at it with tired eyes:

Rpt immed Octopus Bay RSMC floor 17, personal staff Isaac Bentz

Adolph, Magus,
Board of Missions

When he materialized, he felt the little rush that came with suddenly reduced gravity. For him it was not a pleasant rush. He clutched at the knot in his pot belly, grimaced with pain, and looked up. There was an Adept seated by the control board, white-smocked, like himself, with a knotted forelock, like himself. A panel of green light against black displayed the cost: *91176 gm 1.8¢ = $1641.17.*

Bulgakov reached into a kangaroo pocket for his voucher book.

"The Board of Missions is handling this," he said.

"Excuse me, Adept," the other Adept said, "but you are Bulgakov, are you not?"

"Yes."

"Then your voucher won't be necessary. I've got a note here saying that your trip is to be paid for out of general Church funds."

Bulgakov's eyebrows shot up in surprise, then twisted down again as his stomach gave him another searing jolt of pain. This assignment was taking on the qualities of an Initiation—it was like being led blindfolded from station to station. The Reformed Sufi Church was being entirely too mysterious.

The man at the control board smiled at him. "Funny," he said, "I've seen a lot of missionaries pass through here, and you just don't strike me as the type."

"I've been at it for the last decade, but before that I was a cop. I guess it shows."

"Church cop?"

"Yeah."

"So this is probably your first time in Octopus Bay."

"That's right."

The control man's smile twisted; his voice took on a slightly bantering tone. "You're in for a treat," he said. "An inspiration. You can visit the Meditation Center here—the residence of the Celestial Master himself. . . ."

"The seat of the galaxy's spiritual power, I know. That's where I'm supposed to go—something to do with the personal staff of Isaac Bentz. Could you tell me . . . "

The control man's eyes closed tightly, then opened a hair in a resentful squint. "You mean you've been assigned to the CM?" he interrupted nastily.

Bulgakov was shocked. The man was actually showing petty envy! How had they ever seen fit to induct such a one as an Adept? And what was there to be envious of, anyway?

"I don't know where I've been assigned," he said, making his voice as mild as possible. "All I've got is an order to report there."

"Really?"

"But I don't know how to get there. Can you help me?"

"The Chamber of Commerce office is right across the street. Ask them, bud. It's their business."

There were no zoning laws in Octopus Bay. The C of C brochure admitted that the town was built low and wide because it was cheap and easy to build

that way, and if the effect was harmonious, it was also incidental.

In the fashion of old-style journalism, the brochure offered opposing architectural viewpoints on the Aycee Four Reformed Sufi Meditation Center—a neck-stretching eighteen stories high. Some people said it stuck out like a sore thumb. But that, thought Bulgakov, only showed that some people will parrot any tired old phrase that comes easily to the tongue, sounds discerning, and leaves the brain safely out of it.

As he looked up at the white facade and passed through the heavy bronze doors to the lobby, he concluded that the size of the RSMC was not only appropriate, but an esthetic plus—a gleaming bullseye around which the town appeared to organize itself, if you only looked at it the right way.

But once he was inside, he found a part of himself in agreement with the gripers; cowed and outraged at once. The lobby was vast—about five times bigger than would ever be necessary, even if the full building emptied at one time. The walls were covered with artwork. Like the front doors, the elevator doors were bronze, molded into panels showing the signs of the zodiac. They were obviously Terran antiques.

The knot in his stomach pulled tighter and he tried to calm himself.

I've been in the sticks too long, he told himself. *There's nothing really sinful in this display*. Not that much money had been spent on it. Even the doors were probably a gift and, heavy as they were, they'd be fairly cheap to transport with Transmat prices at 1.8¢ per gram. And Transmat undoubtedly gave the Church a discount.

Those doors whooshed open and he stepped inside. He pressed the button for the seventeenth floor, but the cage didn't move. Instead, a voice came from the speaker in the ceiling, saying, "Floor Seventeen is restricted. The elevator will not rise above the fifteenth floor without authorization."

"I have an appointment. I'm Adept Bulgakov."

"If you would identify yourself with the receptionist . . . "

"It's OK," another voice said. "It's him. Let him come up."

The elevator took off.

Bulgakov thought he recognized the second voice—a silky, cultured tenor with a hint of nasality in it, like a holostage announcer coming down with something.

"Doc Hayden," he asked the ceiling, "is that you?"

"It's Adept Hayden now," the voice answered.

"Damnation, boy, you've come up in the world!" Bulgakov said, privately wondering if everyone on Aycee Four had been made an Adept.

The elevator jerked to a stop and the doors opened, revealing a small, dapper man dressed in a waistcoat and doublet, but whose black hair was knotted traditionally. Bulgakov left the cage, shaking Hayden's hand.

"Have you given up medicine, then?" he asked.

"Not exactly . . . " Hayden tailed off, scratching his head. He seemed hard put to explain himself.

Something in the air got to Bulgakov's nose. He sniffed. There was a faint, alcoholic odor that suggested a hospital. He peered over Hayden's head,

but the view didn't tell him much. He was standing at one end of a hall of closed doors bathed in harsh fluorescent light.

"What sort of place is this, anyway?"

Hayden grinned, batted his forelock nervously with one finger, and said, "Why don't you come into my office, and we'll talk there."

Bulgakov allowed himself to be led down thick, bouncy carpeting to an amazing office. A quick once-over told him why the Adept at the Transmat station was so jealous. The office was really a play room full of toys, one of which happened to be a desk.

He sat in a leather easy chair across from an enormous holostage. The holostage was in the "rest" mode now, showing a looped tape of an historic moment in the life of the Celestial Master, Isaac Bentz: his arrival via Transmat, fresh from a strife-torn Earth, in Octopus Bay. He saw Bentz being reborn in the open booth, leaping for joy, and striding straight at him, eyes blazing with inner truth.

Bentz lived only one floor up. It was hard to reconcile that knowledge with all this materialistic display, however marked the things might be with religious charms.

He smiled to cover his distaste and said, "This is a real nice place. You've done pretty well for yourself, Hayden, since I last saw you on Epsilon Indi II. And that was . . . hmm, I don't remember how long ago it was."

"Twelve years," said Hayden.

"A long time."

"Yeah. We should have stayed in touch. I had a hell of a time trying to find you. Or, rather, my Neophytes did. Took them close to an hour and a half. What was the name of that place we finally sent your summons to?"

"Ecesis. It's a little farming planet orbiting close around a red dwarf."

"Nobody ever heard of it outside the Board of Missions."

"It's almost totally Reformed Sufi now," Bulgakov said, being careful to keep his voice neutral. "Aside from that it isn't much, I guess. We have none of these new developments, like restricting the access in a Meditation Center."

Hayden flushed. For a few seconds he seemed ready to burst out with an angry lecture, but then he relaxed, sat on the edge of the desk, and laughed.

"That rule is only due to very unusual circumstances," he said. "It's a combination of factors. First, there's the fact that the Celestial Master Himself usually lives right upstairs, and then there's this book . . . " He lifted a slim hardcover from his desk and waved it. "*Reformed Sufism as a Social Palliative*. What are you gaping at? Has your jaw come unhinged?"

"I'm sorry. The Board of Missions was very, uh, definite in its directives about that book. Supposed to have been written by an utterly hardened heretic. Complete social ostracism for anyone caught reading it—though to tell the truth, we never found a copy. In fact, this is the first time I've ever seen one."

"Sounds like being a missionary out there isn't that much different from being a cop."

"Not as different as I'd hoped."

"Well, the book's caused its share

of problems, God knows, but actually, the author is a good Reformed Sufi."

"Pardon?"

"The first half of the book is nothing but high school history. How the RS came out of Western Terran Occultism —stuff like that. His supposedly heretical thesis doesn't come until the last ninety pages. You'll never guess what it is."

"I won't even try, since you're dying to tell me."

"It's that Reformed Sufism could never have become big if the Transmat hadn't become an integral part of our economic lives."

Bulgakov shrugged. "I can see how that could be called heresy."

"That's because you're not really thinking about it. We've both been RS all our lives, and we're used to rebirth. But think how it looked a century ago — all you knew was that the Transmat destroyed your body and assembled a new one, a duplicate, out of new material at the other end. That's pretty scary when you think about it. Only a Reformed Sufi—a person who knows that his soul consists solely in the information that makes him up—could be comfortable taking such a trip."

"You've failed to distinguish those of us who've grown the seeds of our souls into genuine souls," Bulgakov reminded Hayden, slipping into old missionary habits.

"Sure," Hayden said. "But the seed is also only information. So if you haven't yet grown your soul, there's no risk either. I mean, it doesn't bear on the argument of the book, so don't confuse me. The point is that the Transmat is the only way to go faster than light, and as it became more and more an economic necessity, the conflict between people's desire to use it and their fear became unbearable. The RS offered the only way out. And there's nothing heretical in that insight—I've heard the Celestial Master himself say the same thing."

Hayden pushed himself off the desk and walked towards the shuttered window. "There are assholes out there," he continued, waving his hand at it, "who think that just because there's a reason for a thing, it drains that thing of its magick. Since there's a cause for our success, we've automatically been proved wrong. Some of those assholes have guns."

"I didn't realize . . . "

"Yes, things are out of balance here. If you wanted to be a church cop again, you could probably wangle a promotion to Magister Templi easily."

"Well, I'll never go back to cop-work. But back to the book—I think you misunderstood Bentz. The RS would have been successful whether the Transmat happened or not. The explanation for our success is much simpler than that: truth is persuasive."

"Didn't I once read something a lot like what you just said in the Board of Missions' handbook?"

"What of it?"

"They and the CM don't always see eye to eye. The CM is *old*. He can tell you stories of Earth before the Collapse! His viewpoint is different. There's an advantage for a religion in having a founder who lives for centuries. His teachings are still perverted, of course, but they can only be perverted so far. It's possible that you'll get an oppor-

tunity to talk with him—get his views from his own lips."

"If that's so, why hasn't Bentz made a public pronouncement to that effect?"

"Bentz hasn't been taking as active a part in things as he once did . . . and anyway, no one man can run an organization this big. . . ." Hayden looked worried. "I don't know, maybe things have gotten out of hand. He doesn't make public pronouncements on anything any more. But believe me, I've heard him make that case explicitly and, like I said, you may get a chance to ask him yourself."

Thoughtfully, Bulgakov watched Bentz marching toward him out of the big stage, then disappearing, to be replaced once more by the empty booth. He shivered.

"I don't know what I could say to *any* 170-year-old man without making a fool of myself," Bulgakov murmured, "let alone to the CM." Then he jerked his body straight in the soft chair and looked hard at Hayden.

"Say—I think I just figured this place out. You're the CM's private doctor. This whole floor is like a little hospital—this is where you keep his body going, right?"

Hayden grinned. "You've oversimplified things. We're available to all sorts of high-rankers, and we only do part of the job for Bentz. But basically you're right. Without him, we wouldn't exist."

"And you're responsible for my assignment?"

"Yes."

"I don't see how I can help with a medical problem."

"It's more than that. Do you know Paracelsus?"

"The hospital planet? Sure."

"I want you to do a little cop work there for me."

"I was afraid of that," said Bulgakov, with a frown. "I hate to disappoint an old friend from Epsilon Indi II, but you know why I got out of the police racket, and it seems the older I get the more irritable I become. I'm getting ulcers now from missionary work."

"I'm sorry to hear that, because after I tell you what's going on, you'll undoubtedly feel obligated to help."

Bulgakov continued to frown and said nothing.

"OK," said Hayden. "Be bullheaded if you want, but here's the story: Isaac Bentz developed a bone cancer in his leg too serious for us to treat here. He went to Paracelsus. And now he's disappeared."

The pain hit Bulgakov again. He cradled his stomach in his arms and patted it, as if he were pregnant. "Shit," he said. "You know I can't refuse to help with something like that."

"I know." Hayden was almost gloating. "Look, as long as you're there, you might as well get your stomach fixed. The Church'll pay for it. I'll authorize it."

"Why didn't you say that in the first place?"

"Just seeing if you were the same Bulgakov I remembered. Besides, you may not be able to get it fixed. We don't know what's going on on Paracelsus. Bentz was due back over ten hours ago and since that time, as far as we can tell, nobody anywhere has received any

information from the planet, and nobody's come out."

Bulgakov opened his mouth to object that ten hours was scarcely a cause for panic, but shut it again when he realized who he'd been about to apply that objection to. The founder and spiritual leader of the biggest religion off Earth wouldn't be allowed an all-night poker game, a late stroll, or a visit with an old friend without working it all out in advance.

"You think Shia could have agents working on Paracelsus?" Bulgakov asked.

"The Church Police say they can't discount the possibility. Personally I don't believe it. But the assholes I spoke of earlier have their own organization. They may be there."

"Speaking of the Church Police—what can I do that they can't? Surely they must be . . . "

"They're on the job. They've already sent two or three agents—and they haven't reported back, either. I want you because I know you and I'm reasonably sure I can trust you. In my opinion, we need Isaac Bentz worse now than ever before, and if I can't get Bentz back, at least I want a report I can rely on. Who knows what could have happened to him on Paracelsus? Even if the enemies of Reformed Sufism have nothing to do with this, I fear the worst."

"Paracelsus is one of the flowers of the RS," objected Bulgakov. "You can't work there if you haven't been Examined. If you discount Shia and these new heretics, then you're casting doubt on good Reformed Sufis."

Hayden barked out a short, nasty laugh. "You should work in this place a while," he said. "It's full of good RS who would love to see Bentz disappear. In fact, they're better Reformed Sufis than Bentz is. That's what worries me."

Bulgakov was scandalized. He stayed silent a while, letting the shock reverberate in him. As the echoes faded away, he searched for something with which to refute Hayden—some statement of the CM Himself, preferably—but he noticed, not for the first time, that very little had been heard from Bentz in the last decade or so. It was just barely possible that Hayden was right.

"Isn't there anyone here you can trust?" he asked finally.

"There are a few," Hayden said, "but they aren't you. You're an exceptional man, Bulgakov."

"Nonsense."

"You are. You may not be aware of it yourself, but I worked with you as Medical Investigator for five years and I *know* you. I've never met another Adept like you. But if you don't like that reason, I've got another you'll like even less. There's the possibility that the reason nobody's come back is simply that the Transmat system's broken."

"They've got fail-safes on their fail-safes. I don't believe it."

"Let's say 'tampered with,' then."

"If so, then when I get in the booth at this end, it may be the end of my body. I might not be reborn. You're asking a hell of a lot."

"But you're a true Adept," Hayden pleaded, "and that's why I dare to ask you. I'm an Adept by decree—it's an honorary title given to make my work easier. That's just the way it is in Octopus Bay—I don't know a single Adept, truly, with a full-grown soul. But

you've been an Adept for what—almost twenty years?"

Bulgakov nodded.

"So you're the real thing. Your soul can survive death. You're equipped to take the risk."

In the jungles of Epsilon Indi II the night wasn't much better than the day. The heat was reduced from hellish to a low simmer. Bulgakov sat in a swollen wickerwork bench, studying the sullen boy who sat perched on his bed opposite him. He felt the sopping kerchief tied around his forehead and wondered if it was too soon to change to his spare.

"I'm not lying to you," Bulgakov said. "If you tell me where you got it, nothing will happen to you."

Inwardly Bulgakov cursed Dr. Hayden for having told him about the boy. Hayden had spotted symptoms of Hierozine addiction in the kid. No crime in that, of course, but the stuff was thought to be coming from Shia—it had to be traced back to the agent. It was turning out to be a very unpleasant job.

"Why not let Shia do what it wants?" Asabîyah asked, scowling. "If the RS is right, then what difference would it make?"

Asabîyah. From a strange family, a strange name meaning solidarity, or family feeling. Shiite father and RS mother. Home must have been a hell of a place, and the continual arguments seemed to have produced a comfortable agnosticism in the boy. Asabîyah. Reminded him of a young lady he knew once named Chastity . . .

"Well," the boy asked, "what are you afraid of?"

"Personally I'm not afraid at all," said Bulgakov. "But I'm afraid for you, and for those like you. Truthfully, if you were an out-and-out Shiite I'd feel more hope—but you don't really seem to think the matter's that important."

"Is it?"

This kid is too young to play Socrates, Bulgakov thought, a little angrily. Controlling his voice carefully, filling it with the deep, subdued timbre of pity, he said, "To you, perhaps not. You may never find out what you're missing. You may go right on to an untroubled death—and that'll be the end of it for you. There's nothing wrong with that, really, but there's so much more you could have."

"If you're trying to get me worried about my not-so-immortal soul, don't bother. I don't have one."

"Oh, you have one—but it's a tiny, untried thing. It's never been exercised, and it hasn't grown to fill you. It's so unobtrusive you can't feel it. But it's there, and maybe I can prove it to you."

"Go ahead."

"Have you ever been reborn?"

"No. I've only been alive six years. There was a kid on Earth with my name and my looks, but Transmat, Inc. killed him when he was nine."

Bulgakov smiled. "That's a very impressive pose you've developed. Almost tragic. But you don't really believe it. I've been reborn many times, and I definitely know that there's something beyond the mere atoms of which you're composed that survives the trip. You know it, too. You have your memories, for instance. Are they physical?"

"Depends on how you look at it, I'd say. Look, I'll tell you where I got the

Hierozine if you'll just shut up and go away.''

That answer encouraged Bulgakov to believe he was getting through to the boy. ''This is more important,'' he said. ''There's a part of you that's been made uncomfortable by what I'm saying, that resounds to it. Look there for the seed of your soul. Find it and nurture it. It can be immortal, When I die, I'll survive death because I've grown strong enough, spiritually, to do so. If you don't blow it, you can do the same thing.''

''You really believe that! Not only do you think you have a soul, but you believe it can survive without a body!''

''I know it.''

Asabîyah laughed. ''You're kidding yourself.''

Something thumped Bulgakov's back hard. He pulled his head off an open book: *Editorial Surgery,* by Robert Strampanis, M.D., Paracelsus Medical Center.

'' . . . out of it and wake up, for God's sake,'' Hayden was saying. ''You're supposed to be studying. It's almost twelve hours now and still no word from Paracelsus.''

''Sorry,'' Bulgakov mumbled. ''I was just dreaming about Epsilon Indi. Do you remember Asabîyah?''

''No. And there's no more time for reminiscing.''

''I said I was sorry. It was one in the afternoon when I arrived here, but it was ten at night where I was on Ecesis—now it would be bedtime. And this book . . .'' he picked the heavy thing up and let it thud on the desk, ''is hopeless. I've never studied how a Transmat works. These charts are meaningless, and the prose isn't much better. Why don't you explain it to me yourself, the best you can?''

''OK,'' Hayden said, ''but it'll have to be quick. You're due to leave for Paracelsus in half an hour.''

He grabbed Bulgakov's chair, wheeled him aside, and opened a desk drawer. He rummaged through it and pulled out an ancient, yellowed folder.

''I've got Bentz's medical records here, from the first day he was reborn in Octopus Bay. You won't find these in the computer files. Let's see . . . the first time Bentz became deathly ill was 86 years ago. Lucky for us it was a lingering illness. Putting clones through forced growth is a risky business. It took three before we got a healthy one, and five before the memory transfer took to everyone's satisfaction. Total cost to the Church was $1,100,000, give or take a few thousand.''

''You already told me Paracelsus had something cheaper.''

''Cheaper and better. They've developed a process for curing a person in the very act of rebirth.''

''That's what I don't understand.''

''It comes out of basic Transmat theory. The PK link beats the speed of light because information isn't subject to the same limitations as mass and such. What we transmit over the Transmat isn't the person, but the information of which he consists.''

''I'm with you so far.''

''Good. Now get this. Paracelsus has discovered a way to record that information. Once they have the recording, they don't have to cut out Bentz's tumor—they can *edit* it out, replacing it with a healthy leg derived from the

DNA program. The record's stored in some computer that tests out what they're doing, and when everything reads OK, they put Bentz through the Transmat receiver, cured."

"Oh, now I get it," Bulgakov said. "That's great! Why hasn't anybody heard about this?"

Hayden shrugged. "I don't really know why. . . . The program's still supposed to be experimental, but there haven't been any failures for the past two years. All I know is that Paracelsus has been keeping pretty much to itself lately. That book you failed to skim was given us with the understanding that it wouldn't go beyond these walls."

"And I still don't see how all this ties in with my mission."

"There are so many possibilities with this new treatment—it makes me nervous. My main fear is that they may choose to edit out a few other things along with his tumor. If they're in league with some of the *good Reformed Sufis* here in Octopus Bay, they may choose to make him more, uh, receptive to certain ideas."

"You mean you think they might mess with his brain."

"I don't know what to think."

"No good Reformed Sufi would dream of such a thing. Freedom of individual development is at the very heart of the Teaching."

Hayden smiled a smile that made him look like he'd just got a hernia. "I hope you're right," he said. "I wouldn't know. I never was a very good RS. But I know Paracelsus hasn't done much psychological work. It would explain the delay."

Bulgakov's stomach let him know how much that thought disturbed it. He grimaced.

"Hey, what about my bribe? If your fear is justified, I don't think they'll feel inclined to give me a new gut."

Hayden walked to the door and held it open. "I do have my own crude methods," he said. "If that's the way things turn out, I'll fix you up myself. Now, are you still going?"

Even though Bulgakov was an Adept, equipped to spiritually survive disintegration into his various subatomic constituents, he was relieved to find that the Transmat to Paracelsus still worked.

He arrived in what looked like an old-time doctor's office. There was a bookstand with a gigantic pharmacopoeia; an oak cabinet with glass doors displaying, among other antiques, a row of gleaming, evil-looking needles; a mahogany roll-top desk. Beside the desk stood a fat old man in a black suit and stethoscope. His grizzled hair stood on end, and his walrus moustache was too skimpy to cover his smile.

Bulgakov walked towards him. It felt strange. It was as if Paracelsus were a balloon and the pumping of his legs pushed the planet down—he felt no gravity. On the other hand, he wasn't floating away. Maybe he was developing inner ear problems?

"OK, son," the old man said, "now we're going to run you through a few tests."

"Pardon me, sir, but I'm not a patient. I came to . . . "

"Of course you're a patient. And I don't like being 'sirred.' My name's Bob Strampanis and you can call me 'Doctor Bob.' " He chuckled.

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"You're the Strampanis who wrote *Editorial Surgery*?"

"That's me. Did you read it?'

"Well . . . let's say I tried to. I didn't really understand it."

"That's too bad. But you're in the majority."

"I'm afraid I didn't get your joke about 'Doctor Bob' either."

"You've never seen any of the old 20th-century *Muppet* shows?"

"I'm afraid I don't get much time for cultural activities. Now, the reason I came to Paracelsus . . . "

"Some people think it's a lame joke, anyway. Just call me Bob, then. How's your stomach feel?"

Bulgakov's eyes widened in startlement. He clutched his gut. "It feels fine!" he said. "Do you automatically treat anyone who comes here?"

"Sure. Now, can you tell me your access code?"

"411B72-9 . . . hey! How did I know that? And what the hell *is* an access code?"

"Don't worry," said the doctor. "Until now, that's absolutely the only way we've messed with your mind. And that's only because your code is such a vital piece of information here—it's important that you know it as soon as you get here."

"Until now? What do you mean by that?"

"I'm messing with your mind now, aren't I?"

"That's no joke. Why don't you tell me what's going on here?"

"Don't start foaming at the mouth, now. We're not hiding anything from you. We could've stuck the whole story in your mind at once, along with your code, but it's less traumatic if the patient absorbs the news a little at a time. Now I want you to run in place for a couple minutes, then describe your reactions."

"I don't know if that would be a good idea. I feel funny—like something besides gravity is holding me to the floor."

"That's good, because there isn't any gravity in this room. We're checking out what we call your interface with the reality-construct."

Bulgakov pointedly pulled a chair out from beside Strampanis's desk and sat down. "You're not making any sense, Doctor," he said. "If you want any cooperation from me, you're going to have to give up the idea of breaking whatever-it-is to me slowly."

"Call me Bob," the doctor said again, then grinned and shrugged. "It would be better if you played along with me, no matter how annoying it is to you. But . . . hell, since you're an Adept, I reckon you can take it. You're not exactly where you think you are."

"I'm on Paracelsus, aren't I?"

"Yes, in a way. . . . Look, you know that we record your most probable sub-atomic state here, don't you?"

"Yes."

"How do you suppose we deal with those recordings?"

"I give up."

"You're going to have to try to take it easy, son. Drop that belligerent attitude. Otherwise you're just setting yourself up."

Strampanis waited while Bulgakov arranged his facial features in a suitably passive syndrome, then said, "Editing such an enormous mass of data is a tricky business, even for us. We store

the recordings, in the form of self-programming programs, and test them in this. . . ."

A sphere of three-dimensional image popped into existence next to Strampanis. Bulgakov looked around the room for a hidden holoprojector, but couldn't find one.

He looked more closely at the sphere. It was panning over what looked like acres of microcircuitry boards.

"There's twenty square miles of this," Strampanis said, "and more being added every day. It's far up on the big northern continent here on Paracelsus—easier to cool. What you're looking at is what you would have called your location, in what you formerly thought of as objective reality."

"Huh?"

"This is where you live, son. You're a recording."

Bulgakov blacked out.

He came to as a point of identity in the middle of nothingness. Naturally he had no way of telling how long he was in that state, but he was pretty sure it was somewhere between an instant and eternity. It was boring.

Eventually he heard Strampanis's voice calling to him. So he had ears! That made life a lot more interesting. And a body, too! He'd forgotten what that was like. Suddenly he found himself seeing the doctor's office again, then realized, with a little shock, that his eyes were closed. He opened them.

"I warned you," Strampanis said. "You weren't prepared for the news and you freaked out and if I hadn't known your access code and been right on the spot, you might have been permanently Lost."

"There's an advantage to being in this computer," Bulgakov said. "I could tell, somehow, that you were capitalizing 'Lost.' What, exactly, does that mean?"

"You won't get on very well here calling this place a computer," Strampanis said. "It was originally called the 'Medical Records Editor,' and that's OK—but most of us prefer to think of it as a universe."

"OK. You still haven't answered my question."

"I'm thinking about it," Strampanis said, stretching his arms out, rubberlike, to twice their normal length, then letting them snap back. "Your body, as it is now, is a norm—a standard that you can deviate from at will, once you learn to control it. One possible change you can make is having no body at all, but that's a very dangerous thing to play with. Sometimes the victim of a severe shock will slip into that state, and if he doesn't know how to handle it, he's Lost. That is, his mind is still somewhere inside our universe, but only someone with his access code has even a hope of finding him. And that's chancy."

"And this 'access code'?"

"It's our network in this universe—it's how we interact with each other's programs. It guards our privacy and guides us to each other, and don't give yours to anyone you don't want to see outside the Commons. Unless . . . well, there are some unique things you can do with coding. Let me show you something."

"Wait a minute. Would you please

stop doing that with your arms. It gives me the creeps.''

''Oh, sorry.'' Strampanis snapped his arms back to a reasonable length and shoved his hands into his coat pockets. ''I'll have to give you a little practice using the code-matrix. Until you want to do it differently, you activate it by speaking out loud. Give your code and then the words: 'to 356D33-3.' ''

Bulgakov shrugged, said the magic words, and found himself in a bedroom, staring at a naked middle-aged couple locked in an embrace. All that gave their age away were a few wrinkles, placed so that they were actually flattering, and slightly graying hair.

They were both remarkably well-preserved, but then, thought Bulgakov, why shouldn't they be? He felt his own face hopefully, but couldn't make his fingers sensitive enough to tell. They didn't seem to notice him.

Strampanis popped into existence beside him.

''Who are those two?'' Bulgakov whispered.

''Sam and Marcia Golden, our great lovers,'' Strampanis said in a normal voice. He snickered. ''They like to be watched, but they don't like to be interrupted, so they worked out this special code.''

''You mean they're not aware of our being here at all?''

''That's right. And I've got to apologize to you for them. This is pretty unimaginative for the Goldens. Usually they're our best world-builders. I remember they had something in this code once that reminded me of *The Faerie Queene*—at least in appearance, that is. Do you like to watch?''

''I'll only stay if you want to.''

''Let's get along to the Commons, then. Give your code and add: 'to the Commons.' ''

The ''Commons'' seemed to be an entire planet. At least, there was a plain that stretched to a horizon that seemed as far away as a horizon ought to be. That was on one side of them. A forest loomed on the other side of them.

Picnic tables lined the wavy border where plain and forest met. Far out on the plain, people were playing a game with a ball. Nearer, there appeared to be some sort of dance—but these dancers stood still and rhythmically changed shapes. Animals, mythological figures flowed into one another.

''The Commons,'' Strampanis said, ''has a public code. Public codes are available to anyone, and anyone can come here. There's a path over there that goes into the woods a little way. At the end of it, there's a booth with complete listings.''

Bulgakov was going to ask a question, but forgot it when Louis Philippe walked by.

''Who's that!''

''Most of the historical figures you'll see around here aren't anybody. I mean, they're somebody's creation. It's a fad. Look! Sam Golden's been sitting at that table over there waving at us since we got here. Let's join him.''

Bulgakov stared at Golden's distinguished wrinkles in amazement. He must have beaten both of them to the Commons—but they had just left him an instant ago. . . . Was it possible to travel back and forth in time in this machine? No, he decided, shaking his

head slowly; even here, *that* was impossible.

"Howdy, Sam," Strampanis said. "This is Adept Bulgakov, a new arrival."

"You testing him?" Golden asked. "I was in the mood for conversation, not stretching-exercises."

"Well, I'm testing him, yes, but we've put off the physicals till later. We just came from watching you and the Mrs."

"Thanks for telling me," Golden said. "It's good to know that folks do occasionally peek in, now that the novelty's worn off."

"What have you been doing with yourself today?"

"Oh, I've been sitting here for the past couple hours thinking how the Celestial . . . "

"Perhaps I should explain to the Adept," Strampanis interrupted. "Sam here has twinned himself."

"Tripled," Golden corrected.

"OK. Then there's three of him. Some people have religious problems with that kind of reproduction—you know, which one has the 'real' soul. Personally I don't see any harm in it. God knows, we've got enough space."

Bulgakov closed his eyes. This time it shut out the light and it helped, a little. "Let's see if I've got this straight," he said. "I'm in a place where a person can turn himself—physically at least, and probably mentally—into whatever strikes his fancy, and ditto for his environment. I'm starting to yearn for a little stability."

"You'll get used to it," Strampanis said.

"The Commons is fairly stable," Sam Golden said judicially. "The people change, but the environment doesn't. Not even the sun goes away. What do you want stability for, anyway? Change is Life!"

"The man is an Adept, Sam," Strampanis said with a grin. "And a missionary to boot. Don't try to teach Grandma to suck eggs."

He turned back to Bulgakov and added, "Things aren't quite as easy for us as you're making them out to be. The universe we're living in operates by complicated rules. Learning to make a decent world can take five or six years of hard study."

"Marcia and I give classes twice a week," said Golden. "The course is called 'Beautifying Your Access Code.' It's in the book. You'd be welcome."

"I won't be able to stay here," said Bulgakov. "But . . . wait a minute. I thought you people on Paracelsus had only been doing this a couple years."

"Electrons are a lot more efficient than neurons," said Strampanis. "We run almost a thousand times faster in here than we did before. If you're involved in a five- or six-year project, you're talking maybe two days on the Outside."

"What's this talk about not staying?" asked Golden, giving Bulgakov an astonished look. "Of course you're staying. There's plenty of room, God knows. Why, at the rate the machinery's expanding, we could dump an entire planetful of people in here each year and not come close to capacity."

"I appreciate your offer," said Bulgakov, "but I have other commitments. . . ."

"Ah!" Golden waved his hand as if

swatting at a fly. "So spend two or three years with us and you'll be a day late. Your people can't wait a day?"

"I'm afraid not."

"Adept Bulgakov is from Octopus Bay," Strampanis said, his voice heavy with significance.

Golden looked thoughtful. "Hmm. I still don't understand it. You're an Adept, after all. You should really love this place. In fact, I think you're the first Adept I've seen here who wasn't ecstatic."

Bulgakov couldn't help smiling at Golden's earnest enthusiasm. "I can see that this is a great place," he said. "It's just that things have been moving a little too fast for me to be ecstatic."

"Don't forget the obvious opportunities for spiritual development," Strampanis added, nodding his shaggy head. "It's very hard to measure the results of your spiritual exercise on the Outside. Here, you can *see* the results."

"That's right," said Golden. "So you don't need to be worrying about Isaac Bentz. Hell, that's probably what he's doing right now. . . ."

Golden clapped his mouth shut suddenly, looked sheepishly at Strampanis. The doctor scowled back. All three were quiet for a long time.

Dummy, Bulgakov told himself. *Of course they know!*

Aloud he said, "The subject seems to have come up in spite of your efforts to bury it, Doctor. Now why don't you tell me what's going on?"

Strampanis sighed and nervously pulled splinters from the weathered table-top. "I've been avoiding the subject," he said, "because you need the kind of background information that you've been getting just now before you can even begin to understand. You'd have to know what an access code was, for instance, before it would make any sense for me to tell you that the rules of privacy prevent me from giving you Bentz's."

"I assume that's your diplomatic way of telling me you're not going to tell me anything?"

"Not at all. Hell, I *want* you to talk to Bentz. It's just that you're in such an all-fired hurry. What's your rush? Everything will come clear in time."

"I'm in a rush because I know damned well that something peculiar is going on here. Talking to Bentz is part of my job."

"Well, there's peculiar, and then there's peculiar. Why don't you just relax. . . ."

Something in Bulgakov snapped. He'd had enough. He grabbed hold of the doctor's lapels, shook and said, "Do you recognize the authority of the Church or not? I've come from the Octopus Bay RSMC, and that in itself should override your rules of . . . "

His tirade faded away when he noticed the doctor wasn't at the end of his arm any more.

"Your strong-arm won't work on me, son," came the voice from the next table. "I've had a lot more experience in this environment than you."

Shame diluted Bulgakov's anger. What was an Adept doing resorting to violence in the first place? Still, he felt disinclined to apologize.

"We *have* to stay linked to each other in order to survive," said the doctor. "You yourself flipped out and got Lost not an Outside Second ago, remember?

And when we *have* to stay linked, we *have* to have a strict rule for privacy."

"Hell," said Bulgakov. "If you can only get a code from the person it belongs to, how does anyone ever meet anyone?"

"You're being silly. You've already met two of us, haven't you? Think over Earth History and you'll remember a bunch of societies more tight-assed than this one. Look at all these people around you—the real ones, I mean. You can meet anybody at a public code. And the Commons is probably the best place. Almost everyone comes here at one time or another."

"Including Isaac Bentz?"

"Yep."

Bulgakov relaxed. "I apologize for being so suspicious of you two," he said. "But you'll have to admit that it's pretty hard to believe Bentz is staying here of his own free will when we haven't received any word from him at all at Octopus Bay."

"I can see where you're coming from," said Golden. "But if you'd just think about it, you'd see that this is the place a Celestial Master belongs. This universe is the very culmination of Reformed Sufism."

"Culmination!" Bulgakov's eyebrows shot up and a smile pulled at his mouth once again. "Either you've really got something here, or you're a heretic."

"That's a good one," Golden said, chuckling. "A heretic."

"Look at it this way," said Strampanis, popping back across the table. "The First Lesson of Reformed Sufism is that your soul is only the information that makes you up. If that's so—and everybody here believes it—then this is the most spiritual place available to Man."

"Sure, we're not entirely bodiless," said Golden, as if reciting an argument committed to memory. "We live through the medium of the electron. But we're as close as we can come, unless we happen to be Adepts who choose to die."

"And the opportunity for spiritual development here is . . ." the doctor groped for a word, lost it, "beyond what we can even imagine. With the automated maintenance and construction systems we have now, this universe is expected to last at least two thousand Earth Years, barring cataclysm. That gives us a life expectancy, Inside, of nearly two million years."

"I see how that could be," Bulgakov said. "It sounds wonderful. If it's true, you really *do* have something here. So why have you been hiding it from the rest of the galaxy?"

"We haven't actually been hiding it. In essence, this place is described in the literature we've been sending out to RS hospitals."

"Described as a place where the information from the Transmat is stored and tested."

Strampanis spread his arms wide. "That is how it started out," he said. "After that it just kind of . . . developed."

The doctor frowned in thought a while, then continued: "Some folks have degenerative diseases that work so fast there's no way editorial surgery can work without changing large parts of the DNA structure. That takes a lot of time Inside, a lot of testing, and what it really means is that the patient must agree to

become a different person. That's a hard thing to agree to.

"Those types were our pioneers. They had time to explore their new potentials here and most of them decided they'd rather be themselves Inside than someone else Outside. We let them, of course. It would have been unethical to do any different. After a while, their relatives started getting messages saying: 'Having a wonderful time, wish you were here.' Some of those relatives tried it out and it built from there."

"A lot of us began taking vacations in here," Golden said. "That's how I got started. You could squeeze thirty-eight years into two weeks, and come out not a day older. And as the place became self-supporting, we started asking ourselves, why come out at all? And, with the 1,000-1 advantage, lots of people with think jobs were assigned here. The whole hospital staff moved in at one time."

"You can see how it would snowball," the doctor murmured. "This universe scared some people—mostly descendants of the old, non-RS settlers—but the RS were spiritually prepared for it. More than ninety percent of the Paracelsus RS are Inside now. So, to answer your question, which I haven't forgotten—if the whole galaxy were RS, we'd be screaming the news all over. But we've got Shia to think about, unfortunately. If they think the Transmat is an abomination, imagine what they'd think of *this*. So until twelve hours ago we treated people in here and pretended that this was the hospital. We sent them back by Transmat none the wiser."

Bulgakov had enough experience as a Church Cop to evaluate this claim for what it was—unimpeachable. Shia was unpredictable and dangerous. Now he believed everything they told him.

"So why did you tell *me* the truth?" he asked.

"Things have changed—and before you ask, yes, it has partly to do with Bentz. Now can we take a break from explanations for a little while? It'll give you time to digest what you've heard, and also give me time to run you through your physical tests—if you can call them that."

After several hours of dictating impossible shapes for Bulgakov to twist his body into, Strampanis announced that it was time to go to bed.

Bulgakov realized, with a shock, that he'd missed a night of sleep already, and he wasn't at all tired. He said so.

"Sleep is a matter of will here," Strampanis explained. "If you want to sleep, you can. And until you've been here a while and gotten used to things, you should. There's a room in my world full of psychological props to help you —a bed, gravity, even an alarm clock that ticks."

When they returned to Strampanis's office, he added, "To play it absolutely safe, you shouldn't be out of direct link with another person for a while. So I've taken the liberty of inviting you company for the night."

Bulgakov didn't know what to say to that, so he said nothing. He watched Strampanis pull on the door of his cabinet. The whole cabinet swung out, revealing the bedroom behind. Seated in the bed was a petite blonde lady dressed in white. Freckles splayed out around

her nose, setting off sparkling blue eyes. Her smile was blinding.

"Adept Bulgakov," said the doctor, "meet Adept Carter, of the Octopus Bay Church Police."

Bulgakov stared at her wide-eyed. "You're one of the people they sent out earlier to bring Bentz back?" he asked.

"That's right."

He turned to ask Strampanis a question, but he was gone. He shrugged and walked in. "So," he asked, "when did you arrive?"

"Almost seven months ago," she said, grinning. "Or five hours ago. I was the first one they sent."

"And how many after you?"

"You're the fourth." She patted the bed. "Come sit here by me."

"And you other three?" he asked, sitting down. "You've all seen Bentz?"

"All but one of us, yes. Lew McGiffert didn't stick around long enough to see him."

"Huh?"

"He couldn't stand it here. He's the only one of us who wasn't an Adept, you know. And not a very good RS either, if you ask me. Anyway, people who don't want to stay here don't have to. They sent him in his old-fashioned body to a colony they have on Paracelsus for people like that. It's Outside, on the southern continent, away from any communication equipment or transportation or anything."

"Surely they could have trusted him. Why didn't they send him back to Octopus Bay?"

"You can't always tell who you can trust. Anyway, they'll send him back when this trouble is resolved, hopefully. It's not so bad, really. After all, it's only been a couple hours for him."

"What did the Celestial Master and you talk about?"

Adept Carter sighed. "It's real complicated, and not very interesting. You'll find out all about it in a little bit, anyway. Listen, I came here to relax and have a little fun. If you're not in the mood, I can call Doctor Bob back and he can babysit for you tonight."

Bulgakov laughed. "Even after visiting Sam and Marcia Golden today, it hadn't really sunk in that you could do such a thing as a—a recording."

"Anything you can do out there you can do in here. Would you turn your nose down for me, honey? You know, make it more Roman-like?"

Bulgakov shrugged and obliged her.

"And a moustache under it. I like moustaches—but not too bushy, you know . . ."

He reckoned, when she was through adjusting him, that he looked a lot like the lead male in *Flatterzunge*, a long-running holo series about a travelling musician. He didn't know whether to be insulted, embarrassed, or what.

Giggling, she hopped off the bed, ran her hands down the contour of her smock, and slowly pulled it off. She modeled for him, showing a sleek, well-muscled body. Oiled, too, it looked like.

"Are there any changes you'd like me to make, baby?"

"No," he stammered. "You're fine just the way you are."

"Ooh, I'm glad! I like it, too. You'll have to meet Fred Botkin; you two have tastes in common. He sculpted this for me just last night."

Sleep didn't come as easily as Strampanis had promised. He dozed for a while, but was plagued with dreams of Asabîyah and woke up with the boy's bitter laughter ringing in his ears.

Could this be called surviving death? Only in the most restricted sense.

We're about as close as we can come, Golden had said, *unless we happen to be Adepts who choose to die.*

He'd wanted to answer Golden by saying that, wherever the Church was, everyone had an opportunity to become an Adept. The Church taught that, whatever your condition, intelligence, or station in life, you could at least reach the rank of Adept, where your information was organized so tightly you could survive death. But now his head was clearing, and he was glad he had kept quiet. There was no fairness to the system. If Asabîyah hadn't been cursed with a Shiite father, he still would have had no chance.

If you were lucky enough to be able to devote twenty or so years to the Church's course of spiritual exercises, and if you didn't happen to croak first, then you were an Adept. But in truth, not everyone could do that. For the likes of Asabîyah, there was only the work of the world. Worse, it had to be that way, for if everyone decided to become an Adept, the Adepts would starve.

A family man with a job rarely had time for such study. And life was short. But here, everyone truly had all the time they needed.

This was a good place.

He felt Adept Carter writhing next to him. He smiled. He didn't know if she qualified as sexual bribery or not—the people of this universe were obviously interested in winning him over. And they seemed to want to distract him from whatever was going on with Bentz. Looking at it dispassionately, though, a day's distraction really only put him off about a minute and a half. There wasn't much to be gained by that tactic.

Anyway, if they *were* using her to win him over, the attempt had failed. He couldn't help finding her attitude toward electric sex slightly ridiculous.

But it really didn't matter. He was won over anyway.

The next day, Bulgakov announced his intention of going to the Commons to wait for the CM to show up. Strampanis warned him that Bentz didn't come there every day—sometimes he didn't show up for weeks. Bulgakov said that was OK, he'd wait, and the upshot of it was that he arrived at the Commons in the company of both the doctor and Adept Carter.

"I guess," Strampanis said after they took a table, "this is as good a time as any to explain about Isaac Bentz."

"Please do!"

But not much came of it. Bulgakov concluded that, whatever the trouble was with Bentz, it was a source of acute embarrassment to the doctor—for he started by remarking that it might be better if Adept Carter began by giving *her* impressions; and when she said no, the doctor was really better qualified to explain, he hemmed and hawed the better part of an hour away.

"Damn," he said. "I'm making an ass of myself. But it seems like every time this problem comes up, it gets harder for me to talk about."

Bulgakov developed a theory. What

could abash the doctor so? Hayden had told him that Paracelsus hadn't had a failure in two years—but what if they had? What could be more humiliating than failing only once—on the Celestial Master? Maybe he hopped about the Commons on one leg.

Almost as he thought it, a two-legged Bentz appeared.

"Damn," Strampanis said. "I really didn't think he'd show up this soon. Listen, Adept, I'm afraid you're in for a disappointment."

"Pardon?" Bulgakov found it hard to follow what Strampanis was saying; he was concentrating so hard on what he saw. The CM walked slouch-shouldered, scuffing his shoes, through a crowd of cheering people, all of whom looked real—at least, there were no historical figures among them. They were actually strewing rose petals in his path. A few in the crowd followed him closely, talking to him. He was ignoring them.

Bulgakov fetched the hololoop of Bentz's arrival in Octopus Bay into his mind. The real thing was a letdown. Bentz was young once more—about the same age as on the loop, but there was no fire. He looked like an accountant who'd been smacked hard in the head and was trying to remember his company's net worth.

"I said I'm afraid you're in for a disappointment. The CM hasn't, uh, been himself."

"I hope you're not trying to tell me you don't want me to talk to him."

"Oh, no. Be my guest. It's just that he's developed some pretty strange ideas, and he'll no doubt tell you some of them."

"So he is a failure! You damaged his mind!"

"Huh? Oh, I see! You're wrong. That was the first thing we thought of when he started acting up, and we tested *everything* twice. No, this is just the way his mind is. The reason I'm telling you is I want you to be prepared. Contradict him, speak your own mind, but be tactful, you know?"

Bulgakov, a little miffed at having his theory shot down, rose to walk to the CM. But the CM and his entourage were coming to them. The CM seemed to be staring at him intently.

When he got to their table, Bulgakov bowed, saying, "Good morning, Celestial Master."

"Ah! The slasher and the viper," said Bentz, nodding to Strampanis and Carter, respectively. Carter gasped. The doctor smiled. Bentz nodded to Bulgakov.

"You're a new Adept, aren't you?"

"Yes, sir."

"I don't suppose Hayden sent you, by any chance?"

"Yes, he did, sir."

"Hah! He's a good man. I knew he'd try to help out sooner or later. And he was smart enough not to come himself."

Bentz took a seat at the corner of the table farthest from Strampanis. One of his companions sat down with him. Bentz twitched a wary glance at the doctor, then said, "Have a seat, Adept."

Bulgakov sat.

"I don't suppose you hail from Earth," Bentz said.

"No, sir."

"Stop 'sir'-ing me. And I'm not surprised. Nobody comes from Earth these

days. So you haven't figured out where you are, have you?''

''Pardon?''

''Hell.''

''Pardon?''

''I wish that just one of these damned doctors had been raised on Earth, smack in the middle of a Judeo-Christian culture. That's my background, did you know that . . . ? I didn't catch your name.''

''Bulgakov, sir. And yes, every Adept knows your biography.''

''But they don't understand it, and neither do these doctors. I guess you can't understand unless you live through it. This place is Hell, and I seem to be the only one who realizes it. I'm being punished for my presumption . . . you had a comparative religion course?''

''I understand the concept of Hell, if that's what you mean.''

''And you still don't see it!''

Bulgakov looked at Strampanis with troubled eyes.

''You see our problem,'' Strampanis said. ''We've got our best psychiatrists working on it, but so far they haven't been able to make any sense of the problem. He's lived so much farther in the past—in Outside time—than the rest of us, and there's so much material to work through. . . .''

Bentz poked Bulgakov's arm with a meaty finger. ''He's talking about these imps that follow me around all the time, asking me questions.''

There were tears in Strampanis's eyes. ''We've always treated you with the greatest respect,'' he said.

''Shit,'' said Bentz.

Strampanis turned back to Bulgakov. ''And to think, that when we heard the CM was coming here, we went nuts. Celebrations like you wouldn't believe, because we thought our publicity problem was over. After all, such a decision *should* be Isaac Bentz's. And now it would be possible. He would decide how much of a threat Shia was—who was better qualified? We told all our patients what was going on—opened up completely. Who would ever have imagined that the founder of Reformed Sufism would turn out to be a paranoid schizophrenic?''

Bulgakov nodded understanding. ''So now you're afraid to publicize anything until you cure him.''

''Yep. The temptation to change his program directly has been strong, let me tell you. Of course, we can't, but we've been trying everything else. And we always hope. . . .''

''Listen, Adept,'' said Bentz. ''Why don't we get together later and I'll explain to you just *why* this is Hell.''

''Why don't you explain it to me now, sir?''

''Because,'' said Bentz, pointing his finger at Strampanis, ''I don't want to say anything in front of *this* son-of-a-bitch.''

''You might as well,'' said Strampanis. ''I've heard it all at second-hand anyway.''

Bulgakov felt terrible. He'd always seen Bentz as the living embodiment of the Church; now his view was being twisted with pity. Apparently no man, not even Bentz, could stand the pressures of running the Church for over a century.

''The slasher's right,'' Bentz said dejectedly. ''No sense in trying to hide

anything from the institutional director."

"I'm ranking staff member of the hospital," Strampanis explained. "That's why he picks on me the way he does."

"So, have you decided to explain yourself, sir?" Bulgakov asked.

"Sure," the CM said dully. "I'll start with what seems my least impressive gripe. Have you ever thought, Adept, that you'll never experience anything new here?"

"Nothing new! Why, in the past day I've experienced more new . . . "

"Nothing truly new," Bentz interrupted. "This place is human-made, programmed by human minds, or their semblance. And while the human imagination is wonderful, it does have limitations. It can't throw out the variations God's universe can. It can only base what it does on what it knows, and the truly Unknown is beyond it."

Bulgakov considered that carefully for a minute, then said, "You may be right about that, sir, but I wouldn't be willing to say for sure one way or the other. Our imaginative potential is so greatly enlarged here, I don't think we can predict how far we can go."

"You poor sap. Our capacity to imagine is *diminished* here. All thought is diminished by laziness, and this place promotes laziness like no other place in the universe. Everything can be put off until tomorrow indefinitely!"

"Maybe there is a drift toward laziness," Strampanis objected, "but there's so much opportunity here, that it balances out."

"I'm not talking to you," Bentz said.

"But what he says strikes me as true, sir," Bulgakov said. "Think of the RS itself. You'll have to admit that on the Outside, if everybody became an Adept, society would collapse."

"OK. I know that."

"That's not the case here. Here there's opportunity for everyone."

"True enough," said Bentz, "if opportunity can be said to exist where no one takes it. But ask Doctor Bob how many Adepts have been graduated here."

"OK," said Strampanis, "so there aren't any. So what?"

"There are people who've been living here over a thousand years," Bentz said, still looking at Bulgakov. "And there are *none?*"

"We have millions of years to . . . "

"You see? And ask Doctor Bob how many Adepts here have opted for death."

"None. Again, so what? All that shows is that any human can be scared of the unknown."

"God!" said Bentz, "Don't I know it! I won't argue that one. Still, you'd think after all this time some few would have overcome that fear to embark on the great adventure. They do Outside. But, like Doctor Bob said, there's plenty of time. Plenty of time. There's eternity, in fact."

"Actually," said Bulgakov, "I believe the latest figures show two thousand Earth Years."

"And two million Hell Years. Our recorded history is only a tiny fraction of that time. Don't you think that in two million years they'll find a way to preserve themselves, even beyond the end of the Universe? Not even Adept's Death can promise that. Life here is truly eternal. Believe it."

"If that's true," said Bulgakov, "then everyone here *will* become an Adept,

since, in an eternity, everything that can happen will happen."

"I could use the same sort of argument to prove that everybody here is Damned," said Bentz. "But actually, eternity needn't be that way at all. Eternity can be filled with people doing the same things over and over and over, like a repeating decimal. And remember, nothing new can ever happen here. Is it beginning to sound a little more like Hell?"

"His delusion is well-systematized," the shrink sitting next to Bentz observed.

"You ain't just whistling Dixie," Strampanis said with a sigh. He turned to Bulgakov. "It was still worth a try. I couldn't help hoping that you might get through to him. After all, you're the third person sent from Octopus Bay to fetch him. . . ."

"The fourth," said Carter.

"The third he's talked to, I meant. People chosen from the very seat of his Church—all telling him what sort of universe this really is. I hoped the cumulative evidence would get to him."

"What evidence?" Bentz asked, wearily.

"I've said it before," said the shrink. "He's not going to be in any condition to listen to reason until he has a chance to work out his aggressions."

"All right," said Strampanis. "You guys do whatever you think necessary. But there's to be no direct intereference in his mind."

"Of course not!" exclaimed the shrink, insulted.

"Why didn't you send me to that colony down south?" asked Bentz. "Like that guy you wouldn't let me talk to. Along with the other people who don't like it here."

"There's a difference between not liking it here and being sick," Carter protested. "A hospital is obligated to treat the sick. And an RS hospital is doubly obligated to treat you."

"Don't you see?" pleaded Bulgakov. "This place is the culmination of everything Reformed Sufism stands for. For you, of all people, to turn against it—why, it's turning against your whole life. It proves you're not well."

" 'Culmination' is right!" Bentz said.

There was a long silence while Bulgakov struggled with himself and the others watched Bentz with sad eyes. Finally, Bulgakov said, "You really do want to go back to Octopus Bay, don't you?"

Bulgakov could feel the hostility from the crowd around the table when he said that. It was almost like a physical pressure. Adept Carter was imitating ice. Most were staring at him with gaping mouths.

"Maybe I deserve this," Bentz said. "Maybe the moral choices I made a long time ago weigh so heavily on Humanity that there can be no forgiveness. . . ."

He's slipping into the religious system of his childhood, Bulgakov thought. *He's really a very weak person.* He was astonished to discover that he didn't like the Celestial Master very much.

Aloud he said, "That's nonsense. You yourself have said that something like the RS was inevitable, given the religious problems that came with the Transmat. If it hadn't been you, it would have been someone else. Now, do you want to go to Octopus Bay or not?"

Bentz's back straightened a little.

"You're damned right I want to go," he said.

"Then I'll help you get out of here."

"I'm afraid that can't be allowed," Strampanis said.

Bulgakov frowned. "Somehow, I expected you to say that."

"Hell, boy, what else could I say? What you've been suggesting is far worse than sending him to our colony. You've *been* here. You can judge this place fairly. But what will the galaxy think of us after they've listened to Bentz's stories?"

"I'm going with him. I'll be there to contradict every one of them."

"And why would you want to go anyway?" asked Carter. "I thought you liked it here."

"I do. I hope to come back before I die. But I still have a commitment to honor. When I promised to bring the Celestial Master back, I didn't make any qualifications about his mental state. And neither did you, I'll bet. There are people in Octopus Bay who have a right to know what's going on. They have qualified psychiatrists there, too, you know. . . ."

"I won't see them," Bentz snapped.

Bulgakov gritted his teeth and went on, ignoring him. "Maybe their shrinks aren't as good as the ones on Paracelsus, but they're good enough."

"Don't you realize this man can raise a jihad against Paracelsus?" Strampanis asked.

"Yes, I know it. That's one of the things that's making this difficult for me. But you do have that 1,000-1 advantage. The nearest settled solar system is three light-years away. Surely you can prepare for whatever an enemy can throw at you when he has three years and you have three thousand!"

"War's a bad thing, no matter what your advantage is."

"That's true. And I don't expect the Celestial Master to forget that, once he's back in familiar territory and not being held against his will any more. That would go against all his teachings."

"I told them that a long time ago," said Bentz. "And I've been telling them that ever since, off and on. They don't listen."

"I'm sorry, Celestial Master," Strampanis said, "but we have to assume the worst."

"So let us go," Bulgakov urged, "and then assume the worst. That might be the best thing that could happen to you. You'd have three thousand years to get ready for the bombs—whether they actually came or not, it would still be a date that you couldn't put off or ignore. I don't agree with much of what Bentz said, but what he said about the potential for laziness here—there's something to that. You agreed with it yourself."

"That last point seems well taken," said the shrink.

Strampanis's face collapsed in wrinkled thought.

"If we sent you two back," he said, "we could drop this charade and empty out that stupid colony—send everybody where they wanted to go. The past twelve Earth Hours have been an ordeal for everybody. . . ."

His face cleared suddenly and he said, "No! What am I saying? After listening to his raving not five minutes ago, how could I even think of such a thing?"

"Maybe it's because you're a good Reformed Sufi," Bulgakov suggested. "You've been trapped into a policy that conflicts with your conscience. I'm offering you the chance to break out of that trap. I'll go with him. If he acts against you, I'll act against him."

"But the risk!" moaned Strampanis. "Can you promise to watch him like a hawk? To counter any lies he tells about us? And to make sure he sees a psychiatrist?"

"Yes."

"How about you, Isaac Bentz? Can you promise that you'll see a psychiatrist?"

Bentz snapped his head up as if he were ready to shout defiance, but then all the color drained from his face. At that moment he lost what little fire he had built up and turned into a dejected accountant again.

"Yes," he said.

"And will you keep peace with us?"

"I've already told you I will."

"OK," said Strampanis, "then I'll see what I can do—which isn't much. I'll schedule a staff meeting and we'll reconsider the question. But don't get your hopes up."

Bulgakov endured an Inside Month of cold shoulders while he waited for staff and administration to circumambulate their way to some sort of conclusion. Living in this new universe didn't seem to make it any easier for people to accept criticism gracefully. Even friendly Sam Golden put him off with the excuse that he was terribly busy. All three of him.

So he spent most of his time in meditation—usually a form of Dharana peculiar to that universe, wherein objects visualized with the eyes closed could be compared with what the computer had created when the eyes were opened. That was what he was doing when Strampanis came to visit with Bentz in tow.

"I never would have thought things would turn out like this," Strampanis muttered.

"I hope that means I got my way," said Bulgakov, disappearing an elaborate clockworks that was suspended in the middle of his room.

"It was close, but you can both leave right now, if you want."

"From here?"

"You can be Transmatted from wherever you are Inside. It's keyed to your record, not to your world. We're set up now, so—any time you're ready."

"I'm ready," Bentz said, staring at the spot where the clockworks had been. "You know, you're only acquiring bad habits. Dharana will be harder for you when we get out of—"

* * * * * * * * * *

A surprised smile lit up Hayden's face when they walked into his office. He bounded up from his desk chair. "Well," he said, "that didn't take very long! I suppose he was just ready to leave when you got there, eh, Bulgakov?"

He walked around the desk and embraced Bentz. "Welcome back, Isaac. You look great!"

Bulgakov started and gave the CM a careful look. Hayden was right. Getting out of that place had obviously done him a world of good. Now he really looked like the man on the hololoop. Still . . .

"There's been a problem," he said

to Hayden. "The CM isn't quite as well as he looks. Can you dig out a psychiatrist from your staff who can . . . "

"There's no time for that," Bentz interrupted. "Doc, can you do me a favor right away?"

"Sure," said Hayden. "Anything."

"Are there any Adept Moderators left in this building that you think I can trust?"

"A few."

"Draw me up a list of them. I'm about to become active in Church affairs again."

Hayden's grin became even wider. "It's about time, Isaac, if you don't mind me saying so. What's the list for?"

"I want to convoke a meeting of planetary militias."

Hayden's grin wilted; the color drained from his face. "What's going on!" he croaked.

"Tell you a little later. I'll be up in my rooms talking with Adept Bulgakov, if there are any emergencies."

Bentz opened the door to the hall, swept his arm through it, and said, "This way, Adept."

They walked up a short flight to a spartan living room: bookcase, couch, easy chair, and worn rug. Bentz took a seat on the couch, smiling.

"Just what the hell do you think you're doing, Bentz!" Bulgakov yelled.

Bentz's smile became grim. "Promises made under duress aren't binding," he said.

"You lousy bastard. You're really going to do it, aren't you? You're going to bomb them."

"Into dust," Bentz said.

At that moment, the respect for Bentz built up in three decades of training collapsed. Bulgakov felt only loathing.

"You're no Celestial Master at all," he said. "Maybe you were at one time, but . . . "

"I never was," Bentz interrupted softly. "That title was supposed to be a joke. There was a time—long ago, before the Transmat—when my followers knew that. But they're all dead and buried on Earth and these days no one can understand a religion with humor in it. It's as if no one can imagine a God that can laugh. . . . There's only one real Celestial Master, you know."

"And I don't suppose you think He cares about the slaughter of millions of human beings."

"Are they human beings? Probably not. They're souls, I'll grant you that, but I think the human part of them is dead. And those souls are twisted — trapped in an electric nightmare.

"I learned a lot while I was in Hell, a lot about the religion I founded, among other things. And now I've been given a second chance, a chance to atone. I'll free those souls that can be freed and put the rest out of their misery."

"Don't be so sure of that."

Bentz shook his head and clicked his tongue. "You think they'll get right to work, don't you—that they'll take that three-thousand-year advantage. You're wrong. You've forgotten your history. What they'll actually do is figure they've got plenty of time and put it off, like everything else. Then—I don't know — maybe a century before we arrive, there will be a panic and they'll have to devote all their energy to preparing for us. Their society will become regi-

mented—totalitarian, probably. I can see it now: millions of ranked and filed souls . . . ''

Bulgakov's loathing hardened into a determination to hurt this man—to hurt him as badly as he could. And, in a flash, he knew exactly how to do it.

He smiled a bright smile and said, ''Aren't you being presumptuous? You're only human. What makes you think you can stand against Hell?''

''I don't know it. It's a risk I'm willing to take.''

Bulgakov laughed. ''You don't understand me,'' he said. ''What makes you think we ever really got out?''

Bentz's new-found self confidence seemed to be draining from him. A troubled look passed over his face. ''What do you mean?'' he asked.

''Sam Golden, our best world-maker, has been awfully busy this past month. He told me so himself. I went to visit one of the worlds he and his wife made. Do you know they can fix a world so that anyone in Hell can watch them, but they can't detect the presence of any of the watchers?''

Bentz shook his head. ''It's impossible,'' he said. ''They couldn't create all this . . . '' he gestured at the room, the building, the city with a sweep of his arms. ''They don't know enough.''

''Nonsense. They have records of everyone who's been in Octopus Bay. More importantly, they have *your* records, the entire content of your mind. Everything you know, they know. They can create a Hayden as well as they can create those unpersons in the Commons. I couldn't tell the difference. Could you?''

''I suppose something like what you're suggesting is possible,'' Bentz said, his voice quavering, ''but it's just something I'll have to live with. If you think that's going to deter me, you're wrong.''

''I'm not sure I really want to deter you. This is probably what they want. Don't you remember when we were talking on the Commons and your shrink told Strampanis that you had to be given the opportunity to act out your aggressions? And Strampanis agreed?''

Bentz appeared to collapse completely. He bent over, staring at the floor, arms folded and pressed against his stomach. He rocked back and forth.

''No,'' he moaned. ''No!''

''You didn't really expect them to let us out, did you?''

''No,'' he whimpered. ''No.''

Bentz kept repeating his ''no,'' kept rocking and moaning. Bulgakov judged him a pretty picture of a psychological wreck, and decided it was an ideal time to go get Hayden. Bring him up, show him Bentz in this condition, and explain things to him.

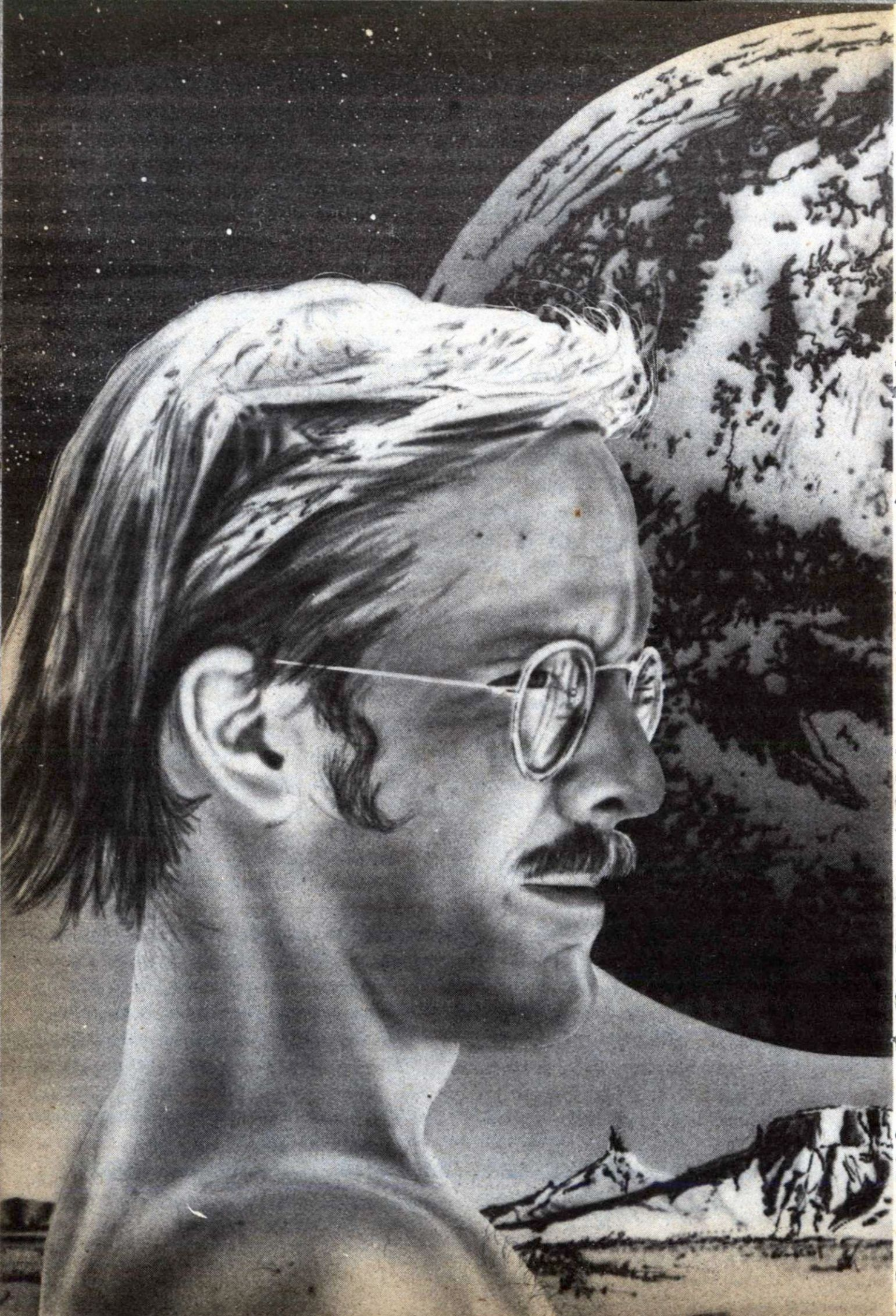
Just in case . . .

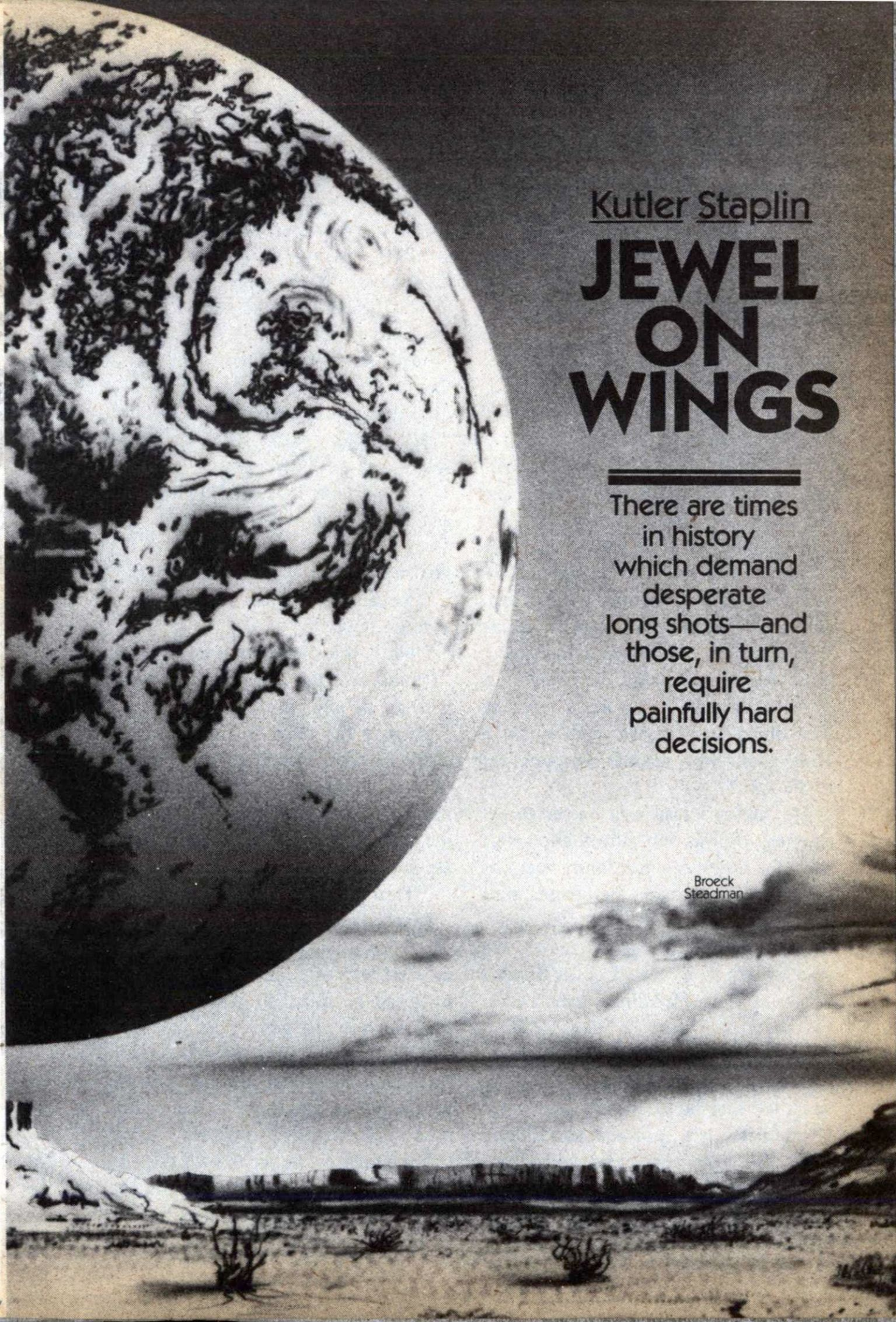
What am I thinking. Just in case *they really did send us off Paracelsus?*

Then there's a part of me that believes what I said to Bentz. A part that wants it to be true, that wants to stay in the new universe no matter what.

Come to think of it, he'd made a good case. It might very well be true. He wondered about that as he walked down the stairs to get Hayden. He also wondered how much it mattered, but there his imagination failed him. ■

● It does not pay a prophet to be too specific.
L. Sprague de Camp





Kutler Staplin

JEWEL ON WINGS

There are times in history which demand desperate long shots—and those, in turn, require painfully hard decisions.

Broeck Steadman

David Macada shielded his eyes and squinted into the northern New Mexican sunset. His dirt-encrusted Levis cracked stiffly as he squatted, hiding behind a clump of mesquite bushes. He was so close to home now, just west of Pojoaque, and he ached to start walking along the rutted, two-lane road even though darkness was a full hour away. Still, he hesitated. It didn't make sense that there were no patrols this near the complex, and three weeks of living as a fugitive from the New Kingdom had taught him to be wary.

He thought about his harrowing journey overland from the east coast, and the ease with which 21st-century men and women could be transformed into blind, savage mobs. It scared him to death; he'd never believed it could happen *here*. And then he'd seen it with his own eyes: the mass arrests, the executions on the east lawn, and finally, a personal inquisition by the Council of Ten about space-based support for a Holy War—with nuclear weapons, for god's sake!

He couldn't wait any longer to get moving. He was only fifteen kilometers from the little pocket of sanity near Los Alamos. His family was there, plus those of about eighty scientists, technicians, and administrators—all the people left from the *Pegasus* project—who still regarded him as their leader. He knew they were waiting for him, even though they had no way of knowing for sure that he was still alive. Ever since the fear-fueled outcry which had consolidated the fundamentalists' dizzying rise to power, a determined nucleus at the complex had seemed to depend more and more upon him to come up with an answer. And time was running out. He stepped into the twilight and resumed his trek.

"Hold it right there."

Damn, why'd I have to get careless now?!? he cursed himself. As he watched, not moving except to lower his knapsack to the ground, three brown-skinned young men blocked his path. They slid noiselessly away from an outcrop of reddish volcanic rock; one of them held a vintage, circa 1985 twelve-gauge leveled at Macada's chest.

His captors argued among themselves.

"—and I say he's no different from any other *Anglo*—kick him in the *cojones* and leave him beside the road, if you're in such a good mood tonight."

"Yeah. We can use his stuff. Look at those boots!"

"No," the shotgun-carrier decided. "I think he's the one. We'll take him with us; he's worth more as he is."

Angrily the other two continued to argue, but they eventually gave in. One of them approached Macada, examining him as if trying to decide where to make the first cut in a choice piece of meat. He pulled something out of his jacket.

"Turn around!"

Macada complied. Then, as his hands were roughly forced behind his back and the first loop of twine was being pulled tight around them, he panicked. He'd learned how to act when the Holy Knights stopped him, how to placate them with the gospel, what they would take as bribes. But these were total outlaws. The rules were different.

Twisting free, he buried his left elbow in the throat of the man behind him. He jerked his hands loose and pulled his

knife out of his boot. His victim, and potential hostage, however, had fallen away from him. He found himself staring once again down the barrel of the gun.

He looked around frantically; there was no way out. He dropped his knife, and got as far as "Where are you tak—?" before the man he had knocked over picked up a stone and smashed it into the back of his skull.

Macada remained unconscious for more than five hours. He was tormented by the images of a society in revolution, a people who'd lived so close to the edge for so long that only a total capitulation to irrationality could ease their awesome burden. The glazed, twisted smiles of the Council floated before him; it had seemed such a logical step to so many to hand the reins of government over to this paternalistic clique, with the reassuring knowledge that their decisions would always reflect a direct appeal to a "higher authority." Worst of all was a nightmarish fantasy in which his wife was branded a heretic and herded in front of a firing squad. He was so far away, he was helpless, and she kept calling out his name. Her face began to blur. He screamed.

"David! David!" She held his head with a hand on each cheek.

"Janie?" Her brown eyes slowly swam into focus. "Did I make it? Is it really you?"

"He's awake!" She turned and called out to the others, then hugged him close against her breasts. "Oh, David—yes, yes you made it. You're safe now, back in the complex."

"How did I . . . ?" He propped himself up with one elbow and felt to see what was hammering on the back of his head. "Aagh!"

As people began to crowd into the room, a svelte woman in her mid-fifties shoved her way to the side of his bed.

"All right, let's give him room to breathe." She smiled as her expert fingers reached to check his pulse. "Welcome home, David, such as it is. How do you feel?"

He grinned at the doctor, who still insisted on wearing the uniform of white coveralls while everyone else had long ago lapsed into the informality of blue jeans.

"Bren . . . I *know* times are bad when *you* start making house calls." He struggled to sit up. "I'm OK, I guess, except for the headache. Damned glad to be here, mostly." He squeezed his wife's hand and blinked at his other visitors.

"Hal, Veeja, Carlos . . . it's good to see you again. Listen, you've got to get everyone to the main hall as soon as—" He gritted his teeth as a sudden stab of pain made him wince.

"You're not going anywhere," declared Brenna Siokin, with the full authority of her profession. "You've got a mild concussion, and you're going to have to take it easy for a while. *Maybe* you can hold a meeting tomorrow."

David groaned weakly. "Just one thing: the welcoming committee—who were those guys?"

Hal Green, the hydroponics specialist, ran his bony fingers through his sparse, black hair. "I'm afraid they were my idea.

"They're Indians—Apaches—and they're our neighbors in these moun-

tains. *And* they seem to be the only other people around here who haven't bought all this New Kingdom crap. Basically, they don't like anybody. Anyway, the good folks in the surrounding towns have been making noises about 'cleaning out' our 'nest of sin.' So I, uh, engaged the services of the trio that brought you in, along with twenty or thirty of their cousins. They keep an eye on things for us, and we supplement the fruits of their various illegal activities with a little extra cash and free medical care. They're the only friends we've got, at this point."

David felt his head again. "With friends like that . . . !"

"I'm awfully sorry about that. I told them to watch for you and to bring you in unharmed. Apparently, they attach a much wider range of meanings to that word than I do. If you say so, we'll sever the alliance, but I think we need them."

"Well, I've got to admit they're effective. Maybe they'll buy us some time if a mob heads in our direction. Considering the reception I got in Washington, we'll be able to use all the help we can get."

They all stared at him questioningly. He shook his head back and forth.

"It's bad. Real bad. The project's finished. That's what we've got to talk about."

The room filled up with a gloomy silence. Then Janie spoke, quietly.

"Tomorrow's soon enough for that. It's late now. Go on; leave us alone, please. Let me have just one night with him, without thinking of what comes next."

The others looked at her and nodded. Hal clasped David on the shoulder for a second, then they all filed out of the room. At the door, Brenna turned back.

"Remember what I told you—take it *easy*."

David's response was lost as he kissed his wife, long and hard. "God, it's been almost a month, Janie. Come here, close to me."

She moved next to him, eager, yielding. Moments later she interrupted their intimacy. "Do you want me to wake Seth up now? He's only asked me, 'When's Daddy comin' back?' about fifty times a day since you left."

"No. Let him sleep; I'll see him in the morning. I need this time with you."

An hour later they fell asleep, locked together just like the thirty-two-year-old lovers who'd run off and gotten married nine years, one child, and what seemed a completely different lifetime earlier.

David was awakened by an unruly mop of straw-colored hair, attached to a giggling perpetual-motion machine that bounced ecstatically on his chest and stomach. He groaned, and then saw his son's beaming smile. He smiled back and they play-wrestled for a few minutes. Finally he groaned again in mock-surrender, as Seth sat triumphantly atop him.

"Oof! I give up! You're getting too big for me, boy!"

"Are we going to go now, Daddy? Is our spaceship ready yet?"

David rolled out from under him, until they were sitting side by side on the bed. He put his arm around Seth's shoulders. Suddenly his head ached ferociously again, and he knew it wasn't only because of his injury. The ordeal

had begun. He was safe again, physically, but now he had to bury the hopes of everyone who'd been counting on him—starting with his own son.

"I'm afraid not, Seth, at least not right now. Daddy couldn't . . . couldn't fix all the problems, so we're going to have a meeting in a little while to decide what to do."

The boy's expression trembled and fell. David, already weakened, recoiled before this wave of disappointment.

"Come on, son! You wouldn't want me to pretend, would you, when it wasn't really true?"

Seth stared up at him with eyes wide and only a little watery. In a small voice he answered, "No," while pulsing with a dozen nonverbal messages that each shouted "Yes!!!" as loudly as possible.

They dressed quickly, not talking much, and went to join Janie for breakfast. As he ate, David caught his wife's attention, and together they watched as Seth shoved his soy strips despondently back and forth across his plate. It was going to be a long day.

David was acutely conscious of all the vacant seats in the meeting hall. He counted only two hundred and twenty-seven; that was all—families included—that were left now. They were little islands of desperation, stranded among the places reserved for another eight hundred who'd already given up on the dream of a life in space. *They* were probably the smart ones, he thought, the ones who'd abandoned the project when the fundamentalists had first seized power.

The Los Alamos group had been the chosen, the first wave of permanent pioneers destined to settle the high frontier. Their lives had been an endless session of study and preparation; as the day neared when the construction crews would return to Earth and the automated lunar mines would become temporarily idle, they'd retired to live in the near-seclusion of the isolated scientific community flourishing in the mountains of New Mexico. A newly completed complex became their home, as the group was left increasingly alone so its members might evolve whatever peculiar social dynamics they'd find essential to survive as a self-contained extraterrestrial colony. It was then, during the sweltering summer of that final year, that American society had wrung itself inside out. Almost overnight, through acclamation backed up by media-managed hysteria, a theocracy was born. Within months, chaos reigned. To David and the others, it was the cruelest joke imaginable.

Now he was forced to tell these remaining few that there was no longer any chance—they'd never be allowed to occupy the rotating torus moored in the gravitational shallows at L5, waiting, empty, as it silently chased the moon through its orbit above them.

"—and it's going to become more dangerous for each of you, every day that you stay here," he concluded. "I know this isn't what you waited so long to hear, but I can't see any alternative. I'm afraid we'll have to disband the project entirely."

No one said anything right away, but David could see the dejection, the frustration, and then, the anger in their tightened jaws and clenched teeth. Carlos Pereira, fidgeting with the rolled-up

sleeves of his blue denim workshirt, was the first to erupt. "*Filho duma puta!* All they'd need to do is authorize one more launch from the Cape! Just get us there, and we can survive on our own. The first-phase construction is done! It's sitting up there, waiting for us! Didn't you tell them? Don't they understand?"

David answered him, softly. "Of course they understand. They've inherited a 900-billion-dollar debt for the fifteen years' worth of work it took to *put* the colony there. Believe me, they're dying to get something in return. But when they told me what they had in mind—how they wanted to transform *Pegasus* into a massive weapons platform—I could barely keep from spitting in their faces. I told them we'd never do it. I was so appalled; it was just a reflex. That's when the Council, in its infinite wisdom, decided that space colonization was 'blasphemous.'

"Of course," he added, crossing his arms defensively, "I am still technically under arrest. If enough of you feel differently, I'm certain the Council would love to have your cooperation. You could send someone else to see them, and dissociate yourselves from me, and then—"

"Please, David! Do not say this. You know we all feel the same way you do." It was Veeja Rawalapur, the group's prime software wizard.

David scanned his audience. He saw only nods of assent, but he wasn't sure that what Veeja said was really any truer than Seth's response had been. It was Janie, smiling reassuringly from the front row, who gave him the strength to continue. He looked up as a technician he recognized, but whose name he'd forgotten, spoke out.

"What *are* they going to do with the colony, Dr. Macada?"

He flinched, mentally; that was the one question, more than any other, that he was hoping to avoid today. He swallowed hard.

"I—I think they intend to destroy it." Even he was stunned, hearing his own voice pronounce the unthinkable. He hurried on.

"They recognize only its potential to dominate the Earth militarily. After my refusal to help them, an argument broke out. There were some who wanted to train their own people to operate the colony as a base for the New Kingdom, and there were others who simply wanted to lob a few warheads at it and forget it. The first bunch won out, barely, but I don't see how they can do it. We just aren't replaceable, at least not without years of training in the very institutions the Council has condemned, plus the cooperation of the same 'intellectual reactionaries' they've been killing with such fervor. Eventually, they'll have to give up on that scheme, and then . . ."

He paused, his shoulders sagging under a palpable despair. He had to keep talking, for himself as much as for the others.

"You don't know what it's like out there! They're executing people in the streets! Hundreds a day, in a hundred different cities! Try to imagine yourself being pulled out of your laboratory and *stoned* to death, merely because you'd failed to memorize the latest set of platitudes which serve as passwords among the devout. I saw it happen in Arkansas, not more than a week ago. Book burn-

ings? It's common. Remember Iran, and Egypt and Saudi Arabia, back in the '70s and '80s? Well, this is worse. I grieve for *Pegasus* more than any of you, but we've *got* to put it out of our minds. The world's gone crazy out there; *if* we elect to stick together, as a group, it's time to pull the wagons into a circle and just try to stay alive."

A numbed silence followed his words. He glanced at his wife, then at all the others in the meeting hall, and saw how fragile it all was. Not just their lives, but their whole way of life. They'd always taken it for granted that the status quo was, at its roots, inviolate. Christ! The idea still seemed preposterous! To even consider the *possibility* that the self-appointed champion of western civilization could decay so quickly . . . But it had. Four generations of creationism in the public schools had resulted in a widespread ignorance and a growing mistrust of science—one day, the spirit of the Renaissance had flickered, and died.

Quietly, a familiar voice asked, "Can we do it? Do we have a chance against them, if we stay here?"

David snapped his head to one side, slightly startled. "I don't know, Bren, I don't know. The reactor'll give us all the power we need, and we should be able to feed ourselves, but . . . it depends on whether the Council is willing to stage a full-scale assault on a civilian target. That's one thing that might still turn the masses against them, at least until they have time to generate the appropriate mood in the country. In my opinion, we're safe for the winter, and probably the spring as well. Call it six months. After that, I think *anything* could happen."

He pursed his lips and went on, matter-of-factly. "We could set up high-voltage perimeters, I suppose, but they could be shorted out. And we've got enough energy to deploy some damned potent lasers, or even a particle weapon, but those would be a lot more effective against an air attack than against a bunch of fanatics darting among the rocks and bushes. We're conspicuously lacking in antipersonnel devices. . . ."

"Well, hell!" Hal Green leaned forward in his seat. "I don't care if we have to build catapults and throw boulders at them! I'm staying." A chorus of angry voices affirmed his sentiments.

"Hold it!" David countered. "*Think*. This isn't an old movie. You know as well as I do that the crazed mobs are only the first step. How long will it take until the Council seems justified in making our mountain fortress uninhabitable for the next ten thousand years or so? *That* they could do, without much trouble. 'Burning out the servants of the devil,' or something like that. And even barring such extremes," he added, "are you sure that staying together is worth coping with a perpetual state of siege? Do you really want to live like that?"

As he watched Hal's features sag gloomily, he could almost hear the first, chill winds of October faintly blowing outside, like someone softly sobbing. He'd never hated his role more; these people had believed in him! He could feel the stares from all the others, who *still*—damn them!—seemed to be waiting for him to *do* something. Well, they'd just have to wait. His expression said it clearly: save yourselves. Finally,

a few of them rose from their seats and began to shuffle toward an exit.

Suddenly, Carlos boomed out "Stop!" He jumped up. "David, everybody, listen to me! So we can't make it here — that's only one more reason we've got to find a way to get off-planet. And I know how we can do it!"

Those who had started to leave turned back. Carlos, a combination of infectious good humor and unparalleled innovation in his work in theoretical physics, was accorded a level of respect second only to David Macada by the *Pegasus* group. He spoke rapidly.

"What Hal said a minute ago—about building catapults—put me on the track, and I'm talking about the rocket sled sitting out there in the Jemez caldera. We've got nearly fifteen kilometers of perfectly straight, flat trackway running along an east-west axis, and megawatts of power available to us from our own reactor. Does that suggest any possibilities to anyone?"

David made the connection almost instantly. First he thought of the Nobel Carlos had been awarded for his pioneering field equations; they held the promise of finally tying electromagnetic and strong and weak nuclear forces together in one conceptual bundle, by neatly incorporating them all into the general theory of relativity. After that, the obvious association was the single most talked-about new technology that had so far emerged from Carlos's efforts: the room-temperature superconductor.

"A mass driver! You think we can modify the track to accelerate —what? — to escape velocity! What kind of vehicle?"

"You don't remember the beta-series shuttle we stress-tested two years ago? The one that burned those pilots up on re-entry? It's still sitting out there in our number-four hangar, if I'm not mistaken."

"Carlos, that's not a shuttle—that's a hull, an empty shell. There's no main engine assembly! All it's got left in it is—"

"—is a fraction of its original mass! It's perfect!"

Then Veeja drowned everyone out. "But even if you could accelerate a stripped-down shuttle to—what is it, a little over 11 kilometers per second? —you'd have to do it in less than three seconds, before you ran out of track. That means anything, or anyone, inside would be hit with, let me see . . . around 420 gees!!"

Carlos was undaunted. "No, they wouldn't. Not if my equations are correct—and I'll stake my life that they are. One of the most exciting things about unified field theory has always been the possibility of artificial gravity fields. I'll admit that that would probably still be a few years away, under normal circumstances, *but I know it can be done!* I can create a local field in that hull that will damp the force of acceleration all the way down to *one* gee! Or even less, if you want it."

Now the meeting hall was alive and buzzing. The two hundred faithful raised their voices with guarded, but growing, enthusiasm.

"What about the heat-shield problem?" someone called out.

"I can answer that question," David replied, regaining the group's attention. "All of this . . . speculation . . . rests

upon one assumption. If we *all* decide we're willing to bet our lives on this scheme, it's an all-or-nothing gamble."

His pulse was racing. He could think of at least half a dozen Herculean tasks they'd have to accomplish, even to have a chance of pulling it off. But to have any chance at all! He saw the staggering consequences of the choice that had been placed before them, and he weighed his next words carefully.

"If Carlos is wrong, we'd die during the launch. And if he's right, any concerns about re-entry would still be meaningless. Because there will be no plans for coming back."

If anything, David had encouraged the confusion that soon splintered the meeting into a loud parade of competing conversations. Would the plan work? What if the crops failed on the colony? Could they cope with medical emergencies? And what about the stress of living in indefinite confinement, in what many might well come to regard as a prison, with no real hope of any help from Earth in a time of crisis. . . . He heard the arguments, back and forth, knowing how difficult it would be for the whole group to reach a consensus: it would take a hundred-and-ten percent from everybody left to try to reach the colony. He also expected that, inevitably, the question would be put to him. Yes or no. And he didn't have an answer. In fact, several hours later, he'd found his emotions torn more savagely than he'd imagined any person could bear.

Janie had refused to go.

They stood alone, under a canopy of aspen and ponderosa pine, as Seth took a seven-year-old's delight in running ever-widening circles around them through the woods. Though neither felt bitter, both adults spoke in a strained, pinched tone as they wrestled with their family's fate. Janie's words slashed to the quick, and brought everything into a searing focus.

"The Earth will endure our madness, David; mankind will muddle through one way or another. That's your *son* there. Do you want to throw *his* life away in this suicidal plan? That's what it comes down to."

He faced her; his mouth was moving but no words came out. *It's not suicidal!* he wanted to insist. He wanted to make her believe it would work. But would it? *Did* he want to take that risk with Seth?

Janie stepped closer, and without saying anything they were holding each other tightly. She pleaded again, gently, with her husband.

"David, think about the place we were first together. Remember the falls at Havasupai? I want Seth to have a piece of that, too. It's not right to send a little boy . . . out there. I know how much you want it, but I need you here — we both need you—and I love you so much. Stay with me, David. Please stay."

He caressed her hair, strands glittering amber in the late afternoon sunlight, and felt her press her body against him as she wedged into the hollow where his chest and neck came together. The Havasupai. Yes, that was Shangri-la, or as close to it as he'd ever seen on Earth. In space, now, that was something else. Even the beauty of a waterfall might be surpassed—not on *Pegasus*, perhaps, but certainly on a later, larger colony

— once the next generation of engineers and environmental psychologists got down to work.

But David understood Janie would not be moved by such factors; for that matter, she had been more than willing to send Seth into space a year ago. Things were different now, however. The maternal, protective archetype dominated her decision-making. Although Seth could easily end up in some urban hell, contending with the hardships of a post-holocaust technological collapse, David knew his wife would always choose the familiar, known danger over the cold, lonely risks of the unknown. In truth, though, he was troubled by it, too. To set themselves and their child apart from Earth was so . . . final.

He simply wasn't strong enough to take that step alone, without his wife.

He ran his hands down over her shoulders, and her back, and lower, and cupped her there with his palms as he closed his eyes to everything except Janie. "Don't worry, baby," he whispered, "I'll never leave you." And he knew he meant it, whatever was to come. "Never."

They remained lost in each other's embrace until Seth tumbled breathlessly into their midst.

"Whoa!" cried David. "What's the big rush, cowboy?"

"Daddy! They're looking for you! Are you hiding?" If it was a game, he wanted to play, too.

As he picked up his boy, David asked, "Who, Seth? Who's looking for me?"

Unhappily, the boy waved a stubby finger in the direction of the complex; clearly, it was no game.

David couldn't see anyone nearby. He turned to his wife, but before he could say anything she smiled and squeezed his hand.

"It's all right, honey. We better go back now. You can't run away from them."

He nodded; he knew what was waiting for him, and realized it was best said quickly, while his mind was still full of Janie's sustaining warmth. He was about to swing Seth up onto his shoulders for a ride when the boy blurted out, "Is it true, Daddy, what everybody's saying?"

David set him on the ground and kneeled down beside him. "What are they saying, boy?"

"That we might still go to outer space!" His eyes danced, and he threw his hands up into the air as far as they could reach, as if to hurl himself from the Earth by the sheer force of his own desire. "And that you're going to decide. Say yes, Daddy! Say yes!"

"No! I mean, it's not right, what you heard. It's *not* just up to me . . . *everyone* has to decide. Now let's get on back so you and your mother can get some dinner." With an effort, he erased a scowl.

Seth got the message; they walked in silence.

After a few minutes they were in sight of the wide, flagstone patio outside the main dining area. Carlos was there, gesturing impatiently for David to hurry; Veeja, Hal, and Brenna clustered around him.

At the last moment, Seth turned and, with a tentative smile, exclaimed, "I

love you, Daddy," before he spun around and dashed off into the building. "I love you, too," thought David, as he braced himself for what came next.

"Janie—" he began, and stopped. She gave him a look that said "Shh, not now," and kissed him.

"Come back," he muttered, as she left him. Just to himself he added, "I need you; god, how I need you!" Then he approached the others.

The shift was jarring.

"—and we can't afford to let everyone 'take their time and think about it.' " Carlos, who had aimed that particular jab at Brenna, continued without pause. "David! Where've you been? You've got to pull this together, and fast, so we can get to work. We'll get everyone together again, and you can make them believe we can do it. That's all they're waiting for—they *want* to be convinced! And you're the only person that everybody will listen to—and take orders from, if it comes to that."

"Carlos," Brenna cut in, "you can't *order* people to commit themselves to something like this. It's different for you—this is *your* idea, after all."

"I agree," seconded Veeja. "You cannot expect everyone to share your confidence. They are scared and they do not understand."

"Then someone's got to make them understand!" Carlos pointed, emphatically. "You, David! You're the one! Will you do it, before it's too late?"

He couldn't tell them yet. Instead, he turned to Hal. "What do you think? Don't you have an opinion about this?"

"Sure. I'm one of those people Veeja just described. I'm scared, but I trust Carlos's ability; and, without getting a big head about it, I *do* know more than anyone else about maintaining the ecology on *Pegasus*. It makes me feel special, you know? If there's a chance, I'm ready to go for it. My wife feels that way, too."

But mine doesn't! thought David, feeling the old ache returning. "Bren? How about you?"

"Me? Since Karl died, I . . . well, there's really nothing for me here," she said, quietly. "I guess I feel pretty much the way Hal does. I vote yes."

"Veeja?"

The Pakistani native shrugged his thin shoulders. "If I remain here, I die, maybe. In my own country, most are starving. If it is agreed that what Carlos has proposed is possible, I want to go. But, as he said, David, this depends so much upon you." And there it was.

As all three of his friends waited for him to respond, David stared into the gathering dusk. Brilliant oranges and magenta shaded into indigo. He shivered in the clear mountain air.

Abruptly, he faced them. "I can't do it. I can't do what you're asking of me."

He saw the uncertainty and the anguish his words had produced; he had to try and justify them, somehow.

"Consider something else for a moment. It was right here, exactly seventy years ago, that Oppenheimer and all the others agonized over whether or not to explode the first atomic bomb. It wasn't really necessary—Germany had already surrendered and we were pounding the Japs pretty badly as it was. But they'd put so much sweat and blood into the problem, and they finally had a solution. And all of them could surely see, at least in their nightmares, the irrevocable

changes that might come from their action.

"It came out in their memoirs, though, over and over again; *they just had to do it!* And maybe we're victims of the same technological egotism. Maybe we're bowing to the same master: the primal man, who can't resist the urge to raise his fist over his head and shout in triumph. *Can* any of us choose to not go, to not throw ourselves into something we all might later regret, just to show that we can do it?"

Janie slipped outside at that instant, and began to walk toward them from across the patio. She went unnoticed, as Carlos creased his forehead, frowning, and fashioned a reply.

"Why do you think we'd regret it? Because of the launch? Yes, there's some risk involved, but I can show you the equations—"

"I'd say that was a bit understated, Carlos, and it's not only a matter of getting off the ground alive," David insisted. "There's a lot of airspace to get through before we'd be out of range of their SAMs, and somehow I don't think the Council would react to our little escapade with a hearty *bon voyage*."

"We'll be in orbit before those idiots even realize what's happened!"

"Maybe . . . maybe not. But even then it won't take any great genius to see that our obvious destination is a much easier target, and there's probably a lot of nations who'd strongly prefer us not to be living up there, right over their heads. Carlos, think of how long it's taken us to get *this* far! Do we really want to do anything that would be certain to invite the colony's destruction? Especially now, while we're flirting with another Dark Age?"

Carlos protested. "But we should be able to knock down anything they might use to carry a warhead. And with a high enough potential on the plasma core shield I'll wager we could even deflect a particle weapon, should they have the brainpower left to deploy one."

"You're missing the point! Why even start down that road, when the stakes are so high?"

"Precisely because they *are* so high! You're the one who's missing the point, David. It's an unhappy coincidence that the same kind of knowledge that gives us space colonies also gives us the means for mass destruction. So let's not waste what may be our only opportunity! We're the best shot, and maybe the *only* shot, for keeping mankind on the road to the stars." *And you know it!* he glared, accusingly.

With their eyes locked together, David stuttered, "I—I still—"

"David," Brenna joined in, "you told us earlier that you were afraid *Pegasus* would be destroyed, in any event. I may have argued with Carlos before, but I think he's right: it's not selfish, or egotistic, to do what we're considering—it's the best gift we could give our fellow man. There's only one thing I can't figure out—*Why aren't you the one who's saying this?*"

Hal echoed her. "You fought for this project, David. I can't believe you don't want it anymore. Is that possible? Were you changed that much while you were away?"

David's defenses were stripped away; there was no way to avoid it any longer. His friends would not let him close his

eyes to the still-bright flame burning inside him, and now he was being forced, very deliberately, to place his own hand over the lamp's open neck and snuff out the light for good.

"No, I . . . that hasn't changed."

"And we know that you are not a man afraid to risk his life; that nasty lump on your head is proof of that. So what is it?" Veeja demanded.

David composed his features carefully. "It's the one thing I value more than *Pegasus*. Janie and I decided—"

"Don't!" she burst out, pushing among them. "Don't say it, David. I don't want to know that you stayed with me at the expense of your dream. I've changed my mind . . . I'll go."

He stared at her, disbelieving. Then he started to smile. "Oh, baby, do you mean it? All of us, on the colony . . . ?"

"Wait, David. That's not what I said."

His eyes widened. "You mean . . . not Seth? Leave him here?"

"Yes." Her face was drawn; her voice was steady. She pulled her blue windbreaker closed at her throat. "He would have to stay on Earth. I think I could do that, David—I love you enough even to leave our child behind—but I just can't let him go. He can live with one of our parents; but I can't send him into space the way things are now. I'm sorry; it's got to be that way, or not at all. It's up to you—you have to decide what's more important."

He stood there, studying his wife, both loving her and hating her for the choice she'd given him. Then he glanced at each of the others. They were frozen, watching him.

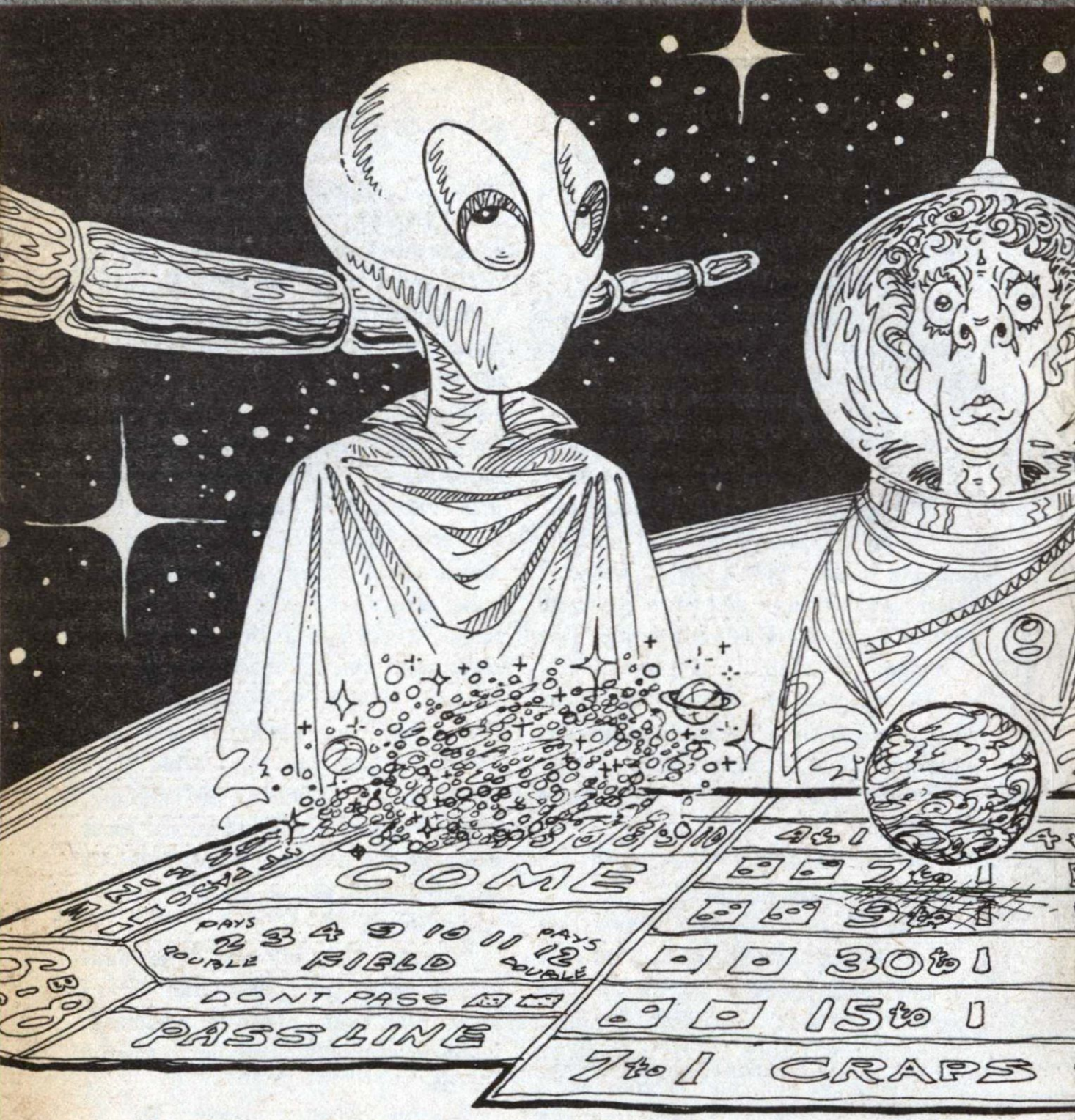
He looked overhead into the deepening blackness. Though his eyes were unable to pick it out among the first flickering islands of light, his imagination could easily see the gleaming metal structure. Space city. Jewel on wings. It beckoned to him; its siren song surrounded him and made it harder and harder to hold on to the pale, receding cry—*I love you, Daddy; I love you, Daddy; I love you*. . . . What price would he pay, to unleash the laughing, screaming demon within him and loose it toward the heavens? *Sweet Jane*, he thought, *what you've given me is no choice at all.*

"Forgive me, my son," he murmured, exhaling exquisite grief, "for I know what I do." Then he was back, his gaze eventually coming to rest on Carlos.

"Call the people together." ■

● I view science fiction as a treasury of models—models of alternative political and social systems, sexual relationships, forms of technology, and so on. The more alternative models of which we are aware, the more flexible our responses can be to present-day situations.

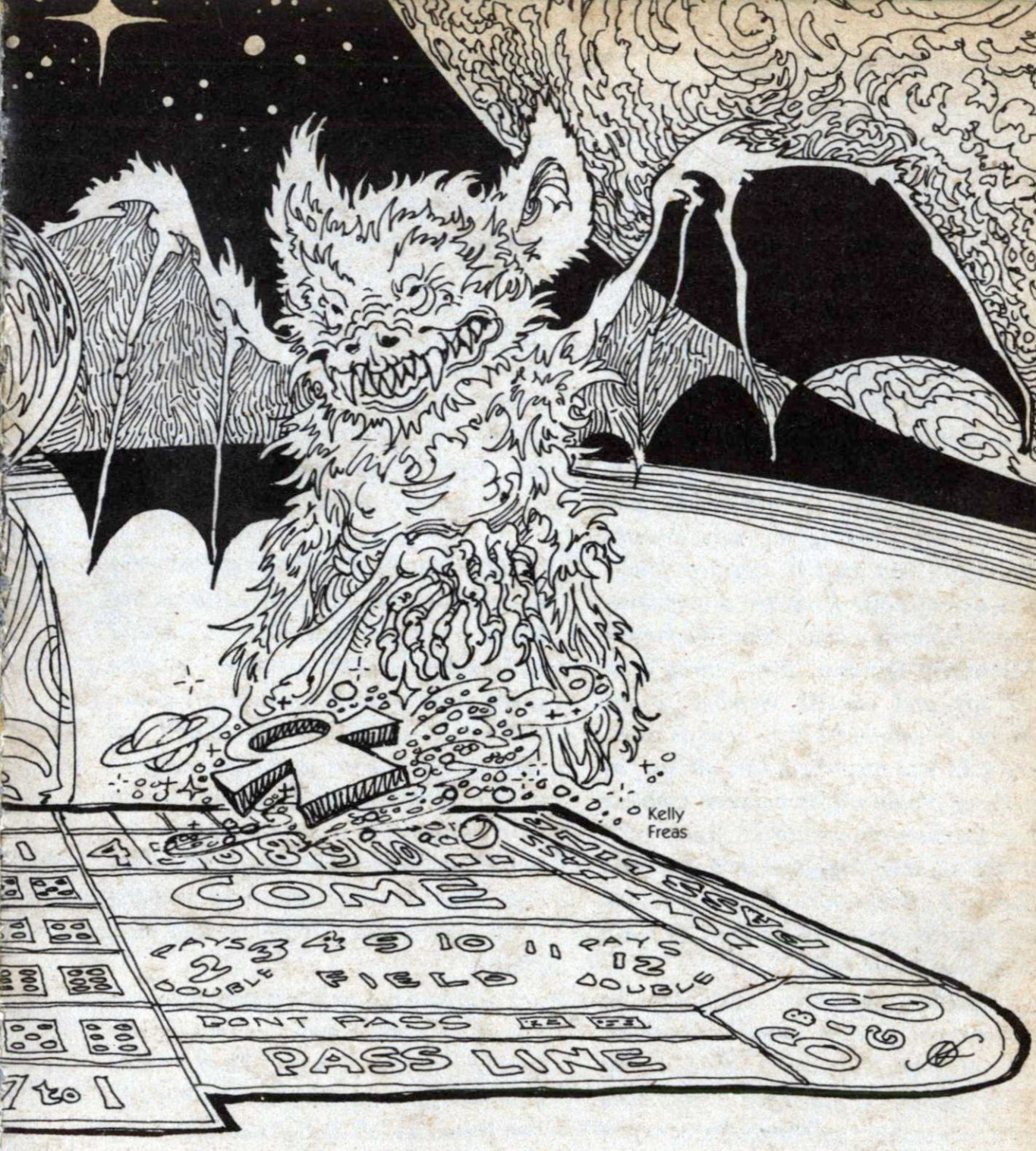
Alvin Toffler



Part Two of Three Parts

Andrew Offutt & Richard Lyon

RAILS ACROSS THE GALAXY



Would interstellar visitors from a civilization far more advanced than our own bring solutions to our problems? And even if they did, what could we offer in return?

SYNOPSIS

At 0920 on July 8, 1853 Commodore Perry sailed the U.S. Pacific Fleet into Tokyo Bay. Until that moment Japan had been isolated, a microworld unto itself. The cultural shock of the uninvited visit toppled the Shogun and his entire class, destroyed classic Japanese culture, and transformed the island nation in ways previously inconceivable.

At 0300 on June 1, 1996 my left lower molar started to buzz. I'm **Irving Quinan** *and I was working my way through Harvard, then, as CIA agent-in-place. The dental noise heralded a communication from my mother. She is* **Gertrude Eisenstein Quinan,** *semi-retired master spy and charter member in the league of smother-loving Jewish mothers. CIA was disturbed, she advised, by a lot of phone traffic between Chinese and Russian observatories. Apparently it had all been triggered by a call from Harvard Observatory. I was to get on my bicycle and pedal up there to learn what was happening.*

(Thanks to the energy crisis and the exhaustion of other critical resources, a lot of us are on bicycles. The U.S. has been running in place for a long time now, not making quite enough technical progress to offset resource exhaustion. Life here slowly continues getting worse. In other parts of the world, things are really grim. In Mexico, for instance. So is the secret way the U.S. Immigration Service Police deal with illegal Mexican migrants: really grim.)

At the observatory I met **Professor D.S.P. Berson,** *Ph.D., F.R.S., and N.A.S., who had just discovered . . . a straight line in the sky.*

The incredibly powerful beam of laser light was so strong that it was self-focused. Berson's explanation (?) involved something about the final stages of a pulsar. The part I paid attention to was his statement that the light beam was a short-lived phenomenon that could not possibly hang together long enough to be any real danger to Earth. Under Agency policy, that meant I should arrange a public announcement in a manner that would avoid panic. And just at the start of final exams, too!

Unfortunately I couldn't get the story into the Harvard Crimson. *My beautiful blond roommate* **Sonya** *(with whom I had gotten exactly nowhere, despite great effort) had taken over the paper and was gleefully-joyously running her idea of a far more important story. A gaggle of Harvard men (?) had set out for Wellesley on a DAPR—Direct Action Panty Raid—and, thanks to a Radcliff counter-raid, were now walking home* sans *dignity, trophies, and their pants.*

I did manage to boost the story into The New York Times, *gaining a post-grad job in the process. Then I made a phone call to my cousin on space station* Kennedy *(all us CIAs are cousins), and things swiftly got hairy.*

My "cousin" was happy to talk with Berson and me. What looked like a straight line to Earth-based telescopes was, with Kennedy's greater resolution, a set of six lines in hexagonal array. Despite the fact that their power exceeded the total output of our sun, the lines were clearly artificial. We were not talking about a short-lived natural phenomenon!

Suddenly the question of whether Earth might be on a collision course with them was of more than academic interest. Turned out, we were. The glancing impact would merely slice off China. . . . Yet even before that grim news became public, it was outdated. The laser beams moved, *just enough so that we would miss them. Too, three of the six beams now showed color changes, a mystery that maddened the physicists. They resented having our world suddenly converted into an anthill beside a railroad track. While they and all the rest of us scuttled and scurried and opined and guessed, the laser beams* were. *And they represented powers vast beyond our comprehension.*

And finals continued, at Harvard.

Just as I finished my exams, every agent in the Boston area was called to a meeting at a CIA safehouse. That included me, CIA A.I.P. The sense of anticipation/apprehension was extreme. We knew that a NASA Mars probe had been diverted to flyby the lines and this meeting had to mean that their secret had been discovered.

It had, and it was a mindblower. My personal mental discomfort was not alleviated by the briefing officer's attitude, which, though he didn't quite say it, was, "Really, this is only what we should have expected." His argument was that, since our sun is a very ordinary star, we should expect a galaxy with an enormous number of such stars to be heavily populated with intelligent races. Obviously they would want to travel, even though moving at near lightspeed required the use of vast amounts of energy. The laser beams were the obvious solution to their problem: they were the tracks of the Transgalactic Railway!

A Star Train accelerates by taking energy out of the light rails and decelerates by putting it back. We couldn't object to the sanity-boggling concept of a Galactic Railroad because he had the photos: a Star Train leaving the rails and on course for Earth. Not a missile—a train.

On leaving the meeting, I picked up my orders. Decoded, they told me to watch the 0700 news—and *relieved me of all duties. I was fired without even an explanation! I returned to our shared room and was sorry that Sonya was out. Her psyche is a labyrinth of twists—but O!—her soma! She was far, far too tied up with Women's Rights to make time for me, though. Her mental set was that all the world should be concerned with nothing else.*

At 0703 the network news was interrupted by a news conference: Our President. Dear old **President Fairborne** *advised the American people that indeed the Aliens Were Coming, but not to worry. Rather than land, they would orbit the Earth and we'd go up and trade with them — we being a joint U.S./U.S.S.R. team acting under UN instructions. After many inspirational minutes and the predictable quotations from Lincoln they all use to try to establish kinship with someone competent, the president invited questions.*

Would the CIA be involved in First Contact? —No. While our team would include a representative from the Defense Intelligence Agency (DIA), the operation would otherwise be entirely a State Department "exercise." And what about press representation? Ah.

One reporter would go along, having been chosen by lot.

All at once my termination by the Agency made a good deal of sense! The Company would thus give nominal obedience to the president's orders and, by fixing the lottery, still be represented.

Sure enough, within the hour my phone rang and by 2113 I was on a plane for Houston to begin astronaut training.

PART II

5: Airout and Anthill

In Houston I wondered how I possibly could have completed four years as an inmate of a fine institute of higher education without having heard of hystoxic or (Somebody's) technique for clearing out the eustachian tube in rapid descent from high altitude, or the Armstrong Urination Technique. Nor had I been so misfortunate as to experience Decompression Sickness. Also I met a centrifuge. We did not fall in love, although we spent a lot of time together.

Some of NASA's equipment was, I suspect, purchased (used) from the Spanish Inquisition.

In Houston I also met my fellow members of the First Contact Team. (FirConTeam, right? Right.)

Colonel John Wareagle of the Defense Intelligence Agency is a tall, arresting man with a nose right off a Roman coin and skin like some of the friends of John Carter of Barsoom.

Kathryn Call-Me-Kathy Myers, Ph.D., is an attractive and amazingly supple careerist in the Foreign Service: ours. She looks neither German nor Jewish and it's fairly obvious that she and Wareagle have a Thing going.

Judith Burkhalt, Ph.D. and Ph.D. again, taught linguistics at Princeton and shocked a lot of people only last year when the paperback of her *English As She is Spoke* brought her a $560,000 paperback advance and earned even more. She is also a 156-cm-tall Yogini who can converse quite affably and equably while standing on her head, which is topped—when she stands erect—with orange hair that doesn't match her eyebrows or mustache.

I believe crop-topped Asad Bashir, professor of social anthropology and author of the books *Understanding Islam* and *Understanding Extraterrestrials,* was included to appease and please the prodigiously rich new Arab League. Asad does not drink alcoholics. He does use marihuji, which Mohammed had forgotten to forbid. Strangely, Asad calls the stuff grass.

And there is the Right Honorable Horace M. Windhorn, Secretary of State of the United States.

There was also this recent graduate of Harvard University, now a reporter for *The New York Times,* representing all newspeople. His name is Irving A-for-Abram Quinan, and he and Asad are self-consciously over-friendly.

Astronaut training (which should be Astronautical Training, Judith Burkhalt has already pointed out) is an experience I hope to forget. (Which reminds me: I'd better program an Erase-on-uncoded key to playback in this Computerecorder.)

As soon as we arrived, we were given

shots to "simulate the physiological effects of weightlessness." Exodermic syringes are *not* painless. They *do* make one feel that one is being . . . shot. Then it was off to the old swimming pool, which contained no water.

I promptly fell in love with astronauts-trainer Beth Roberts . . . and met her husband two hours later. He is John R. "Tex" McCay and is three or ten meters tall, beautifully built, ridiculously handsome, an athlete and astronaut, and a Physics Ph.D. There oughta be a law.

Once I'd been given my—uh!—shot, I braced the doctor.

"I thought all functions of the human body were independent of gravity, so that there are no physical effects of weightlessness."

"Almost," the doctor replied equably. "My tits float and so will Kathy's. You'll have to do exercises to prevent all sorts of nasty long-term effects. The main problem, though, is the system that monitors the bladder and generates the urge to urinate. Now if you'll just step over there while I take on my next victim, the supply clerk will issue your diapers."

"My . . . d—"

S of S Windhorn, who was last after me only because he had been busy being important with a couple of chiefs, was next for the shot. "Wait!" That distinctive accent *Commanded*. "I thought this was supposed to be astronaut training."

"It is," Dr. Eakins said equably, "but in one week we can cover only the basics, Mr. Secretary . . . the basicmost basic being toilet training." She gave Windy a sweet smile. "You see, in space humans have no physiological urge to void the bladder. That necessitates a system to monitor the bladder and catalyze that urge. Because of that and other conditions in space, the simplest and most intelligent recourse is . . . diapers."

"I . . . heard . . . Doc . . . torrr," Windhorn declaimed ominously.

"Even so," Eakins went on cheerily, "there is no physiological urge to . . . let us say, utilize those diapers. So . . . training is necessary. *Reverse* training. For your own health and indeed life, you must learn to violate your earliest childhood training by exercising a conscious effort of will."

I remembered the (unpublicized, understandably) problems attending the moon-program astronauts, and realized the ingeniousness of diapers. The thought also occurred to me that Freud would have *loved* this!

"One week is little enough time for that," the doctor was saying, "but in add—"

"*Doctor*. I am the *Secretary *of* State* of the United States. *I* demand that other arrangements be made for one who is second in this nation only to your president."

"Mr. Secretary, there really isn't any alternative."

I wondered if the others knew she was telling the precise truth. For years NASA has been quietly asking Congress for the money to develop a decent space toilet. Maybe congresspersons are too embarrassed to try writing and discussing a bill for such a matter, and maybe it just isn't the kind of headline-grabber they want. NASA doesn't dare make any great fuss about the request—the glam-

orous figures of astronauts in most unglamorous diapers is bad image! Of course, Congress also tends to heed only those who shout the loudest. It's a pity that NASA didn't develop high-tech space toilets back in the Good Old Days when Congress gave them abundant money—spurred by John Kennedy and a toy called Sputnik—but they didn't. All the Big Money Days left us were diapers and a squirt-in-the-bag system. It is a system, and it is scientific, and it is impossible to use when one is wearing a space suit—or when one is a woman. It's also just plain impractical for any such large installation as a space station. The clutter of people on the station would mean a lot of bags . . . and an intolerable risk that one of them would break. That would result in a contamination problem even worse than the disgust.

All this not only isn't a jerk, it's deadly serious. Kidney problems are hard enough to treat on Earth—and urine is one hell of a contaminant, particularly when it's floating around loose in little golden globules.

Unfortunately, the Secretary of State was in no mood to be reasonable. Drawing his thin-as-a-dollar frame to its full height, he glared at Mandy Eakins.

"Doctor. I. Just. Gave. You. A. *DIRECT ORDER*."

"Mr. Secretary," that fantastically patient woman said, "the only other choice is what we do for the mon—simians. Since we can't teach chimps to use diapers, we—"

"Don't bother me with technical details, madam!"

"I am no madam, mister, I am a doctor."

"I stand corrected and direct! that you behave as one. *Arrange* it, Doctor."

She stared. "But—"

"Doctor! The subject, damn . . . it . . . is closed. If you value your career you will say no more."

"Yowzah," Doctor Eakins said, and turned swiftly away. Doubtless he assumed that was in embarrassment and chagrin. I rather imagined that she was covering a smile.

Windhorn the sententious-pretentious had made up his mind and closed it. He had no desire to clutter that order with an intrusion of facts. There was no way he could be told, now, that for space-going simians NASA devised a special pump that attaches . . . well, it *attaches*. When the timer on the pump decides you gotta go, you absolutely positively gotta Go.

Windhorn wasn't a bad Secretary of State, I guess. It was just that he was Number Two, and he knew who he was better than. That was every American except the president. Had we been in another country, he might well have listened. And learned. And thanked the docteur or dottori or daktari or whatever the physician was called, *there*.

Once the doctors *here* were through with us, we were fitted for space suits. I was lucky in that a standard size fits me perfectly. After this came a lecture-cum-demonstration on the use of the spacesuit and emergency procedure during an airout.

The lecture ran long. By the time the break came, we were nearly broken.

We recovered, and soon Dr. Myers — Kath, she instructed us—and John Wareagle had slid into a spirited discussion.

"But can't you see," Myers said with her voice climbing the decibel staircase, "the aliens can be the salvation of human civilization. We are at a critical stage! We're running out of too many natural resources, that's obvious, and we haven't developed the technology we need to get along without them. The aliens could give us that technology."

I noticed a strangeness without really taking note of it. Though she was talking loudly and with heat, I was somehow having trouble hearing her clearly. Wareagle, meanwhile, was snorting.

"They will help us the same way the white man helped my ancestors! They'll destroy our pride and our culture will crumble. Can't you see?—We are going to be second class citizens in *their* universe."

"That's a completely misplaced analogy!" Myers snapped.

My ears were beginning to hurt and it wasn't from their loud voices. I swallowed nervously, and that seemed to help a little.

Wareagle was shaking his large head. "It's an exact analogy. Compared to them, we are a primitive culture. Whenever an advanced culture impacts a primitive one, the shock destroys the primitive, and—"

I had been swallowing constantly and now I saw that so was Wareagle. In fact, so was everyone present. He saw it at the same instant I did and our shouts were almost in unison: "Airout! Suit up—fast!"

We imitated a kicked anthill, scrambling madly for spacesuits and helmets. FirConTeam realized what was happening: to simulate a space emergency, the air was being pumped out of the room we occupied. Training started fast around here!

Asad had sense enough to try the door. Naturally someone had had sense enough to lock it from the other side. Meanwhile, panicking in the scramble, Windhorn got hold of my helmet. Despite the fact that it wouldn't seal on his suit, panic wouldn't let him trade with me. We wasted valuable air and time in a push-and-tug. SOP for such problems is simply to slug the doke and take the helmet, dog it on, and then helmet him. I avoided that on the grounds that slugging the Secretary of State could be dangerous to my career health and probably what freedom I had as well. Besides, by now there wouldn't be time to help him once I had gained my helmet and donned it. No, I did not believe that NASA would pump the room down to a truly dangerous level. It wouldn't be pleasant, though, and besides, anyone not suited in a short time would be scored as dead.

In that sort of test would saving my own life while killing the Secretary of State be considered a passing mark?

My ears were splitting and I felt lightheaded and dizzy. Really fascinating pinwheels were starting to catch my eye. I knew they weren't there and fervently hoped this wasn't a pass-or-die test. The room's air pressure was dropping rapidly. I could hear the air roaring out through one of the aircon ducts, a 20-centimeter square. And Windhorn, damn him, was hanging on. And kicking my ankle.

Since I couldn't stopper the square duct with a round helmet, I did a little Dutch Boy At The Dike—in reverse.

The fabric of my suit didn't have enough give to seal, so I pulled down the bottom portion. Desperately, since my ears had ceased reporting sound but assured me that they were going to imitate an overstuffed seedpod, I backed into place.

My plastic pants seemed to seal the hole—until they and my diaper were sucked right off.

The edges of the duct bit into my rearward flesh with seeming ferocious glee while I had a most unpleasant vision of the thing's swallowing me hindside first. I had a moment or three to wonder—just how far, doubled forward into a human hairpin, would I get before I stuck? And how long before my tail ceased being three times redder than John Wareagle's face? And lord oh Buddha lord, how long would it take how many people to drag me out of there—in which direction?

Buddha Saves. The suction stopped.

Clever Asad pointed out that the pump must have a safety switch to shut it off just at the point of reaching critical vacuum.

A perfectly suited and helmeted Kathy Myers glanced at me, pinked, and turned away—grinning. Wareagle looked and laughed.

"What d'you think you are, a character out of Heinlein?"

"Name's Peter," I think I gasped. "At the dike."

Well, they got me out of it, with a small loss of skin. Every one of my rearward capillaries was trying to vacate the skin that remained. Had the test been real I'd probably have been killed, while my blocking the hole saved the life of the distinguished Secretary. He'd probably have awarded the posthumous medal, making noises about No Greater Love. At least it was more than a passing score! On paper I'm a hero, and marked Ingenious as well.

Gosh.

That's on paper. In fact, I'm a goat. Windhorn is really p—no, I won't say *that,* considering that he's the man with the attached pump.

Windhorn is really *angry* that I blocked his only chance to flunk out. And the NASA brass consider such tactics as mine little short of cheating. The drill is teamwork, not heroism.

And the guy who has to clean the duct must hate me, because my diaper was dirty.

Tomorrow we blast off for outer space, because "lift off" sounds sissy; tonight I skrimmed a teleset and caught a news program. Despite the new FCC okaying of 22 minutes of commercials per broadcast hour, I was soon bracked in on quite a bit. While we've been in training to make history, a lot of it has been happening.

With a speed approaching the miraculous the United Nations General Assembly voted approval of the joint U.S./U.S.S.R. resolution appointing the two superpowers the negotiators for Planet Earth in all dealings with the presumed Aliens. Surprise! I had expected hellaceous opposition to that one, with enough jawboning to shame the Tower of Bab-el. Looks as if the State Department is doing its job, for once. (Maybe because the Boss is away and morale is higher?)

That's the positive. The negative is a good part of the reason for so little

controversy as to who would negotiate with the Visitors. That's a hellaceous and even violent argument concerning *what* is to be negotiated. There's no vinism like chauvinism, they say.

Just while I was watching the debate, the Foreign Minister of Japan eloquently explained why Our World needs, above all else, the technology to extract metals from sea water. If we could buy / obtain / trade for such technology from the Aliens, it would end Japan's dependence on foreign ore, for which President Mukwena's government is charging them an arm and a leg and the backbone as well. However! The representative of South Africa in turn declared that all but the short of sight could see that the world's most urgent need is the secret of practical fusion. That would allow them to generate all the power they want without having to buy thorium from the People's Republic of India. In its turn, India wants genetic engineering. With a very smooth Mad. Ave. presentation Mister Markandaya explained that soybeans themselves don't fix nitrogen. It's the bacterium that infects their root nodules, *Totylenchulus reniformis*, that does the work. If only this delightful bug could be persuaded to set up housekeeping in wheat roots, India could grow abundant harvests . . . without having to buy fertilizer from the vast Saudi Arabian Petrochemical complex.

Meanwhile, Prince Rasheed pointed out that what is obviously most important is the weather control the Saudis want—absolute total control, such as that for a hydroponic garden in a greenhouse. With that control and the more-than-abundant synthetic nutrients they can whip out, they can achieve the Arab dream: transforming the desert sun and sand into a single humongerous farm. That would spare their having to import so much food from Argentina . . . which wants advanced mass production technology. Something like a Xerox machine, that gentleman seemed to mean, but one that makes objects rather than pictures!

Obviously the ideal thing for ruining Japanese industry. And around we all go again, skip to my loo.

That's only a small part of it. Literally every nation sees the coming Visitors as Aladdin's Lamp not to mention the Cornucopia and wants only something marvelous—that will wipe out some other nation.

The only agreement was on the Mexican Resolution, and too bad they're stuck with responsibility and blame for suggesting it.

Given that the world in general and Mexico in particular suffers from an extreme overpopulation problem, Mrs. Preciado and her aides quite reasonably proposed what Earth should *not* buy from the Aliens. That is, any medical technology or medically/physiologically applicable technology that would decrease the death rate and thereby compound the population problem.

Passed after brief debate.

The result of that sensible, logical action was the Old Age Riots. It's one thing to know your candle is going to go out someday because that's the way God, Allah, Blind Chance, or Stalin made the world. It's very much another to be old, looking Death squarely in the skull face, and to be told that all this must be because your younger neighbors find it convenient.

You might think that an arthritic band of threescore-and-tenners yelling "Gray Power and Life!" couldn't be dangerous rioters. Unless you saw them attacking the police with the greatest weapon of the truly old: complete and ghastly disregard for their own lives.

Before the rioters broke into the UN building and started clobbering the delegates with canes and slashing them with Medicare cards, the General Assembly did manage to draft one set of preliminary instructions for us (carefully pronounced!) traders—instructions that are completely self-contradictory.

No matter how this comes out, a huge vociferous hunk of the world is going to hate us traders, without regard for the pronunciation.

If only one of us was smart enough to pull a Kissinger and con everybody!

6: Them and Us

Contact minus 9 days. Our introduction to life in space began badly and tapered off after that. No sooner had we come on board the *Kennedy* than Station Keeper Harman, without even introducing himself, began to search our luggage. (We CIAs would never be so rude as to search someone's belongings while he watched, but you can't expect proper manners from these NASA types.) Harman was quite angry when he found Indian Cigars (long seedpods from the catalpa tree) in John Wareagle's case. With nearly incoherent profanity he explained that the *Kennedy* had precious little atmosphere. Any poisons—such as cigar smoke—would rapidly accumulate to dangerous concentrations and would only slowly be removed by the air purification system. He went on at some length about space being a hostile environment, and how one careless error could kill us all.

Then he found the marijuana in Asad's case and nearly had kittens.

Midway through his explanation of why we grounders deserved the disaster we'd undoubtedly suffer, the solar flare alarm loudly proclaimed imminent doom. Of course none of us knew what it meant. Harman wouldn't explain anything except that we could come with him or stay here and die—he didn't care which.

That didn't go down too well with the Right Honorable Secretary of State Horace M. Windhorn.

If I'm lucky maybe Windy will decide he hates all of us and forget that he's mad at me. Mother says I should think about my career. Anyway Harman led us to the Hidee Hole.

People down on Earth live under an atmosphere thicker than a battleship's armor. They don't have to worry about the fact that the sun occasionally hiccups, flooding space with high-energy protons. Five seconds' exposure and you'd better not be planning a large family. . . and a few minutes will make you eligible for early and very permanent retirement.

Fortunately the astronomers can see the first signs of a coming flare and give us an hour or so warning. The *Kennedy* is designed so that all the supplies and as much of the mass as possible are clustered together near the center with a small empty space at the very center. So small a space that with all of us in

it we had to take turns: odds breathe in, evens breathe out, etc.

After about an hour in the hidee hole the mechanics of crowding had moved me around so that I was mostly surrounded by female members of our party. While it's sexist and unworthy, I couldn't help wishing that Judith had a little more padding and a little less mustache. As for Kathy—sweet, small, soft Kathy with eyes and hair black as the night and golden-brown skin . . . oh, I envy old John Wareagle and I pity him. Here on the *Kennedy* with zip privacy, just what is he going to do?

Over three hours of abject misery destroyed my last horny thought. The terror remained. Outside the Sun was filling space with lethal radiation like some monster runaway nuclear reactor. Invisible death was two or three meters away and . . .

"Something," Harman announced, "is definitely wrong. The geigers are silent! By now they should be screaming like a bunch of headless grounders."

"Do you," Windhorn exploded, "mean to tell us that all this might be a False Alarm?"

Just then the All Clear sounded. Harman nodded cheerfully. "Seems that way, but it wasn't a total waste. Saved us the trouble of doing this as a training exercise."

Later, since I had a bit of time on the communication comm, I checked on what had happened. It turned out that while we played Sardines, American and Russian astronomers were screaming at each other by phone. Our guys swore there was no hint of a coming flare while the Soviets vowed a bad one was imminent—or rather, their government said that on their behalf.

Now what in Buddha's great round belly did the USSR have to gain from this kind of false alarm?

That's a problem for the future. Just now the pressing problem is that because of the alarm Harman didn't finish the search and Windhorn was able to smuggle in a set of piss bags. Now Harman and the other station keepers are *forcing* him to wear his monkey pump — after he filled several bags and carelessly let two of them get sucked into the ventilation system.

They hit the . . . well, in my *N.Y. Times* article I'll report that due to a fan malfunction, Space Station Kennedy is having a problem of sanitary contamination.

I picked up hints that the Russians had carried out a dress rehearsal for some major operation. Tricking us into staying in the Hole could have been part of that rehearsal, which only makes the mystery larger and darker.

Contact minus 8 days. Windhorn glowed with pride as he announced that we would not be going over to the *Lenin*. Instead, the Russians will be coming on board *Kennedy* tomorrow. The debate over which space station to use has been long and heated because national prestige was involved. Finally the Russian negotiator argued that *Lenin* should be used because it was singularly well equipped with hidden camera and microphones.

The Secretary of State of the whole United States told the Georgian gentleman that he was right, and suggested that we use whichever station had the

most bugs. Agreed; *da* and okay.

Space station *Kennedy* won by three microphones and a TV microminicam.

Defense Intelligence Agency's John Wareagle, Colonel, promptly suggested that we rename the *Kennedy* the Space station *Nixon*. Judith suggested Space station *Bacteria Culture*, since there are so many bugs. Given the lack of acceptable toilet facilities, some of us would rather call this place the *Honest John*.

All that aside, the onboard correspondent for *The New York Times* and all newsmedia has a rather awkward problem. The *Times* wants color. They want me to write a sort of night-before-the-great-event article, and I can't figure out how to do it. There's no way I can tell people what it's like out here without repeatedly contradicting myself. For example, the *Kennedy*. It's magnificent; a man-made star in the vault of endless heaven, the crowning achievement of our civilization. And the view from the *Honest John/Kennedy*! Absolutely unconditionally unequivocally sublimely take-your-breath-away. The blue-green Earth wrapped in cottony white clouds. The stars, diamond-hard white on the utterly black jeweler's case of a night. It is as incredibly beautiful as all the past writers claimed, including back before we saw it from up here.

The *Kennedy* is also the most bleak, ugly, miserable prison in existence.

Not a single gram was hauled up here for ornamentation and only about two for convenience of human beings. *Kennedy*, with all it contains, is stark beyond belief.

Even the machines are naked, with their electro-mechanical anatomy on permanent display as an assault on the eyeballs and human esthetic sensitivity. (The paint Kathy Myers has dubbed EUY, and we have taken it up: Early Utilitarian Yukh.)

The *Kennedy*'s atmosphere comes from hydrazine and recycled water. They yield oxygen and nitrogen that, in endless recycle with purification systemry, is . . . adequate. It lets us breathe and live, or rather exist. It tries but fails to eliminate a host of human and machine odors that must be enough to gag Jenghiz Khan's sweatiest troopers with breaths reeking of mare's-milk hooch. Sweat. Burnt lube oil. Our diapers. More sweat. Ozone from an occasional spark. Asad's body's unfortunate persistent insistence on producing gas. (No, we aren't using the methane for *any*thing.) All of these are offensively here, with too many more. (At least CO_2 and liquid waste, along with hydrazine and what water vapor the machinery can scrounge without attacking our armpits, are pulled out, thank the Benevolent Buddha, and turned into water.)

No single one of these odors is so stenchy as to be unbearable—except when Asad's internal machinery is really trying hard and one is too close—but they are all entirely too present. We hate to exercise for it means sweat and pollution, but in space exercise is an absolute necessity.

Like the air, the composite and recycled water has an unhappy taste, which is why we astronauts put Tang in it. The Tang hasn't already been through anybody, much less several somebodies.

And still, for all the discomfort, the magnificence continues true. Space sta-

tion *Kennedy*—technically SOC *Kennedy*, since NASA just *had* to come up with Space Operations Center just as it ignored Blastoff for Lift-off—really is the frontier of humankind on the unknown. This is the human creation most fitting and proper as the scene of our first meeting with extraterrestrials. The Aliens.

How can I explain such a paradox in a nice pleasant encourage-the-earth-bound-Earthfolk article for *The N.Y. Times*? Try to concentrate on the "individual" quarters with their hideous name of "habitation modules"?

I don't know. And I'll just have to worry about it some other time. Right now it's my turn on the zero-gee washing machine. Disposables are for wasteful mommies down on Earth; my diapers urgently need doing.

Contact minus 7 days. The Cosmonaut First Contact Team came on board today. All five of them came into *Kennedy* with a space-can full of luggage each—though Tatiana Vinogradova *left* their space shuttle with two cans. She is a *Pravda* correspondent the same way I'm a *Times* reporter. Exactly the same way. The can she left on *Kennedy*'s outer hull is about the right size to hold a strat nuke. As soon as she was on board, 'Tiana Vino was quietly hard at work. I'd planted a few telltales; one by one, they were disturbed. She hasn't disabled any of our bugs, though. On the contrary, one or two were a bit out of adjustment and now they're fine. A most talented reporter!

All this adds up to what might have been expected: they don't trust us and fear we may try to make an under-the-counter deal with the aliens for weapons. To make sure that doesn't happen, they've tapped our bugs—which we set to make sure they don't try an under-the-counter deal. . . . If they don't like what they hear and see—well, there's that tin can Tatiana clunked onto *Kennedy*'s hull.

More than a mite unsettling. Still, it would be more frightening if the Russians had *not* taken any Us-and-Them action. That would mean they were planning a weapons deal.

Contact minus 6 days. Oh boy. I really did it today. By one interpretation I just saved all humankind from extermination. By another — and more likely—I committed a several-billion-dollar blunder and probably deserve to be sent out to walk home without a spacesuit.

At the start it seemed that it would be another fairly routine day. The station keepers—keepers of the SOC and thus SOCcers, of course—took us outside for a lesson in how-not-to-kill-yourself-in-outer-space. 'Tiana Vinogradova hinted that she'd like to go off and be alone with me for a while.

I tried to be cool. Alone with a beautiful (maybe even willing) female and both of us in spacesuits. Make that space—suits. Could even James Bond accomplish anything in such a situation? All Irving Quinan could manage was to spend the time in nowhere conversation while above and all around us sprawled the grandeur of the cosmos: the brilliant stars blazing in the cruel beauty of infinite black night.

Zen, damn and blast! If only they made these suits so a fellow could do

something! What an experience that would be! That would truly be eat your heart out everybody.

Only after 'Tiana departed my wonderful company did I realize that she had managed to pump me. She'd wanted to know about the period we spent in the hidee hole. Never mind the discomfort; had there been any danger that we wouldn't survive? With the additional people of the Soviet team, did the Hole have enough room for all? While I couldn't imagine a more uncomfortable scene, the answer had to be Yes, we'd all survive. That seemed to satisfy Tatiana Vinogradova.

What did it all mean? Obviously I didn't know, but there was a damned easy guess:

Sometime in the near future we'd have to cuddle together down in the Hole, because space would be full of lethal radiation—not from old Sol, but man-made radiation . . . a Russian nuke.

As soon as I could get back inside, I made for my communication system. It didn't take long for my sources to confirm my fears. Three days ago a grim rumor had swept through high-level Washington, causing the great and powerful many a sleepless hour. According to this rumor, the KGB Analysis Section believed that they had deduced the true nature of the incoming Train.

They recommended a nuclear attack on it with maximum force the moment it comes in range!

This, they claim, is the only possible course of action, given their observations and conclusions. To wit: the Train has been under continual radar observation since it left the light-rails. One brief radar signature indicated the firing of ion rockets. Other than that one slight correction, the Train has done nothing to alter its course. It does not respond to radio or laser signals. The thing is following a ballistic trajectory that will end when it strikes Earth's atmosphere. At 51 kilometers per second.

The KGB theory is that the Train is on a course that will lead to its destruction because that is its purpose. It's a missile, they are ready to swear. loaded with germs maybe, or short-lived radioactives. The Railroad's purpose isn't trade, KGB Analysis insists, but colonization. The first Train evicts the previous tenants of the desired real estate. . . .

So sayeth the protectors of the Russian Empire. It's difficult to argue with such logical xenophobic paranoia. The Soviets are especially vulnerable to the old Them/Us psychology/philosophy. Russia's been invaded a lot. That's bad, but the worst aspect of this situation is that we—our government I mean—can't even talk to them. They flatly deny having any plans to blast the Train and we won't know for sure that they're lying until . . . Bang. A bit late, then.

The State Department (ours—or Windy's boys, at least) has taken an official position that the rumor is false. Their proof is the fact that the U.S.S.R. sent its First Secretary up here. He did not seem slated for Replacement, Soviet Style. Thus they'd hardly put him up here if they planned to fill space with radiation.

I know better but I can't prove it.

Besides, proving it wouldn't do any good. The only way to stop the Russians is to convince them that they're wrong about the Train.

Hello, Train-people? Please tell us that you're good guys or some of us will blow you away. Sure.

Airforce Skywatch believes it has the correct explanation for the Train's odd maneuvers. The trouble is, proving it would require taking photos with the great telescope on *Kennedy*. Triff: to make room for us, the *Kennedy* staff of astronomers has been shuttled down to Earth. When all this popped up today there was hardly time to return them. And no one would spend that kind of money on my say-so anyhow.

I needed help. No use asking Col. John Wareagle, DIA. His mind would doubtless concur and agree with the Soviet plan. On the other hand . . . 'Tiana might not agree with her own government. As soon as I could get her alone or nearly, I broached the subject.

"Ms. Vinogradova, I believe that as reporters we have a duty to . . . "

While I explained the proposed *N.Y. Times/Pravda* cooperation, she nodded in agreement. We started to work. She, sweet innocent girl that she is, wanted to sound another false solar flare alarm. With everybody else sardined in the hole, she and I would be free to use the Great Telescope. Charming.

That's the sort of thing you expect from amateurs.

Mother taught me that the best way to rob a bank is in broad daylight. For example, she has always looked like every cleaning woman in the world. Several times she walked right into high security communist installations, armed only with mop and pail. Then she proceeded to clean the floors and the toilets and empty the waste baskets. And the wall safes.

Faithful to my mother's teaching, I called Spacetrack and asked them for instructions on how to use the telescope. I was, I explained, doing something very hush-hush for Secretary of State Windy-I-mean-Windhorn. Since the telescope was highly protected with failsafes, virtually idiot-proof, they accepted my claim without much question. Of course, when 'Tiana and I started actual work on the 'scope, other people on the *Kennedy* started noticing. But with official Spacetrack instructions coming to us over the control speaker, they were all sure we weren't doing anything improper.

It went as easily as that. The only real problem was that, in order to point that super-telescope so that it would view the Train, we had to turn it dangerously close to sunward. I had to counterwire the failsafes.

As the first pictures rolled out of the autoprinter, she screamed joyously in Russian and we grabbed each other. Exactly as Skywatch predicted, we saw that each car of the Train had deployed stubby wings. Obviously our Visitors plan to lose excess velocity by a controlled flight through Earth's outer atmosphere.

With my hand just above her hip I asked anxiously, "Do you think this will be enough to convince KGB that the Railroaders aren't invaders or destroyers?"

"Oh, yes!" she replied happily. "If they were really serious about that nonsense they would have risked the telescope on the *Lenin* instead of tricking you Amerykans into hazarding yours."

My hand departed her suit. I had a

sinking feeling that turned to real card-carrying horror when I saw the last set of photos to come out of the autoprinter. Meaningless blurs. The *tink* sound I then heard couldn't have been the 800-cm mirror breaking. It had been gone for several seconds. Exit one multibillion-dollar telescope.

On rubbery knees I remembered that Mother had also taught me to "Always gift-wrap the garbage and someone will steal it."

First I removed all obvious evidence of the disaster. Then I acted the role of the young newshound who'd just got a sensational story. Naturally I sent the pictures and my story to Earth through regular channels.

An hour ago the telefax printed out the front page of *The N.Y. Times*, complete with the pictures and a slightly altered version of my Big Story. In the new version the hero who Saved All Humankind from attacking the Train and starting a suicidal war was the Honorable S of S Horace M. Windhorn.

Good old Windy. He's sooo predictable. Not five minutes later he took me aside and explained that if I took a "realistic" attitude I could count on his future gratitude. It was not anyone on the *Times* staff who had rewritten that openly sent story.

Otherwise, the so very Honorable Secretary told me, I would find that it was my word against a lot of very skillfully manufactured records. Said records would all show that dear Windy was solely responsible for the decision to photograph the Train.

I wonder what they'll do when they discover the busted telescope. Take it out of his salary?

7: Waiting

Contact minus five days. This morning the shuttle arrived with the goods "we" hope the aliens will buy from us.

Unpacking this weird assortment was exciting, and before long we were acting like children opening Christmas presents. Kathy M. spilled the large box of pearls so that they floated all a-glisten through the air like tiny white bubbles.

"Careful there!" John W. called. "There goes the price of Manhattan!"

While we laughed, Kathy took the carved ivory and jade figures and floated them among the pearls to make a drifting collage: a true self-supporting mobile. Meanwhile 'Tiana Vinogradova was unpacking the micrelectronic devices. Probably in hopes of stealing an advanced CIA bug or two. . . . And the distinguished Secretary of State was carefully examining a superb collection of pornography . . . while Wareagle blasted us with snatches of music from a fine record library. I knew he wouldn't be content until he found some authentic American Indian music.

British-educated Asad Bashir left us promptly at 1500, but quickly reappeared sucking his afternoon tea from a nipple-equipped bottle. He glided over to me.

"Irving, we now have an excellent collection of cinema films. Would you have time to help me arrange a film festival?"

A film festival! What a charming thought!

"Sure. And—tell me something, O Lion. Do you think these trade goods are adequate?"

After brief thought, Asad—which does mean "lion"—said, "I should think that we can muddle through with these. We have samples of nearly every form of portable wealth, you know: everything from flower seeds to microfilm courses in zen archery."

"Uh-huh. Is there anything here the Aliens are really likely to need or want?"

Windhorn interrupted. "If you want to know about the Aliens, read these." He shoved a crate of books at me.

"What's this?"

His reply was drowned in a thunder of Amerind music. Thinking maybe he'd decided to share pornography with me, I let the crate thump me in the thighs, and reached down with my left hand to nudge it up to eye level. That created just enough momentum to make the crate drift coyly away. Pearls seemed to dodge in air. Or "air."

At last trapping it, I learned that the box contained a handsome and distinguished set of books. *Analysis of the Probable Nature of the Extraterrestrial Visitors* had been written by the Moeller-Rand Thinktank, the same group that chose our trade goods.

At first glance, the books seemed an exercise in silliness. Why write ten volumes on a subject no one knows anything about? Why spend megabucks to send twenty kilos of books into orbit when microfilm could be sent cheaply and stored in a pocket?

Both questions had answers. Heavy books rather than microfilm because that way there'd be a record of our having received the report. (Them-Us.) The Moeller-Rand Thinktank has a record unequalled since the Oracle at Delphi. They were accurate—and always told the paying customer only the good news he wanted to hear. Bad news was reported in a form in which it could be overlooked and indeed mightn't even be noticed. As for example—buried amid a ten-volume report.

Pausing only to admire the floatby of a multi-kilo Stilson wrench in red and blue, I went off to study, pushing the books before me.

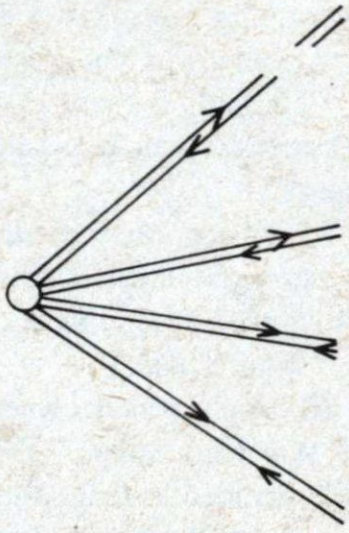
Volume One contains discussions of such questions as Would Biped Aliens Desire to Learn Judo; What is the Probability of their having an institution resembling royalty and being able to appreciate Shakespeare, etc. Fascinating. Give me a box of pearls any time. Stalwartly I persisted.

Hours and a cricked neck later I began to hit pay dirt. Not the real hot stuff the thinktankers were trying to say without being heard, but sexy things strongly related to it.

Volume Five: An Analysis of the Probable Design of the Galactic Railroad began by saying that ("as proven in Vol. IV") the Railroad is a transportation system that makes sense only if it operates on a galactic scale, trading with millions of worlds. Vol. V then proceeds to reveal what sort of hardware would allow them to do this. Zen! I knew it was only guesswork, and yet I still couldn't keep my blood pressure down.

"The mass energy required to fabricate such a truly astronomical length of rails implies the wholesale conversion-into-energy of entire stars." (The soulless thinking machine that wrote that sentence actually failed to use the exclamation point!)

Assuming lasers based on black hole technology (!), the thinktankers describe the typical procedure for adding a section to the Railroad. They postulated (assumed!) a star, a few natural black holes, and a switching point, "as shown in fig/ 2337A."



Uh-*huh*. A careful study of all the fine print in the footnotes yielded that a "switching point" was the "System, discussed in detail in Vol. III, by which the Railroad switches a train from one set of tracks to another."

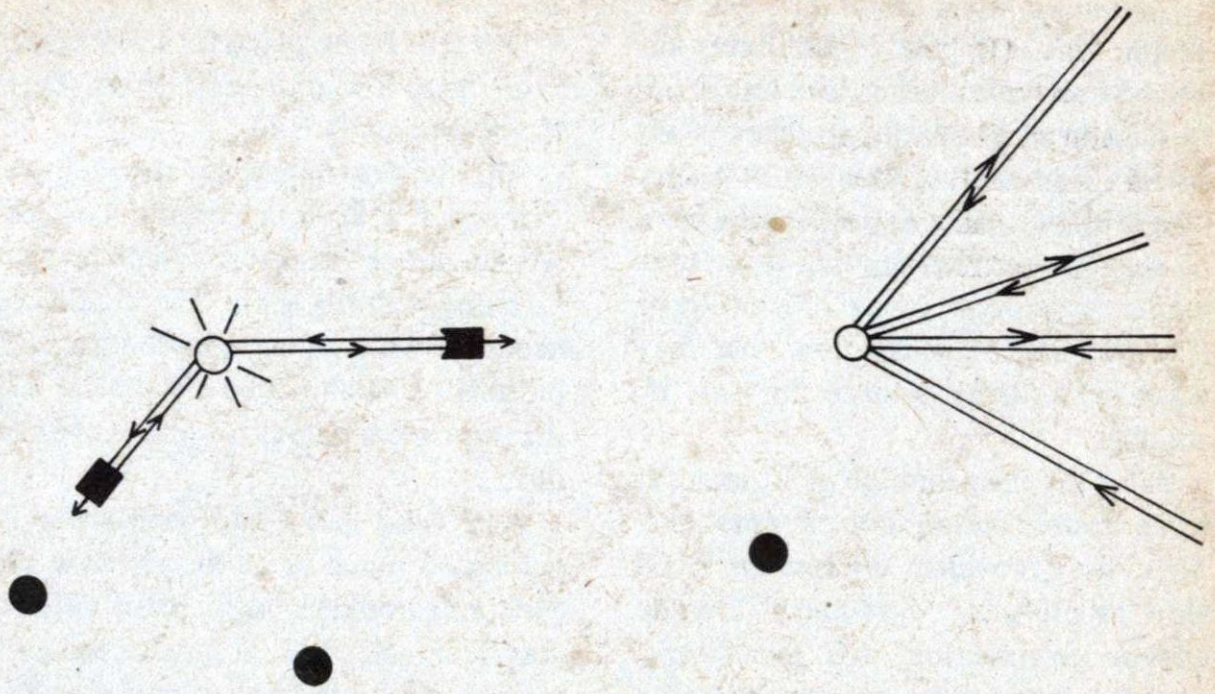
While I could see the logical necessity of such a gadget, Vol. III is 976 pages of relativistic quantum mechanics about black hole technology. I decided not to pursue that problem in any detail. I studied it enough to get a vague idea of how a black hole laser works. (*Collapstar-laser*, I mused.)

Stripped of details, a laser has two parts: mirrors and inverted population. A black hole bends light with no losses and is therefore a perfect mirror. Further, black holes convert matter to energy with up to 50% efficiency, which borders on the fabulous, and produces tremendous population inversions in the process.

Q.E.D., with black holes you can build one hell of a laser.

According to Vol. V, the first step in extending the Railroad is to drop one of these lasers into a star. By assimilating the star's mass(!), it generates a beam of light. This beam travels out to a track-laying Star Train and is reflected back to the laser by the Train. (And never mind the linguistics of "reflected back"; here it seems necessary.) That process accelerates the Train and redshifts the light to lower energy. The reflected light goes back through the laser, getting pumped up to full energy again. Then it's sent out to another track-laying Train. Again it accelerates the Train, losing energy, and is reflected back to the laser. Again the laser restores its energy and this time sends it to the first Train.

Thus there is a continuous band of light running from Train #1 through the laser to Train #2 and back through the laser to Train #1. *Continuous*.



The trains continually accelerate and, fed by the star's mass, the band of light grows ever longer. Using the black holes as turning points, the Trains proceed to the switch point:Switchpoint. It, naturally, switches them onto the established light-rails.

The conversion process is complete when the star is all gone, turned into light-rails and a black hole that now serves as a turning point (!).

It's then that the Switchpoint performs a complex operation. It severs the band of green light and splices it onto itself, thus producing a double band of light. One runs clockwise around the black holes and the other counterclockwise—a structure I remembered from General Clown's description back in the safehouse in Boston . . . what now seems ages ago.

OK; of course the Railroad actually uses such double bands in threes, but that's a minor complication. The point is . . .

At the same time that it makes the splice, the Switchpoint also switches a pair of follower Trains (which came in on the other tracks) so that each follower Train is running behind one of the first two Trains. That way, each length of light-rail cut off by the splicing operation is confined between the track-laying Train and the follower Train. Since the Trains are on the established rails, they can go anywhere in the Galaxy where extra railing is required. These carried sections of star rail are also continuous bands of light, reflected back and forth and back between the rail-laying and follower Trains.

While that tends to accelerate the lead Train and slow the following one, both Trains can hold constant speed by using the established rails.

Having explained all this in considerable detail and with a lot of math, Vol. V went on to answer the standard layperson's question: "B*u*t how can these Galactics afford to leave their lasers on all the time?"

The question simply results from a

simple misconception. The light-rails are permanent enduring structures. Affording them is merely a matter of affording a prudent investment of a very small fraction of the Galaxy's total mass in a stable non-depreciating form. Actually the process *conserves* resources (!). The light-rails do glow, but they waste less energy than do the stars by shining.

After my scan-through of Volume V, I had trouble sorting out my emotions. This Thing provided, in prose thick and slow as molasses, a vision of literally cosmic engineering. All guesswork, sure; but it had to be close to the reality of Star Trains. Buddha and Moses! What an incredible Universe we live in!

I spent some time getting over that, not that I ever will. Then some more digging uncovered—in Volume IX, and O the incongruity of using the ancient Roman numbering system in *this* discussion!—the facts the thinktankers wanted to report without their being noticed: An Analysis of the Probable Attitude of Alien Beings Toward Earthpeople. After the vast vision of Volume V it would have been an anticlimax if it hadn't been so frightening.

The Railroaders will expect us to be a typical world, like millions of others, the thinktankers advise, and then they proceed to a complex statistical argument to deduce what is "typical."

Its core is something called the Lifetime Ratio. The ratio (on average) of the length of time a planet is inhabited by intelligent civilized beings to the total time that planet provides the conditions necessary for life. If this ratio is low, then the entire galaxy must contain only a few civilized worlds. Since there would thus be no place for the Railroad to go, there would be no Railroad. There is a Railroad. Q.E.D.

Ah, one does appreciate simple logic.

Since the Railroad exists, civilized worlds are obviously abundant and the Lifetime Ratio is high. The conditions needed for life form a situation that lasts billions of years. Ergo the typical civilization in our galaxy is billions of years old!

And Asad and I had been proud of having so much more history than our FirConTeammates! Billions of years, I was fatuously told, is an exceedingly long time, and there are limits on every form of growth. The thinktankers predict that the typical galactic civilization will be a mature one, a civilization that has developed until it reached some sort of natural limit. Whatever the limiting factors may be, humankind is far short of them.

The thinktankers predict that when the Railroaders see how primitive we are they will decide that coming to Earth was a mistake, and depart. I've been working my poor un-thinktanker brain, and damned if I can find a flaw in the argument. What if they come, see, contemn, and contemptuously depart our kidstuff company?

Contact minus 4 days. Today we've had a round of explosive, knock-down drag-out arguments. Trying to explain what the Moeller-Rand report said, I barely got a word in edgewise. Everyone else has his or her own viewpoint as to what the aliens will be, and each argues for that viewpoint with great conviction—and force.

Kathy Myers sees the Railroaders as

Earth's one hope of salvation. Our world, she says with painful truth, is rapidly running out of fossil fuels, uranium, chromium; dozens of other minerals and essential resources. She thinks our whole technological civilization may collapse, unless we can buy from the aliens the technology necessary to overcome our shortages. While she's sure they have such technology at the tips of their fingers/tentacles/pseudopods, Myers has a waking nightmare: the visitors look at what we have to offer, decide that none of it is worth the cost of interstellar freight, and perform the extraterrestrial version of sniffing in disdain. Then they depart.

(I refrained from mentioning how wild they might be over zen tennis or those scummy mediocrity-*über-alles* books of Michael Korda.)

Since the cost of freight to the stars must be, uh, astronomical, she has a worrisome point. Nevertheless, John Wareagle didn't agree. The result was that Myers and her aging lover (?) nearly came to blows.

Wareagle's disturbing hypothesis is that the aliens are going to destroy the whole of our culture the same way the "white" man destroyed that of his people, the American Indian. We are suddenly going to find ourselves second-class citizens in their universe. It's a disaster scenario that I think would delight Wareagle if he didn't have to share it.

The fight between Kathy and John was the spark that ignited the general shouting. Not everyone was angry but all did insist on speaking loudly enough to be heard. Asad, mustache bristling, floated about the room like an Arabritish walrus, sucking at his tea-bottle and loudly proclaiming the anthropological view of the aliens. Despite his excellent British education he kept mouthing the buzzwords "basically" and "myself" until linguist Judith threatened to throttle him on the next repetition. She came down on him with too much heat: it was the moment, not the offense.

"But," Yuri Sarytshev interrupted, pushing his voice out announcerishly until the medals jingled on his chest, "you ignore the essential physical facts! The Star Train moves with an acceleration of 320 Earth gravities. Since no living being can survive that, it follows that the Train contains only cybernetics. Automatic machinery. You might call it the ultimate vending machine."

And so it went. A host of blind men, each proving the true nature of the elephant and each petulantly indignant when others failed to appreciate such brilliant logic. Nerves were tighter than laser beams and tempers shorter than the memory of a campaign promise. Once Tatiana said something that sounded anti-Amerind, and Col. Wareagle rounded on her.

"Commie!" he snapped.

"Well, of course," she said, but only I laughed. Briefly.

"Do not strike her, please," Asad unnecessarily said. "Surely our Visitors will no more tolerate the greedy individualistic ways of humankind than the white man tolerated the *American* Indians' penchant for violence."

"That's unfair!" John protested with an instant jerk of his knee. "My people were provoked! We—"

"On the contrary," Asad replied affably, and paused for a dramatic sip of

tea. "The American 'Indian' nations lived quite happily for ages in a state of constant war with one another. The white man's crime was—"

Someone else interrupted. It went on.

Perhaps the man closest to the truth is Stepan Arkadyevitch Shchurin, Deputy Minister, U.S.S.R., and leader of the Russian team. According to him, all the rest of us were committing the same fallacy: imagining the aliens in human terms. Instead they will simply be Aliens, creatures utterly different from us.

While we paused in our ranting to consider that, Asad quietly quoted Carl Sagan: " 'The Cosmos may be densely populated with intelligent beings. But the Darwinian lesson is clear: There will be no humans elsewhere. In a hundred billion galaxies you will not find another.' "

Things got a little quieter. Of course there is a reason why all of us were so insistent on our own opinions, so intolerant of the ideas of the others, and so completely humorless.

We're scared.

We face the unknown.

Literally anything is possible.

Pandora opened only a little box. We are about to open the Universe. Among us all only Minister Shchurin, bright, brave, and dangerously ambitious Stiva Shchurin, is able to discuss the danger openly. And he's the most frightened of us all.

Contact minus 3 days.

Waiting.

Yesterday we spent all our pent-up nervous energy in loud debate and worse. Now time drags.

There are lots of last-minute preparations that ought to be made, but no one is doing anything. We're all too tense with expectation and dread. This is like the last few hours before a very important final exam. You know there's a lot you ought to study but you can't concentrate.

(I just said "like." Judith's been lecturing us about the word's overuse "by lazy dolts," as she puts it. All the world hates a linguist. So does Space Station Honest John Kennedy!)

Maybe I should use that phrase in my next *Times* article . . . THE NIGHT BEFORE HUMANITY'S FINAL EXAM. . . .

Night? But what is night or day out here on this Zen-blasted tin can floating in the middle of nowhere, Major Tom? If Congress wanted us to do good work, it should have provided toilets!

I think Tiana is sexy. (She thinks being called "Vino" isn't too cute, even though her good KGB education taught her it's Italian for "wine" . . . which she prefers to vodka!) Anyhow, I think she's sexy, dammit.

No point in holding a grudge over the telescope incident, or to take the James Bond view that I could let her pay for it in the sack. No. That really is a rotten ugly-male attitude. Besides, since the telescope cost billions, it's pretty impractical.

How the affirmativaction do John Wareagle and pretty Kathy Do It? Anyone who sees them together knows they're making it, yet how they find any privacy on this tin can is a mystery to me.

Kathy . . .

I just realized! It isn't that she has a good tan; it's too uniform to be a tan.

Her normal skin pigment is light brown and her eyes and hair are jet black. Myers is hardly a Mexican name . . . but a great many Americans of Mexican ancestry changed their names when the ISP started cracking down on the Illegals. Maybe. Maybe some other things too.

Forget that. It's not an immediate problem and I keep having this feeling that there's a vitally important idea at the back of my head that won't quite come forward. (It can't get around Tatiana Vino-et cetera.) The thinktank report was only speculation, but suppose its main conclusion is on the mark. Suppose the galaxy is full of mature civilizations and Earth is the only young, developing civilization! Old cliché or not, it is *so* sensible! The galaxy is big, but it's also billions of years old. Just how many worlds could there be on which atomic power was discovered a few decades ago?

Okay, follow that logic and consider its implication. Far from making us useless, our "youth" offers the Railroaders something they can't get anywhere else. In Volume X the thinktankers acknowledge that this possibility exists. Though what that something valuable might be, they cannot imagine.

Neither can I.

Contact Minus 2 days. I had a nightmare last night—a bad one. Probably I'd have wet my bed if I had a bed to wet, and didn't have to wear these Nixontape diapers. Thank heaven for small annoyances; they make it a lot harder to be scared.

But the nightmare . . . it turned out that the Russians were right. We on *Kennedy* had a ringside seat at the destruction of humankind.

They let us live. We were to be sold to zoos.

Contact minus 1 day. Waiting. Tempers are short and so is sense and sensitivity.

Patience is a word.

8: Collision Course

It's too early to understand the event of the past week, and maybe we never will. Seven days ago a perfectly controlled "meteor" entered Earth's atmosphere: the Star Train. Our expectations seem to have been right in outline . . . and were they ever wrong in some critical details!

The Train is composed of twelve winged cylinders that are not mechanically connected in any manner. The expectation was that they would separate and maneuver independently through the atmosphere. Not exactly! At 10,000 km the straight-line formation broke up and the Train formed into a V wing!

Kennedy is in near circular equatorial orbit at an altitude of 2,000 kilometers. The Star Train passed directly "beneath" us, blazing crescent flashing across the nighted planet. It vanished from our sight into the dawn.

Radar continued watching, and its image appeared on our telescreens. The Star Train had entered the upper fringes of our atmosphere at extreme speed — with enough kinetic energy to vaporize it a hundred times. If it went ever so slightly too deep into the atmosphere,

it would burn up. If it didn't go quite deep enough, it would fail to rid itself of enough kinetic energy. In that case the train would spin helplessly into space.

The Voice of NASA described Their flight in a steady drone that gave no hint of how perfectly They were threading a dangerous needle. They left the atmosphere with perfect orbital velocity, and the calculated orbit was displaced on the telly. It looked as if They were headed to intersect *Kennedy* (meaning crash into us), but that was surely an illusion of the small telescreen.

"Object," the Voice of NASA announced, "to pass within forty (four-zero) kilometers of *Kennedy*. Time to passage twenty (two-zero) minutes."

We waited. The sense of expectation was too great for any of us to speak. Dry mouths prevailed on *Kennedy*. The only sound was the dull Voice of NASA Space Track, with the twang of Texas.

"Radar reports signature of brief ion rocket firing. New orbit calculated. Object to pass within one repeat one kilometer of *Kennedy*. Time to passage seventeen (one-seven) minutes."

"New data. Error in previous orbit calculation indicated." Pause, beat, beat, sweat: "Object to pass extremely close to *Kennedy*. Double precision orbit calculation in progress. Time to passage ten (one-zero) minutes."

Another long, dead silence. We felt ourselves grow damper while we listened to our hearts beat: "Object to impact at relative velocity of oh-five kilometers per second. Time to impact oh-six minutes."

It is almost impossible for anyone to turn on his/her heel, as writers of fiction have it, but I swear: Windhorn spun to the station keepers, literally turning on the heels of his magnetic boots, which one *can* do, in zero gravity. "Fire all rockets!" he ordered with more than urgency in his rising voice. "Blast us out of here!"

"But sir . . . the *Kennedy* isn't a spaceship. We don't *have* any rockets."

"Except," another answered, "for the attitude control rockets. In six minutes they'd move us maybe fifty meters or so."

"Good!" Windy shouted. "Fire all the whatever-they-ares! At once!"

In the same calm, softly authoritative voice with which he'd told us all to call him Stiva ("Steve," for Stepan) Deputy Minister Shchurin said, "No, H.R., no. You don't understa—"

"I understand!" Windhorn snapped to his Russian equal. "I understand that this is an *American* space station, and that I am in command!"

Shchurin wasn't the only one to look shocked—and from that moment, to me he was Stiva. John Wareagle and I exchanged a glance. The station keepers were going to obey the dummy American rather than the clever Russian — unless someone quickly Did Something.

So . . . poor old klutzy Irving Quinan started to move, and stumbled right into the Secretary of State of the whole United States of America, and bumped right against the emergency-actuate button on his monkey pump. While I pretended to be hurt, Horace R. Windhorn squeaked and, with an expression of stricken horror on his face, shriveled.

After that there was a lot of confusion. Everyone suspected and some as-

sumed that I had just committed downright mutiny. No one could be absolutely sure, though, and it didn't matter. Wareagle loudly proclaimed that with Windhorn temporarily incapacitated we were all under Stepan Shchurin's orders. After all, he was co-commander of the ComFirConTeam. Some argued. No one did anything.

"Incoming Train," the steady voice of NASA Space Track announced, silencing everyone else, "shows negative repeat zero rocket burn and continues on calculated course. Time to impact three repeat zero-three minutes."

The station keeper named Harman said, "It's too late to use the attitude control rockets."

After that silence was sovereign. We were busy being scared.

Like fish in a tank whose water needed changing, we floated dully in the Observatory Chamber. The ceiling was a steel-web-glass composite that afforded a grand view of our blue-green world with its overlay of cotton batting. I saw clearly the fleecy clouds over the American continent and a storm gathering off the African coast. And I could see a tiny bright spot coming up over the rim of the world. It certainly wasn't the moon.

NASA's Voice made every one of us jump, which isn't easy when you're floating free.

"Negative ion rocket firing. Object continues on calculated orbit. Time to impact ah-zero two repeat two minutes."

In the corner all but unnoticed, Windhorn said "Faaha" or something like that. He was getting his bladder drained, forcibly—and, for all I know, maybe he was having an exquisitely unpleasant involuntary orgasm as well. It's a nice thought. Still clutched in the tight embrace of terror, he was trying incoherently to order the rockets fired. Maybe.

The spot in space  was growing brighter. It still showed no perceptible width. In astronomy, it's just a point. All talking had ceased. Like the condemned in a gas chamber, we couldn't talk because we didn't dare breathe. All of us stood or floated or squatted in air, and we stared.

"Ah-negative ion rocket burn." This time the emotion was apparent in the Voice of NASA; I heard a quaver. "Obj-ect continues on calcyoulated orbit. Time to impact sixty six-oh seconds. Jesus, Jack, those people are going to be" *click*

Yeah, we thought we probably were goint to be, too. The bright spot was not a point anymore. It was showing width.

"Fifty seconds." NASA's Voice had changed. Now it was Ms. Emotionless.

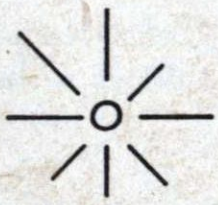
Was the spot round?

"Forty seconds."

Yes, it was.

"Thirty seconds. Repeat . . . twenty-eight seconds to impact."

The separated Train had switched from the V formation to cylinders in line.

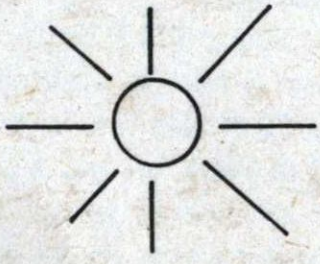


"Twenty seconds."

God, suppose I had guessed wrong—

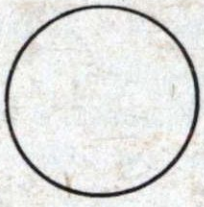
"Ten seconds."

Would anyone understand, ever?



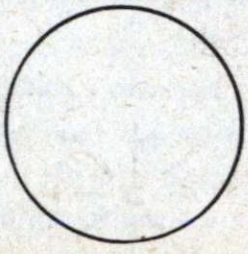
NASA said, "Five seconds."

The Star Train was a bright new dime on the other side of the street.



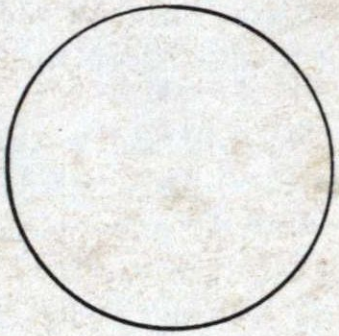
"Four."

It was big as the moon.



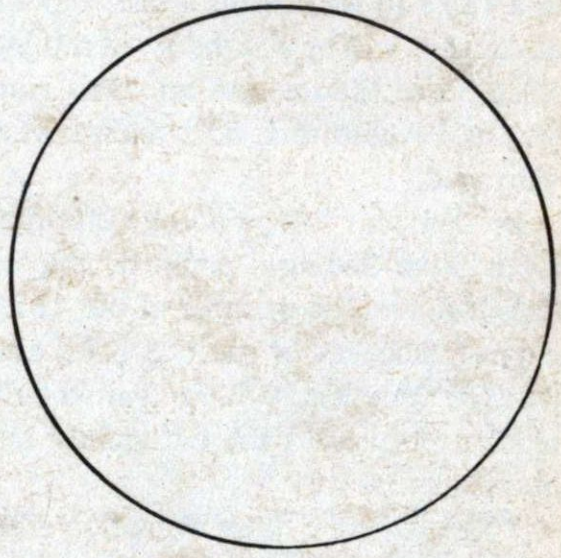
"Three."

I could see the pockmarks in the shiny metal. Death had acne.



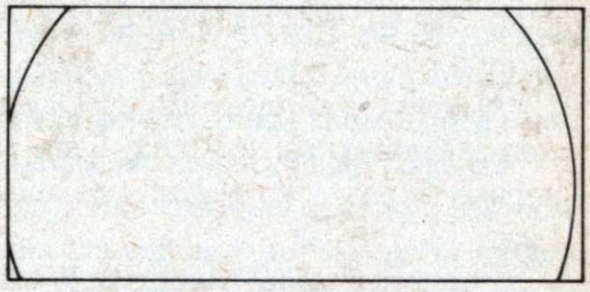
"Two."

Sonya, why—



"One!"

The Star Train filled our vision.



Zero.

Cylinder after cylinder flashed past.

NASA said, "Ya aH O O O O O O O! !"

The Star Train was gone.

As we all started to breathe again, Deputy Minister Shchurin said, "I believe that humankind has just passed a major test."

John Wareagle and I nodded our agreement. "Fine," Kathy Myers gasped. "Will one of you please let the rest of us in on the secret?"

"Son of a bitch," Judith Burkhalt, Ph.D., Ph.D. enunciated clearly. "I've just swallowed my bridge."

"Thank God for diapers," Yuri Sarytshev said with said with great fervor in a voice fit for a mausoleum, and we all laughed as if he was the greatest thing since Steve Martin, and only this minute, as I record this, do I realize what Yuri said.

Be damned! I hope no one else did. Even Stiva Shchurin could be mighty displeased with a member of the Academy of Sciences of the U.S.S.R. who thanked You-Know-Who, particularly in front of several Yankee Capitalist Imperialists.

"The Aliens," John Wareagle said, interestedly watching tears of laughter float like tiny pearls, "have repeatedly showed accuracy far beyond anything we can do. Even with Space Track's precision, what looked to be a collision course was for Them a close but well-controlled flyby." He swatted at someone's tear. It eluded him, dancing in air.

"A-lienss," Kathy Myers whispered. Why she looked so unpleasant amid our mutual group elation was beyond any of us. And she added, "Themmm."

"We had enough information to deduce that there was no real danger," Minister Shchurin said, although that deep voice of his wasn't quite level. "Had we succumbed to panic and fired the attitude rockets, we'd have shown tham that we're full of paranoid mistrust."

"Full of standard xenophobia," Wareagle said. "Which we are."

9: Contact

After all that, fear and tension and terror and relief, we went back to waiting. It was agony. Hadn't we spent all our adrenaline?

NASA Space Track provided a running report while the Railroaders maneuvered their train into a stable orbit. We tried to work off our tension with what we considered jokes. Judith declared that this was as good—almost—as anything John Dykstra had achieved in the War Star series. Instead of correcting her, Asad predicted that the Train's doors would open and Ray Harryhausen-animated Things would come pouring out, all in conductors' caps.

"Pardon me boy, is this the Transgalactic Choo-choo?"

That was Wareagle's brilliant addition to our sophomorism. Our laughter was out of all proportion to the humor. Mouths were dry, but we were letting them run freely while our minds were elsewhere. It's called whistling in the dark, among the tombstones.

Obviously the Aliens knew they were expected to approach the *Kennedy*. It was just as obvious that they were determined to do so with the minimum use of ion rockets, even though that meant

hours of delay. Hours, for us, of anticipation-apprehension.

The Aliens' abstemiousness with rocket fuel increased our fears. If these creatures from the stars themselves are so frugal in using fuel, how generous will they be with trade goods?

The fact of their having tested us, tried to see whether we Earthies would bluff out of their game of chicken, was not encouraging.

Eventually Space Track estimated that the Train would be in a docking position in half an hour repeat thirty minutes give or take two-point-five.

That meant it was time to suit up. Only three of us would go outside to meet them. The honor and danger of leading, of being first to greet the Railroaders (first to greet extraterrestrials, we assumed, although a lot of folks on Earth were bandwagoning about how they'd communicated with these Visitors) was reserved for our linguist par excellence and leader of the Soviet team: Stepan Arkadyevich call-me-Steve Shchurin.

With him would go the man Stiva's co-commander would prefer to have in irons or ejected *sans* suit: me.

Only Shchurin would be on camera. I would be operating the TV minicam and providing a running commentary. Station Keeper Harman would stay behind me and try to keep Shchurin and me from accidentally killing ourselves. (I think Judith's broken me of saying "myself." It *is* dumb.)

The sheer mechanics of getting into the suit and checking out the camera ate time greedily. It also kept me mentally occupied. Before I had opportunity to worry, I was standing in the void.

Dead ahead, the Train drifted slowly toward us.

The stubby wings on each cylinder made it resemble a great sea serpent, a line you can bet I muttered into my in-suit microphone. The Train's exterior was scaly and crazed with lines in streamline patterns: re-entry burns. Each of the dozen cylinders (did the Railroaders have twelve fingers? dumb; did the Railroaders have fingers!) was about ten meters in diameter and a hundred long. A string of overturned siloes, I said, trying to remember if farmers' silos were that broad. The ends of the cylinders were rounded, and in each we could see six holes, in a hexagonal pattern.

Insignia? No; I guessed the holes served to allow the laser beams to pass through the cylinders and permitted the firing of the ion rockets. I saw no other provision for either function.

The lead cylinder—I refrained from calling it the locomotive—was less than two hundred meters away. Aimed at us was what appeared to be an airlock. A door, at least.

With the whole world watching, Stiva was not about to idle about. He twitched one good pulse out of his thrust stick and took off for the Train. My camera sent that Earthward. The inexperienced Deputy Premier had aimed the stick reasonably accurately and was headed pretty well. As he had not however aligned his center of gravity with the thrust stick, he traveled by spinning heels-over-head.

The Ambassador of Humankind landed on the alien spacecraft ass-end first.

Unfortunately, my camera was func-

tioning. Unfortunately, I repeated Shchurin's mistake. The audience saw only a panoramic view of the stars, the blue Earth, the *Kennedy,* the Train, stars/Earth/*Kennedy*/alien vessel clunk. With an assist from Al Harman I managed to land on my feet. I gulped hard to swallow my heart. Though I'd had a fair amount of practice-walking on steel with magnetized boots, clumping in the manner of the Fee-Fie-Fo-Fum character, this somehow felt . . . odd.

Ah! Another thing, I realized: Stiva should have rebounded off the Train's hull! Instead he had stuck. Adhered.

Harman had aided Stiva up. I kept the camera off him until he was walking reasonably well. Everyone on Earth with a teleset saw him approach the airlock, bend down, and . . . knock.

If anyone/anything heard him, there was no sign. Literally billions of people were watching us, and we had nothing to do but stand around and fill our diapers.

Shchurin motioned to Harman and me. "What do you make of this?" Again he reached down and touched the cylinder's surface.

You can't feel anything through spacesuit gloves. I reached down and felt anyhow. As soon as my hand was within some five centimeters of the surface, I detected weight. It wasn't just that some force acted on the suit. My fingers, inside the gloves, *felt weight.*

"Damn," I muttered, to billions.

Squat-lying easily on the hull, Harman took a small wrench from his tool kit. He released it some ten cm from the hull. It floated. At five cm it dropped, bounced, and lay still.

"There is no Down up here, ladies and gentleman," I said, just as if I was making sense. "But please observe this." And I asked Harman to do it again. "We have just made a significant discovery," I said, just as if I knew what I was talking about. "Our Visitors maintain an *artificial gravity field* outside Their craft. The field is a sheath a few centimeters thick—just enough to make it easy to walk about on the outside surface of the train."

I tried demonstrating that, and discovered it wasn't so easy, at that. Crawling would have been. . . . Once I hunched a little forward and kept my feet down, almost shuffling, I was able to walk . . . "easily."

We discussed the importance of that for a few minutes, filling time while we wondered what the devil you do when the aliens don't answer their door.

Each of the Train's cars had at least one porthole, with light streaming from most of them. We kept glancing at them. No one had to say anything; we all had the same thought. Playing peeping tom might be bad interstellar diplomacy, but the temptation was irresistible. Shchurin gestured, close to the ship. I gave the viewers a fine view of part of space station *Kennedy* while our fearless leader squatted, planted his hands, and hands-and-kneesed it to the nearest porthole. He peered within, squinting. I panned *Kennedy,* glancing repeatedly at Stiva. He motioned. Harman and I joined him.

"As our Visitors do not answer our knock," I told my microphone, "we are going to be nosy neighbors."

We stared "down" into an empty chamber—or, rather, an unoccupied one. The furniture was fascinating! The

maroon couch and chair and the deep-violet chair were normal in shape—and half normal size. The polished chrome(?) perch looked capable of accommodating several hens—or a bird larger than a human. As for the double-seated chair—one seat above and behind the other—well, I managed to avoid telling billions that somewhere there lived beings with double-jointed arses.

We were meanwhile overlooking the obvious, because it was impossible. Harman caught it, and said it: "Uh . . . there's no glass in this porthole."

That couldn't be, of course, and Shchurin started to say so. He bit it off. Bumblebees "can't" fly, either. After a long pause Stiva said, "The way is clear. We could simply . . . walk in."

Well, wiggle-float in was more like it, but I was nervous about that.

"Sergeant Harman: do you have some small object in that tool kit?"

He offered me a wrench.

"No," I said, "something smaller than that. A hair would be just right."

A grinning Harman slapped his helmet to remind me that hairs weren't available just now. Then he fumbled briefly in the tool kit. Producing a spool of fine wire, and then pliers, he snipped off a couple of centimeters of wire thinner than the frames of steel glasses. He offered it to me. I gestured, keeping the camera on the porthole. No dummy, he didn't shove it in or try to throw it; Harman tapped the wire so that it floated "down" to the porthole.

It contacted the gravity sheath, dropped, and vanished in a flash of light.

Harman snapped, "A trap!" and Shchurin swore fiercely in Ukrainian.

"No trap," I said. "Look, we're standing in vacuum outside a room full of air." (Immediately Harman began nodding; he knew. I went on for the billions who didn't, including Earth's Ambassador to Whom/Whatever.) "There is no glass in the porthole, or perspex, or anything solid at all. There is something else: a gravitational field strong enough to hold an atmosphere. A, uh, 'drop' of ten centimeters through that hole is equal to falling thousands of kilometers. That bit of wire was accelerated to such speed that air friction burned it up."

At this point, while I showed everyone how brilliant the *Times*'s rep was, the three of us were in full view of the external cameras on *Kennedy*, now actuated. Busily and doubtless fascinatingly we discussed what was and might be implied by the gravity field and the unearthly furniture. We were unaware that behind our backs the Train's airlock was opening. Ground Control were either watching what my closeup camera showed, or they were drunk on the job. No one warned us that something was coming up behind us. Hundreds of millions of viewers doubtless shrieked "Turn around!" at those idiots on their screens. We knew nothing of that.

I was first of our trio to experience a very close encounter of the third kind. Something tapped me on the back, and Harman's and Shchurin's hands were in clear view.

I said, "Deputy Premier, Sergeant Harman—I believe that we should turn slowly, in place, without making any sudden moves."

Contact!

10: Us and T! H! E! M!

We turned around slowly, without making any sudden moves.

The . . . thing that had floated out of the Train's airlock was a perfect sphere a half-meter wide and seemingly of crystal. I stared, wondering how a see-through beachball with a severe glandular condition might be intelligent. Glowing red figures appeared in its, uh, belly. First a right triangle flashed into existence, after which squares appeared on each of the sides. Swiftly we were shown geometrical proof of the Pythagorean Theorem.

And then, having "spoken" in proof of intelligence, the visitor stood empty, waiting. A perfectly transparent sphere with the diameter of an old-fashioned rain-barrel.

It was our turn to say something clever. We not only couldn't duplicate the Railroader's act, we couldn't follow it. We had nothing with which to draw.

Stepan Shchurin, representative of Earth and pride of the Soviet Union, could think of nothing better than to count on his fingers. That surely showed our visitor that we were intelligent, but not very. The worst part was that since spacesuit gloves are rather clumsy, Shchurin appeared to find it hard merely counting to five. I was fidgeting, humiliated, trying furiously to think with a brain gone into fibrillation or something like.

All this was cut short by the second opening of the airlock.

The beings that emerged this time were quite different from the first, and really more what I had expected. Both wore spacesuits that would have fit a human. That is, a human could have been put inside either suit. No human could have moved its legs in one, as the joints were hinged backward, while the other suit provided more flexibility than any human needs or can use. The faceplate of each suit was partially silvered, so that we could see nothing of the aliens Themselves.

Earth's ambassador commenced gesturing. In vacuum that activity appeared singularly unhurried. An arm ending in a pointing finger floated toward the aliens and then *Kennedy*ward, and then toward us. Either understanding or already assuming that he wanted Them to follow us, the Railroaders didn't wait for Stiva to finish giving directions.

They took the lead, and They didn't stop at Kennedy's airlock.

Three aliens entered space station *Kennedy* while three Earthmen stood outside—on nothing.

We waited ingloriously while the airlock cycled and yawned open for us. When we were at last inside again, we found that the two biped Railroaders had moved very quickly. Having tested our atmosphere already, They were removing their pressure suits! I made a mental note to refer to this as vindication of carbon-atom chauvinists.

The two were in great contrast. The being that had worn the hyper-flexible suit was magnificently golden, a creature that moved with a swift easy grace impossible to humans—and that somehow did not horripilate, as it might have done had it been serpentine. Raise "feline" by several powers and you're getting close.

Its hands were six-digited, with twin opposed thumbs. The finger joints were universal, so that the hands had neither front nor back. (I remembered Sagan's remark that the devonian ocean fish we are evolved from had five phalanges on each fin; if they'd had four phalanges, or 27, we'd have four fingers on each hand—or 27. Long long ago, in a far-away ocean, a fish on a carbon-based planet plied the waters with fins ending in six phalanges. . . .)

Only the head and hands of this golden alien, this angel from space, were visible outside its clothing, which was a single white garment falling somewhere between a sari and a kimono. Lovely, flowing, graceful.

The head was not just hairless. Aside from the wide, wide blue eyes, it was featureless as an egg.

The other being's scarlet skin was partially covered with coarse black fur, rather like a fur coat from the Salvation Army. Although nature had not seen fit to cover it fully, it wore no clothing. Nor was there any fat on that big body; only corded muscle on angular bones. The legs—which ended in feet resembling a bird's claws—bent backward at the hip and forward at the knee. The arms were jointed like ours. Each ended in a skeletal four-fingered hand that was only bone covered with paper-thin skin. Scarlet skin.

Not reddish, like John Wareagle's; *red*. The fact that it possessed no discernible sex organs made me wonder how it had come by two navels—and why.

Unfortunately this visitor's face was its least pleasant aspect. A wide mouth full of pointed yellow teeth, a flat nose with flared nostrils, small red eyes in yellowish sclera, and pointed ears that projected out and up from the angular head. A bat, yes. And the bat-like illusion was made complete by the wings. They were black and leathery, with a span of about a meter.

Oddly, it was one of the "godless Russians" who first mentioned the demonic aspect.

I wrapped up the telecast by saying that our Visitors were obviously members of two totally different races, most likely from two different planets. Since we had seen furniture suitable only for beings of yet other races, these two likely represented some sort of interstellar federation in which humankind would, in due course, surely take its proper place.

That was perfectly sensible and fatuous. I added that, toward the end of entering their alliance and its doubtless enormous benefits, I and my fellow Contact Astronauts and Cosmonauts would be working night and day.

We have been, too.

The days or rather "days" that have followed have brought many questions and few answers. You can guess how we dubbed the two biped aliens. He/she we called Angel had no interest in communicating with us, and by our standards no politeness either. When Kathy Myers and Andrei Andropov tried to show her/him/it one of our periodic tables, for instance, the pupils of those lidless blue eyes contracted to periods, to dots—to nothing! They vanished utterly, leaving blue spheres. Angel ceased to move. There was a flurry of con-

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cern—until we realized that Angel had simply gone to sleep while we were talking to it.

Devil, on the other hand, seems eager to converse, but curiously lacks the aptitude.

Kathy did the finger-counting bit, this time in binary. Little finger up one; ring finger up two; little and ring finger up three:middle finger up four; and so on.

Devil was a painfully long time catching on. When he/she finally did, it appeared overjoyed and pleased with Kathy, almost as if Devil thought binary numbers were something new.

The main communication effort is with the sphere, which is not crystal at all. Nor is it transparent, in the usual sense. It's an image projector, simply that. We were able to see behind it, thinking we were seeing through it, because that's the image it projects when it's in its neutral state!

Its presence creates some distortion, which keeps it from being invisible. That is, it bends light rays, "pretends" not to—and doesn't quite succeed.

Our largest surprise to date came when Stiva consulted a math text. The sphere immediately opened a slot in its top—an odd sight, a hole floating in the middle of empty air! Stiva did the obvious; he put the book into the slot.

End book. It was rapidly cut to shreds and spat out the sphere's bottom. (Make that the outermost curve of its convex ventral surface.)

That was like being caught in a blizzard, without the wind: thousands and thousands of strips of paper floated all about us. Batting at them, we realized that the book had not been destroyed so much as carefully converted into strips each a bit over a centimeter wide. The confusion was compounded by Station Keeper Anspach's yelling "Fire Hazard!"

Theoretically, the lack of convection currents makes a dangerous fire on *Kennedy* impossible—but since the disaster on Station Able, no one trusts the theory. The blizzard of book scraps was duly vacuumed away.

It was Judith Burkhalt who had the weird idea, then; she produced a ream of paper. First elaborately showing the sphere that it was blank, she offered the paper. Again the slot opened.

"Wait!" poor Anspach called—too late. In went the ream.

Out came instant fire hazard.

As best we could judge without spending a few days on a total reconstruction job of this new blizzard of shreds, the sphere had printed the book it had just destroyed.

"It's a physical computer!" Secretary Windhorn exclaimed. "It learns by eating!"

I started to laugh at that absurd notion . . . and thought better of it. Windy could be right. We'd just seen that to extract the information it could destroy the object which contained that information. How far did it carry that principle? Didn't primitives used to believe that one could become smarter by eating the brains of others? And isn't RNA-gained intelligence based on a similar cannibalistic concept?

I pushed such grim speculations aside and thought about the obvious: we'd just learned that the sphere wasn't an organic being but a computer! A robot, a language-translating machine. Maybe it's a fully intelligent robot and the social

equal of Angel and Devil, as we can't help calling them. And maybe it's only a gadget they haul around. Clearly it saves them the trouble of continually learning new languages. From our viewpoint there is a considerable saving of labor.

There's a catch, too.

In learning our language the Aliens learn much about us. In teaching them by programming their mobile linguistics computer, we learn nothing about Them.

That was and is manifestly unfair, and potentially dangerous. I began pondering whether I shouldn't try to redress the balance by spying. My job and purpose, remember? Oh my, there was no CIA on Station *Kennedy* or the ComFirConTeam.

Just Irving Quinan, *New York Times*.

Naturally there was a most important human judgment to be made. The same sort I'm sure used to give pause to men such as Helms and Turner and Grimsley and other CIA heads: could I get away with it?

We still know precious little about our visitors: Angel, Devil, and Sphere. (Well, we had to name it something.) There are only guesses as to what kind of culture(s) our Visitors represent.

The best guesses seem to be those of the Moeller-Rand report. Assuming it's right and that They represent static civilizations billions of years old, what then? *If* such old civilizations have long since abandoned and forgotten all the antisocial arts—such as planned espionage and intrigue—then my chances of getting away with acting my true role of *espion* should be good. . . .

DIA's Wareagle and I learned as much as we could by observing the Train with one of the smaller telescopes. That readied us for the next stage. After some consideration, I decided to avoid a possible international incident by turning a possible intergalactic one into an international one. That is, I asked Tatiana Vinogradova whether, as a *Pravda* correspondent, she'd like to join me in some investigative reporting. Wareagle and I had decided that we really could use 'Tiana's help. Besides . . . with that extra spacecan still hidden out on *Kennedy*'s hull, it wouldn't do to give the Russians cause to think we were maneuvering behind their backs.

Tatiana's answer was simple: *da*.

Our first objective was a detailed examination of the outside of the Train and our first problem was concealment.

While 'Tiana didn't like my plan, she couldn't offer a better one. *Kennedy*'s exterior looks like a junkyard because for years the astronomers packrat-stored their surplus equipment outside. We let ourselves into *Kennedy*'s hull on the side opposite the Train and made our way through the scientific junk. We went with care. Neither of us was anxious to catch the creepie-crawlies. (That's what you feel if you rip your spacesuit. The blood in all your large arteries and veins gently boils, causing slugs of liquid to squirm through your body. A most peculiar sensation, I've heard. Despite a lot of rupturing, your body doesn't actually explode and you have a few seconds to try to restore air pressure.)

Soon 'Tiana—actually "Tasha" is the proper diminutive of Tatiana among their people—and I were facing the Train from a spot on *Kennedy* directly opposite the nose of the "locomotive."

We simply squatted, gathered ourselves, and "jumped" over to the Train. The leap was accomplished in slow motion, for like most inexperienced spacepeople we feared losing control and moved with nearly compulsive slowness.

'Tiana was even less skilled than I, and the moment we were caught by the Train's shallow gravity film we landed with a considerable thump and clatter.

It didn't matter. The metal on which we stood—well, rested, on hands and knees—was flaky. Swollen and riddled with tiny bubbles. Re-entry had not done this. As for what had . . . extrapolate. In Japan they give new windows for the Bullet Train the Dead Chicken Test—load a dead chicken into a cannon and shoot it at the window at the speed of the train, 200 kilometers per hour. For high-flying aircraft this same problem is worse. Freak weather conditions can sometimes lift tiny insects to 30 kilometers or more and at mach 5 a collision is like being hit by a machine gun bullet. Carry this reasoning further and remember that space isn't empty, and the superhero The Flash isn't possible.

To the Train, moving through space at a very high fraction of lightspeed, each stray atom became a high-energy proton. We now occupied the radiation shield; the one portion of the Train where sensitive detectors could not be located.

From this vantage there was one interesting item to be seen: the insides of the six holes that ran the length of the cylinder. We measured each hole at 10.3 centimeters. These apertures had to be the coupling mechanism, the system that allowed the Train to ride on rails of light. We took photographs and made such measurements as we could. Peering into one of the holes was like staring at the inside of a rainbow. The best explanation is that the rails are coherent laser light, and there has been speculation that the Trains use optical frequency linear-induction motors to ride them.

Having hopped a spacegoing Train, we two hoboes found that there was only so much to be learned while standing in the safety of the radiation shield. We unslung our oxygen tanks while John Wareagle watched us through a small telescope. The oxytank hoses were long enough so that we could lie down with the tanks above our heads and crawl.

See, if one assumes that the aliens had built the best intruder detection system their technology permitted, what we were doing was doomed stupidity: we'd be discovered and rudely told to go away, or merely destroyed. On the other hand . . . first we had reason to believe that the Railroaders might not be so suspicion-prone as we, and second we had seen them display parsimony. In which case it could be assumed that they built only what appeared adequate.

What the hell, all that was at stake was a couple of intelligence agents. There are lots of those. And John Wareagle of DIA was safely inside *Kennedy*, watching. We crawled, imitating wiggle-worms on the Train's hull.

His voice sounded in my helmet: "You're about to pass between two of the eyes at six o'clock and two o'clock. Go single file and keep your butts down."

He referred to the shallow indenta-

tions that were distributed along the length of every Train cylinder, with a fisheye lens peering from the bottom of each. Thus the aliens had studded their craft with eyes that saw in all directions. Behind those eyes, I assumed, was a mechanical intelligence whose attention never wandered. We hoped this was all we had to worry about.

"Bear slightly to your right," Wareagle's voice muttered.

We did. The Train was not drawn up in a straight line but in a broad curve. That way only one side of each car was visible from the others. This limited our danger of being seen only to the eyes of the cylinder we were crawling on. Assuming that each eye had a 170-degree field of view, we had a blind crawl-area 30 or 40 cm high. That's touchy, but neither Tatiana nor I carries any spare meat on these bodies, and neither of us is steatopygic. Thanks to our figures and the Railroaders's artificial gravity, it was possible.

We squiggle-squirmed along. It must have been a strange sight to the watching Wareagle. Not a particularly interesting one! Not with us in pressure suits, which are hardly form-fitting. In fact, having half my body within gravity was an odd but pleasant sensation.

After a lot of wiggleworm squirming we gained our objective: a porthole. There we planted the first of the serious instruments of chicanery we'd brought: a telecamera with a light-pipe lens.

The light-pipe ended in a metal rim, which we slipped around the porthole. If a creature inside happened to be watching, we provided nothing for it to see except the hole's growing narrower by half a centimeter.

We moved on, approaching the end of the first car. The porthole in its end, facing the second cylinder, was dark and apparently not in use. We didn't bug it. The car-to-car jump was easy, even for novice spacers such as 'Tiana and me. I mean I, I! The crawling was hardly the way I'd choose to spend an afternoon, with or without a member of the other sex.

It was a long job, and hardly fun, planting a bug on each of the twelve cars. We accomplished it. It isn't the first time CIA and KGB have cooperated on a clandestine mission!

It happened near the end of our return journey.

Though our oxygen was getting low, we knew it was sufficient for what we expected to do. I noticed that by stretching I could reach the port of the third car's airlock. Of course it would be locked, I thought without really thinking; it had to be. Naturally I reached out and pushed. It slid smoothly inward.

The port had been ajar!

I considered that, and its implication.

Someone had left the outer lock's hatch open. Therefore no one within the car could open the inner one. Either this car's occupant was deliberately locked in, or—the cylinder was empty. That latter seemed more likely. In any case I couldn't pass up such a chance.

'Tiana and I had agreed to maintain radio silence at all costs. Fine! That saved me useless discussion/argument.

I started forward. She grabbed my leg. Next she pressed her helmet against my suit's knee joint. Even in vacuum there was enough sound conduction in my metalloid suit to hear/feel her angry

rumbling. Tatiana tugged; I slipped. I nearly fell through the door. Clinging to my leg, she accompanied me.

First we'd hopped a freight. Next we had illegally bugged a (presumed) non-enemy—to my knowledge—for the first time in space. Now we were breaking and entering.

No, just entering: we hadn't broken anything, including legs.

We were in darkness. I closed the port just before 'Tiana switched on her suit lights. Then we made the discovery that there was no second door in this airlock!

There weren't any walls, either.

We were in a cage.

Before I could begin to make sense of that, I felt *weight*. A glance at 'Tiana told me she felt it too; we'd both begun to grow heavy. The sensation built rapidly and passed the point of mere unpleasantness all too soon. In seconds we were flat on our backs and close to terror.

Could the Train be accelerating? No no—but what, then? Still able to raise my arm, I reached for the door. I couldn't touch it. The empty air two centimeters this side of the door now felt like a steel spring. Though it yielded—ever so little—to my push, I couldn't get through to the door. The gravity continued to build. First I was forced to drop my hand. Then I had to lie totally flat.

I couldn't help remembering the NASA official who had boasted that our suits would function perfectly under high-G stress, that the suit would remain in perfect working order under G stress that would reduce the person inside to strawberry jam.

Lovely trap these Railroaders had for interlopers!

Now hindsight makes my blunder too clear. Airlocks are clumsy devices, really, little more efficient than refrigerator doors. Airlock door seals are forever developing small leaks. Unless one wishes to waste a lock full of air with every departure, one has to wait while a vacupump evacuates the lock. Clumsy. Inefficient. So . . . the aliens used gravity manipulation instead. It's perfectly sensible.

It's just that I hadn't read the Training Manual and was scared jointless.

The invisible elephant sitting on my chest became a buffalo.

The buffalo became a yearling calf, and a large dog, and it became possible to sit up. We sat up. Tatiana lost no time butting her helmet against mine, but I couldn't even be certain whether she was shouting in English or Russian. The voice was equally audible whether or not our helmets were in contact. Naturally; we were now in an atmosphere. Nor was I interested in telling my companion that she sounded like a couple of Munchkins. Or the Beegees.

Waving my hands to be left alone, I pondered. Item: Angel and Devil could both breathe our air. Item: I was gambling my life already. Item: Our suit tanks didn't contain enough air for us to go exploring within this 10x30m cylinder *and* still get back to *Kennedy*. So . . .

I swallowed several times, told my heart to ease off the double-time beat, took a deep breath, shut off my suit tanks, and removed my helmet.

The air was sweet, like the clean breeze from the glaciers of Iceland.

While that was no proof that it didn't contain lots of CO or a dozen other subtle poisons capable of killing Canadian rats if not officious FDA officials, I was grinning from here to here.

Not 'Tiana! She was staring at me, her face clearly showing that she thought I was committing a most stupid suicide. As she couldn't speak clearly without removing her helmet, she pulled it off.

"—kind of fools is CIA hiring? In KGB we do not—"

"Hey—I told you: I'm a *New York Times* correspondent. Thought you said you worked for *Pravda*."

"Why lie? We're both dead."

"Funny—you don't look dead, Totchyonna," I said, pronouncing her name her way.

"Don't be cute and don't look amorously upon me now, *American*. How can I be sure you are a man? I want nothing to do with people who pretend sexes are the same."

"We don't! We merely believe them equal and both free! I don't know what misinformation your oppressive government has foisted on you, but—"

"Bah! I am *woman* and unlike U.S. the Soviet Union does not oppress women. We have been free and equal since the Revolution! Who first sent a woman into space? Who has more female physicians than any other country? Huh! I have no wish to be Tatian Vinogradov; my name marks me as *woman!* I have my rights, and I contribute to the glorious victory of Socialism. But in U.S. — can you deny it? — is only one kind of toilet facility—people's room! — not men's and women's room, only *people*'s room!"

"Uh—well . . . " I couldn't see much use in explaining that under ERA we had to have people's rooms because separate but equal facilities were unconstitutional. Instead I said decisively, "I'm going to do a bit of exploring, *woman*. Coming?"

"Of course. Can KGB stand back while CIA learns alien secrets?"

"What's KGB?"

She gave me a sort of smile. "Can *Pravda* allow *N.Y. Times* to scoop it?"

Smiling, I began by exploring our cage. Now I saw that it was provided with a gate. It allowed ingress to the cylinder; the bolt was on our side. I had drawn the proper conclusion from the wrong facts. It took me a few moments to figure out the bolt mechanism. I knew damned well that Tatiana was sweating while trying to appear calm, because I was.

With her it was surely worse. Russians traditionally mistrust things foreign, and that leads to or means fear, and she could be right. The big tin can we were about to enter was likely just an empty freight car designed to carry back lord knows what from our planet. But it *could* hold . . . anything. I hoped to find and steal a treasure trove of knowledge; 'Tiana Vino feared some nameless alien horror.

Nor could I prove that this car wasn't locked from the outside because those inside had antisocial habits. Eating habits, maybe.

The bolt clicked. The gate flipped itself open. We stepped out of the cage to walk along a narrow corridor. When we came to a corner, I got down on hands and knees and slowly peeked around. At first, I thought a fabulous ruby was afloat a few centimeters in

front of my face. I jerked back automatically—and realized that I was looking into a large compound eye.

It was staring right back.

The eye's owner was small, round, and bristly as a cactus. It used its lower spines to speed away from me with a centipede's gait. Meanwhile it hooted through a hole in its . . . top. Loudly. *Real* loud.

Other creatures came running, hopping, crawling, rolling.

They were furred, feathered, scaled, carapaced. One human-*shaped* being was ivy-covered, or appeared so. Here came a centaur whose upper body gleamed in bronze armor. Its flesh was transparent so that bones and organs were revoltingly in view and its hooves looked more like the pads of camels. A rug with melting chocolate eyes came inch-worming toward us. Before I could fall in love with those eyes, I goose-fleshed at a patch of darkness staring at us with a single eye like a black-eyed Susan. Cute.

There was a bewildering host of others. Some of the smaller (passengers?) were armed with an assortment of weapons all of which could be called swords. None had anything resembling a gun or bow or throwing weapon.

That was nice, I thought, until I remembered: the twentieth was the first century of human history in which men had not habitually worn swords. And for thousands of years bits of metal with sharp edges and points had done a perfectly adequate job of ending human lives.

Gulping, I tried to look friendly—not smiling; I was damned if I was going to bare fangs at strangers! And I took a half pace forward. Maybe it was a third of a pace.

Slowly! Arms up, hands clearly empty in their heavy gloves.

The cylinder's occupants buzzed, whistled, sang, and worse.

In all that vocal reaction I detected not one sign of understanding. One approached; it must be a highly evolved beetle, its body encased in scintillant black armor. Standing upright on its lower limbs, it was nearly as tall as I. The upper limbs were arms ending in six-digited fingers, while the middle pair was short, largely atrophied. A tradeoff for height and intelligence, I suppose. The upper area of the main body segment was covered with small spots that I saw were holes. Probably its breathing system. The shining, rather glassy eyes fixed on me were complex, weirdly so. While the centers were simple lenses resembling mine, out at the edges they became the compound eyes of an insect. That should give it better side vision than I possessed.

Apparently its eyes can't move, I decided. *So to focus on anything it has to turn its head.*

Insectoid, but not like anything I'd ever seen seen under a microscope.

These little details of strength and weakness, you see, were of interest: Edward the Black Prince-beetle was coming toward me with short sword raised. It was left, uh, handed.

In my pressure suit I was an even match for a turtle. Half turning away, I started to undo the suit. I heard Tatiana make a squeaky sound. The giant beetle could simply have rushed in and stabbed me, right then. Instead, it stood and waited.

Chivalrous, I thought, and wondered: did this black creature have some ritual that in its culture was the equivalent of mounting a horse and couching a lance?

At any rate, having offered single combat, the Black Prince also acted in accord with some standard of fairness. I unsuited, keeping my head turned its way, studying it.

"You have come far to see us," I said, "and we mean absolutely no harm. It isn't seemly that you come at me with a sword."

It stood up straighter and brandished the weapon. I kept unsuiting. My karate, I judged, would be useless against that armor. This would have been a very nice day to have stayed at home. Hmm . . . since the thing had the same joint arrangement as a man, I judged that judo should work. Despite its moving with easy grace, I saw no indication of supernormal quickness. My longer arms partially offset its sword. *(Sure. I can get a hand lopped off all the faster.)* No; it was not that sort of weapon. "Sword" is perhaps not the proper term; I didn't know that much about old weaponry except, of course, for whistling arrows, double-edged *sakars,* and such traditional Tibetan weapons. Dad had taught me.

This weapon was a hexagonal spike without a cutting edge. Its grip permitted one- or two-handed use. It was the logical tool for one carapaced creature to use against another; pry him open and stick 'im.

I thought I had the key. While I unsuited, I was careful to move my head in imitation of the beetle-being. Perhaps it would not realize that this creature it had never seen before—a human—could move its eyes independently of its head.

I said, "Tatiana . . . whatever happens, do not interfere."

"Dear foolish comrade, don't worry. As soon as they are busy watching you die, I shall leave—rapidly."

Once I was out of my pressure suit, sounds rose from the aliens: hoots and drumming and whistles and squeak-hoot-whistles. Were they applauding me for having removed my armor, or were they mourning me in advance?

The beetle, seeing that I had completed my odd ritual of disrobing for combat, advanced. Poised just beyond my reach, it began tossing the sword back and forth, from right "hand" to left and back. It danced and shifted, feinting continually, a fighter right out of *West Side Story.* While I turned my head as though watching that overgrown spike flash back and forth and back and forth, my gaze remained fixed on its legs. I hoped it would telegraph the lunge I knew it would eventually make.

It did. Sword in right hand, entire weight on its left foot, it thrust at my chest. My chest wasn't there. I had dropped onto my hands. I kicked its left ankle.

As it fell, I caught its sword arm, twisted, and shoved. We rolled apart and the great beetle swiftly came to its feet. I had the sword.

Wonderful first contact, I silently told myself. Well, let's see . . . I had held out empty hands in gesture of peace, and that had been taken as a challenge. Logic demanded a different action, obviously. What was alien logic, in this creature's society, on its planet? Maybe . . .

This time I tried tossing the spike back to its owner, folding my arms, and bowing. We won't discuss my tight stomach and gooseflesh.

The beetle alien stood for a moment, then transferred its sword to one of its middle limbs—and returned my bow! It turned and walked away.

Be damned, I thought; *if one of Burroughs's heroes had ever tried a bit of pacific logic, his woman mightn't have been kidnaped for the next fifteen books in the series!*

Feeling marvelous clever, I heard Tatiana's urgent urging: "Very good — come on! Now we can escape."

No; the glass-fleshed centaur was doing something with a (iron?—surely not) pot of water. One of its hands was washing itself. The other hung idle at its side. The procedure was as ineffective for the creature as for a human. Stupid? No, I thought, hoping; ritual. Despite the misadventure with open hands, the symbolism here seemed unmistakable.

I stepped forward, pointed at the hand trying to wash itself, and said, "Russian."

The alien had a good ear; its reply was a perfectly recognizable "Russian"—in a voice like distant thunder.

I put my hand into the pot and we washed each other's hands.

"American," I said, and it repeated.

Each member of that weird host raised one hand, or paw, or tentacle, made self-washing motions, and burbled/whistled/sang/wheezed "Russian." Each then raised both whatevers and chorused "American."

Tatiana Vinogradova practically screamed: "You—you just taught them

that 'American' means friendship and mutual help, while 'Russian' means the opposite!''

''Yes,'' I replied. ''It's simple and simplistic—but accurate.''

Seething, Tatiana started forward. Weapons came up. Tatiana seethed in place.

A small biped, clad from head to toe in shining, highly ornamented armor, came to stand beside the centaur. Its chest was a battlefield of symbols and designs. The pointed helmet, judging by the joint arrangement, most likely accommodated a pointed head. Of the creature itself nothing could be seen save a single eye: ketchup red. It held out both steel-gloved hands, palms up. One was empty. The other held a shining gem that alternately appeared red and green. An alexandrite, or something like.

The creature piped, ''Ameriss?''

I dipped into the tool pack of my discarded pressure suit. Holding out one empty hand and one proffering a pair of cutting pliers, I said, ''American.''

The deal was made.

In no time I had traded off the entire contents of my tool pack. And Tatiana's tool pack. And both our watches—the Russian joined happily in, with those gems so seductively flashing and gleaming! Also our spacesuit spare parts. And . . .

Hell, we bartered everything except our suits and diapers. It hurt to have to continue turning down increasingly sweetened offers for my apparently exotic oxytank.

We returned to the *Kennedy* loaded with precious stones.

No diamonds—merely emeralds, rubies like droplets of frozen blood, sapphires, many wondrously beautiful stones I'm sure are unknown on Earth. Besides, the magnificently faceted ruby the centaur traded me for my onyx-set college ring is the size of the eyeball of an Earthly cow.

CONTINUED IN NEXT ISSUE

In Times To Come

● Our next issue is the one that didn't quite fit into our current "monthly" system of nomenclature—we've gone back to naming issues after months, but since we're doing 13 issues a year, there's one left over that needs a name. We're calling it "Mid-September." (We got lots of other suggestions, but not in time to use them.) Sam Nicholson has his first cover story in some time, with the characteristics that have made his work popular with Analog readers—but with a few new departures, too. A wise man once said that the Earth is an awfully small basket for mankind to put all his eggs in—but what do you do when the basket seems to be falling apart? You might not want to put all your salvaged eggs in one new basket, either. . . .

We'll also have the conclusion of Andrew Offutt and Richard Lyon's *Rails Across the Galaxy*, and Margaret L. Silbar will discourse on "Gluons and Glueballs"—which, despite what it may sound like, is a subject right on the frontiers of particle physics.

Jay Kay Klein's biolog

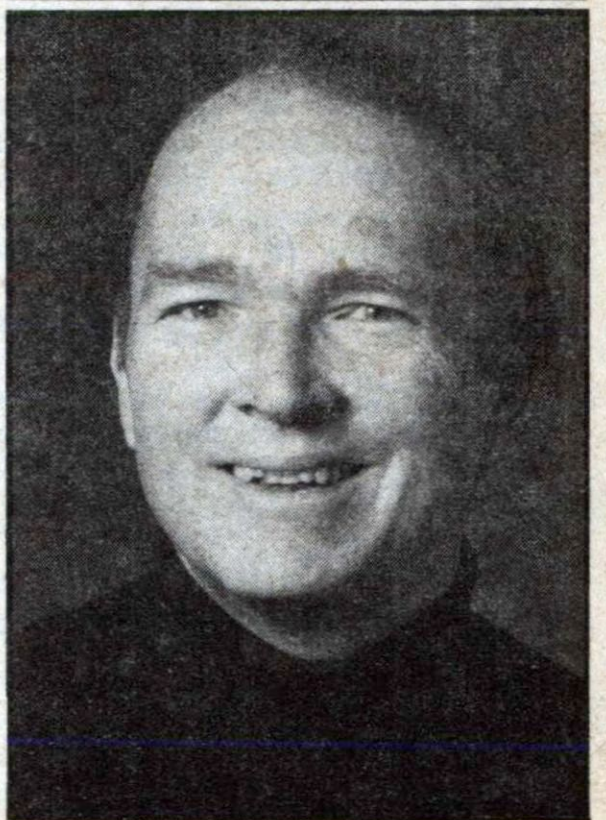
Richard K. Lyon is one in *Analog*'s continuing series of "discoveries" down the past half-century whose first published story appeared in this magazine. Not so traditional was Dick's novelette, it being the very first story he'd ever written. To top it off, it took first place in the AnLab for the July 1973 issue.

He was a "Depression" baby, born in the very depths of that man-made catastrophe, but his father had a steady job in the U.S. Navy. The result was Dick's never really having a hometown, so that his present address of Linden, N.J., near New York City is all of a piece with his birthplace of Cleveland. A B.S. from William and Mary and a Ph.D. from Harvard in physical chemistry led to his present position as Scientific Advisor to the EXXON Research and Engineering Company, the corporate research division of the oil giant.

At Harvard he studied under G. B. Kistiakowsky, who developed the implosion mechanism of the atomic bomb in WWII. Dick's research in gaseous detonations needed instruments available only in the astronomy department, so that he became a steady visitor on bicycle to those facilities. At EXXON he's done basic and applied work in air pollution, shale oil production, radiation chemistry, combustion, and other areas of interest to a petroleum company. His biggest coup, perhaps, was discovering that deadly NO_x would break harmlessly into N_2 and H_2O when NH_3 was injected at the right temperature point in a polluting exhaust. This "Thermal DeNO$_x$" system is now used worldwide.

Writing came about in an almost Holmesian inverse way. That famous detective wondered "why the dog *didn't* bark." The standard beginning for a writer is to turn something out with elements pleasing to himself. In Dick's case, he wanted to please his wife, who liked stories with strong female characters who had all manner of fantastic adventures. In the absence of ERA regulations, the supply of these was strictly limited. Hence the creation, first, of Gertrude Eisenstein, cleaning-lady master-spy for the CIA, and then of Tiana Highrider, a red-haired vixen who captains a pirate ship. In addition to athletics and weapons handling, Ms. Highrider has to use her mind to survive mysterious dangers. Dick feels that as long as *he* has to solve problems at work every day, *she* should have to live by her wits, too. A trilogy in collaboration with Andy Offutt resulted, culminating in the *Web of the Spider* (Timescape, 1981). ■

Richard K. Lyon



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the reference library

By Tom Easton

The Engines of the Night, B.N. Malzberg, Doubleday, $10.95, 199 pp.
The Gardens of Delight, I. Watson, Timescape, $2.50, 191 pp.
Pictures at an Exhibition, I. Watson, ed., Greystoke Mobray Ltd., £1.25, 166 pp.
Fall Into Darkness, N. Yermakov, Berkley, $2.50, 296 pp.
No Enemy But Time, M. Bishop, Timescape, $16.95, ? pp.
In the Shadow of Omizantrim, R.E. Vardeman and V. Milan, Playboy Books, $2.50, 222 pp.
Water Witch, C. Felice and C. Willis, Ace, $2.50, 216 pp.
Beauty, R. McKinley, Pocket Books, $1.95, 247 pp.
Software, R. Rucker, Ace, $2.25, 212 pp.

Oh, my. Now I know what they mean when they say book reviewing has its occupational hazards.

I'm getting hate mail. A certain writer has sent letters to both me and Stan, objecting most strenuously to having his book called a "potboiler." "What do you mean?" he screams. "Here I've got a formula that works, people are buying the books like mad, there's talk of a Japanese movie, and the pot on my stove stays full to overflowing." (I *do* paraphrase.)

And then he offers Stan and me a pot of tar apiece and an old feather pillow to share. I feel moved to defend us—a "potboiler" is not necessarily formula hackwork; it is a book written to keep the pot on the stove boiling away; that is, it is a book written mainly for money. That is *not* a bad motive, but many writers seem to feel it is not *enough* of a motive to stay in this heart-breaking business. I suspect the letter-writer shares that feeling in his heart of hearts; otherwise, he wouldn't sound—and presumably feel—so defensive. And that despite his financial success. It is a fact of the market that the pure entertainer —long may he live!—sells more books than the writer who tries to add in a bit of art or even of education.

Is there anything to put on the other side of the ledger? Not surprisingly, I've had some very nice notes from writers whose books I've praised. More surprisingly, a couple of writers have actually admitted that some of my negative remarks are justified. It *does* balance out. And too, many writers say any publicity is good publicity.

I said writing is a heart-breaking business. The best documentation of this claim I can offer is Barry N. Malzberg's **The Engines of the Night.** Like Silverberg and others, Malzberg has pub-

licly resigned from the writing of SF at least once. Like most such retirees, he has returned, unable to give up what can only be compared to an addiction. (Those who stay away don't seem to trumpet their leaving.) But Malzberg is more vocal than the others. He has continued to curse the publishers who pay in pennies, promote only in Outer Mongolia, and cheat on the royalty statements. He also curses the fans who praise the writers both uncritically and for the wrong—even insulting—reasons. His voice is a scream of anguish for the damage writing—perhaps especially the writing of SF—does the writer, driving him to drink, divorce, and dementia. All who are familiar with Malzberg's work know this scream. It is the cry of a scalded cynic, and it is a cry of truth.

How much truth is there in this book? Let me quote the last four paragraphs:

" 'We've tried,' he says. 'I want you to know that, that even the worst of us, the most debased hack, the one-shot writer, the fifty-book series, all the hundreds and thousands of us who ever wrote a line of this stuff for publication: we tried. We tried desperately to say something because we were the only ones who could, and however halting our language, tuneless the song, it was ours.

" 'We wanted to celebrate, don't you see? We wanted to celebrate the insistent, circumstantial fact of the spirit itself, that wherever and in whatever form the spirit could yet sing amidst the engines of the night, that the engines could extinguish our lives but never our light, and that in the spaces between we could still thread our colors of substantiation. In childhood nights we felt it, later we lost it, but retrieval was always the goal, to get back there, to make it work, to justify ourselves to ourselves, to give the light against the light. We tried and failed; in a billion words we failed and failed again, but throughout was our prayer and somewhere in its center lived something else, the mystery and power of what might have been flickering.

" 'In these spaces, in all the partitions, hear our song. Let it be known that while given breath we sang until it drew the very breath from us and extinguished our light forever.'

"And then, in hopeless and helpless fury, Ruthven pushes aside the microphone and cries."

Ruthven is the creator of a multi-book series, beloved by the fans, prosperous—and turning ever more to a defensive alcoholism. There may be more truth to his con speech than in all the rest of the book. It justifies Malzberg's scream. It explains it. And it deserves an audience.

Ian Watson has a pair of interesting items for us. In **The Gardens of Delight,** the starship *Schiaparelli* lands on a strange world that seems to embody the perfervid imagination of Hieronymus Bosch. There are the Gardens, Hell, and Eden, through which prior colonists endlessly cycle, after each death reawakening in the next zone. Over all, there presides a god, and the purported rationale is the evolution of the individual to god-like perfection.

Ship psychologist Sean Athlone, whose name is significant, becomes a probe. His very name is the "Great Work" of alchemy, and the Boschian landscape is an alchemical metaphor. Yet there is the god, which Athlone sees as a mere powerful alien and seeks to understand in mundane terms. Eventually he meets the god-alien, and finds it and its kind are one of the manifold potentials emitted by naked singularities. He learns of its efforts to reenact vanished sentient species and of its joy

to have live sentients to study. Yet he never learns the whole truth, one that surprises even as it fits.

Gardens is a strange book, as strange as Bosch's original painting. But Watson has handled the imagery well, emerging with a story that could stand discussion in terms of Bunyan and Dante. It's an allegory that denies itself even as it says perfection of the soul is possible. Try it on.

Watson's **Pictures at an Exhibition** is an original anthology assembled not long after he finished *Gardens*. Like the novel, each of the stories takes the reader into a painting. By Stableford, Bishop, Langford, Watson, and more, none are as explicit as *Gardens*, but all are interesting, in part for their frame: a piecewise recounting of the meeting of two living, human-descended spaceships, one's synthesis of a human representative, his meeting with the other's female rep, and their mating. The stories are visions meant to program the reps with a sense of humanity and to inform them of their roles. As such, they fit together admirably, so admirably that in fact this anthology deserves the name of novel.

Clearly the stories here are akin to every SF story ever written around a cover. But Watson was more ambitious than those editors of eld. He, in effect, provided both the cover and the interior illustrations, and then he orchestrated the writers themselves. Did he assign their topics? I don't know, but I don't see how he could achieve the results he did without considerable discussion. The writers may even have had to confer as well, making this a committee novel, but one much more tightly knit, more coherent, and more impressively effective than, say, Asprin's "Thieves' World" series.

With luck, the book will have an American publisher by the time you read this. Don't miss it.

Nicholas Yermakov has been doing some nice work. Now he gives us **Fall Into Darkness,** a book whose setting is so traditional as to be trite. Novi'kavkaz was once a colony of Earth, a world with a high technology of its own. But the past is a memory and the workings of its marvels are forgotten. Laser pistols and computers remain as heirlooms, neither repairable nor replaceable. Civilization is falling fast to barbarism, and the foot on the accelerator belongs to J'endar, a power-mad populist and crime lord.

J'endar's aim is first to weaken the feudal nobility by destroying its elite guards and champions, the Z'kazans. He thus takes advantage of a Z'kazan scandal to try to rouse the people against his targets. When Z'kazan S'rakhin is banished with his family from the city, J'endar sends assassins after the man, his wife, and his two young sons. They kill the wife. Later they kill the ravaged husband too, but the boys escape.

I call the setting trite, and that is so. But the treatment is not, by far. Yermakov follows his young survivors into piracy and gypsydom, focuses on their growth and their eventual acceptance of mission: to seek their parents' murderer. They return to the city just as J'endar's revolution is coming to a boil, and they play a part in foiling it. Yet they are neither superheroes nor grand leaders of men. They are people of honor, destiny, tragedy, and love. They act decisively, but their satisfactions lie elsewhere and the achievements they dream of have little to do with power.

Yermakov's grandparents were Russian. He speaks the tongue himself, and he shares the spirit. It shows here, for

not only does he use the Georgians as the rootstock of his characters and Russian as his source of names and special terms, but the novel itself has a kinship to the "Russian novel." (Sorry, Nick! I hope that's *not* a kiss of death!) I enjoyed it, and I think you will, too.

Picture, if you will, a time machine that can project you into *a* past, a duplicate of the true past, but one that has stayed with its geographic locale as the Earth has perambulated around the galaxy. No paradoxes are possible.

How does the machine work? It won't carry just anyone back anywhen. The passenger must be a very peculiar sort, one who dreams of the past, and dreams true at that. Such a person is Joshua Kampa, a.k.a. John-John Monegal, whose dreams observe the Pleistocene of Africa and *Homo habilis*. Discovered, he is recruited as chrononaut and sent back. Marooned for two years, he joins a tribe of habilines, marries an evolutionary prelude, and fathers a daughter. Finally, he returns to find only a month has passed in the "present."

This is the story of Michael Bishop's **No Enemy But Time,** but it is hardly the whole of it. Bishop spends much time on Kampa's background—born to a mute whore of Seville, adopted by an Air Force noncom, raised an Air Force brat, a dreamer who links himself to an anthropologist dedicated to the question of human origins. Kampa comes alive as an individual, even if his attitudes and acts do not always seem rooted in known talents or abilities or inclinations.

But Kampa is the only character who does come alive. All others are at least a little stiff. Some are outright caricatures. The book is not faultless, but it *is* overall a pleasure to read, and no one should be surprised if it cops a prize or two. Its treatment of anthropology is so effective that the few flaws are easily overlooked.

Robert Vardeman and Victor Milan have been busy fellows. They devised an idea for a series, *The War of Powers,* sold it to Playboy Books, and got to work. Book Five, **In the Shadows of Omizantrim,** is the latest. Number Six, *Demon of the Dark Ones,* should be out by the time you read this.

The City in the Sky is the series' centerpiece. Floating in the air ever since it was built by the reptilian Zr'gsz, it is now held by humans led by Queen Synalon, evil and sorcerous usurper, and defended by elite eagle-riders. Moriana, Synalon's sister and the rightful Queen, is in exile. She believes her lover, Fost Longstrider, is dead, killed by her own hand in the struggle for a magical jewel in a glacier-buried city. But he lives, he does, and—in company with his jug-dwelling ghost, an ancient philosopher who preached asceticism while alive but now raunchily repents—he seeks Moriana.

They finally meet. With the help of the remnant Zr'gsz, they capture the Sky City. Synalon escapes. The Zr'gsz begin slaughtering humans, foes and allies alike, as they awaken the demon imprisoned in the City's bowels. Moriana and Fost escape. And so on, for Vardeman and Milan alone know how many volumes.

The authors play with magic, sex, adventure, tragedy, comedy, and fate. The story is boisterous and bawdy, and it takes itself none too seriously. It is therefore great fun for the reader, and with a little luck the authors are making plenty of money.

Yes, the money's there, folks. But it's not the only excuse for these books. These authors enjoy their work, and if

I dared to call the books potboilers, they'd laugh and cry, "Of course! But look at the fun we're having!"

I do have the feeling my letter-writer doesn't enjoy his work nearly as much. At least, if he does, it shows in neither his books nor his letters.

Water Witch, by Cynthia Felice and Connie Willis, is set on a dry world whose water is managed by hereditary dowsers, water witches with the extrasensory ability to know where lie every drop and flow. A coup topples the ruling family, last of the dowsers, and installs those who trust the computers. But the computers are inadequate without a knowing mind to guide them, and disaster threatens.

Into this scene steps the charming waif Deza. Her father, a con man who had earned their living by telling people that she was the last true water witch, is dead. She is alone, cast upon her wits for survival. And she *is* a water witch.

It is clear early on that she is the infant princess who escaped the coup with her father. The rest of the story exists solely to restore her to the throne. There's nothing wrong with it, either, for it offers plenty of intrigue, conflict, and action.

Yet the story has two basic problems. The water sense, of course, is one. The other is a driving force in the story: gembone, the fossilized bones of dead goatlike *mbuzi* turned to jewels by the crystallization of mineral-laden ground water. So far, so good, but Felice and Willis tell us that the hooves of a live mbuzi can "fossilize" as well. What's wrong? Well, for starters, fossils are the remains of *dead* organisms, by definition. For another, there's no way ingested ground water could deposit its minerals in hooves, for hooves are essentially lifeless, without access to the body's fluids, just like hair or fingernails. In fact, they *are* nails, which in turn are sheets of joined hairs, and they have no relation to bone at all.

I quibble. Yes. I pick nits that should affect no one's enjoyment of the story, not even mine. But a flaw is a flaw, and one mission Stan gave me with this column was to comment on the "science" in science fiction.

Two short notes: Robin McKinley's first novel, **Beauty,** is an effective retelling of the story of Beauty and the Beast. As far as my memory goes, it departs from the original very little except in length, wealth of detail, and richness of characterization. The flavor is there, too, and the book is surely a boon for all those who once wished for a longer version.

Rudy Rucker's **Software** concerns the battle of the Big Boppers, robot factories, hotels, and spaceships, for the minds of their smaller fellows, and even for the minds of men. They promise preservation of software—mind, to men—in eternal bodies. They gain their own aging inventor, but not all others are convinced.

The tone is less antic, more sedate, than in Rucker's earlier books. It resembles Goulart more than Wilson, but a darker Goulart. The antics are those of a wake, not a circus, and the message is antireligiously paranoid. ■

● A hen is only an egg's way of making another egg.

Samuel Butler

brass tacks

Sir:

Your (January 4, 1982) editorial, "The 'Moral' 'Majority'," brings out many good points; I'm with you at least 90%. On this subject there's a lot more to be said, particularly if you treat the general case of the mechanisms by which individual behavior is constrained by all the varied influences and power structures within a society. A comprehensive treatment would fill a number of weighty tomes.

Let's simplify. We can categorize many of the constraints affecting each of us in three groups. The first contains those constraints due to our own internal sense of right and wrong, our conscience if you will. The second contains those arising from what we are *told* is right or wrong, whether by a religious organization, a peer group, or any other external source. The third contains those arising from our perception, not of right and wrong, but of legal and illegal. These constraints are backed by the power of the civil government, the state, which reserves to itself the more forceful means of coercion.

I feel the point of your editorial might have been sharpened had you focused specifically on the civil government, asking, "What constraints on individual freedom should we (society) use the power of the state to enforce?" And "Why?"

Phrasing the question in this way makes it easier to avoid the fundamental fallacy, the implicit proposition that "If it's wrong, it ought to be illegal." Once the "MM" slips that by you, you're well on the way to accepting a theocracy.

As for the "MM", which I think of as the Mullah Majority, surely it's easy enough to understand. Suppose you were a religious evangelist. (Sorry about that, but suspend your disbelief. . . .)

And suppose that, while successful by any standard, with thousands of followers to whom your every word is gospel, you've . . . peaked out. Your most fervent exhortations, your best PR work — all it can do is hold you up there. It can't increase your following. What to do? You're too young and ambitious to rest on your laurels.

Obviously, what you can do, either individually or in a consortium with others in the same dilemma, is to bid for political power. Not by running for office yourself—you might lose!—but by offering your loyal followers as a voting bloc to whoever makes you the best offer. Not in money—don't be crass. But you can find some candidates who will offer you their help in putting some of your teachings into law, throwing the power of the state your way. Then you won't have to persuade people; you can *force* the entire population to follow your tenets. What a trip! Iran, here we come. . . .

Finally, I'd like to offer you another formulation to compare with your proposed guideline. (My reservation as to your guideline is that it seems to need extension to cover actions which present a *clear and present danger* of hurting someone else. Would you refrain from interfering with the driver going 90 mph through a playground until *after* he'd killed someone else?) Here's my proposal—

Every human being should be responsible for the foreseeable consequences of his actions.

Yes, that's right. The guy who has more foresight should be more responsible. And, incidentally, the guy who leaves a pistol by his bedside so that his seven-year-old can (accidentally!) kill a playmate should be charged with some degree of homicide. And so on, and so on.

As a guideline, I like it. But I don't believe in ultimate or universal formulations. My favorite curse is "May you live in a land where everyone follows the golden rule . . . and they're all masochists."

WARREN RAYLE
6880 Columbia Rd.
Olmsted Falls, OH 44138

Stanley:

The next time you write an editorial on a group or person, I hope you know more about it than just a dictionary definition of its name.

Referring to the January 4 editorial on the "Moral" "Majority," how would you feel if an editor wrote a derogatory letter about *Analog* with only the definition "summary" in mind from his vest-pocket reference? I imagine you'd feel slighted.

From reading the logical reasoning from the conclusion of your article, I think you would agree with many of the premises upon which the Moral Majority stands. One way to find out is to send for the *Moral Majority Report*, from 500 Allegheny Ave., Lynchburg, VA 24501.

CAROLYN CLEAVELAND
Gatesville, TX

We might well agree on some points, but it seems pretty clear that we disagree sharply and very importantly on when and how people should control the activities of others. This view is supported by every bit of news coverage, including many direct quotes, I've seen concering this organization (which, by the way, was not *the principal subject of the editorial, as you'll discover if you reread it with careful attention to capital and lower-case letters). On the chance that they've been consistently misquoted and misrepresented, I took your advice and wrote for their version of the story.*

That was eight weeks ago yesterday, and I have yet to receive the courtesy of a reply.

Incidentally, "analog" does not mean "summary."

Dear Sir:

I enjoyed your discussion in the January issue about the "moral majority," and your proposal of a rational moral law that would permit freedom of action "unless it hurts someone else."

Perhaps you have forgotten it, or perhaps it was before your time, but I recall reading a science fiction story decades ago in which the author set a human culture on an isolated planet and used this gimmick to explore the concept that with truly intelligent beings only two laws would be needed.

One law was expressed in the simple admonition DON'T ANNOY OTHERS, although this was interpreted in practical matters to include all kinds of physical, mental, and functional "annoyances." The second law was a converse of the first, DON'T BE TOO EASILY ANNOYED, and in application this second law was given equal weight. For example, any person invoking the first law against another automatically invoked the second law against himself.

The catch, of course—although the author of that interesting story did not bring it out—is that all humans are NOT "truly intelligent beings," so the author's concept could not possibly work. Nor could yours, unless you first wiped out about 90% of the "human" species, the part that is incapable of truly intelligent (versus instinctive) behavior.

As you pointed out, those who would tell the rest of us how to live have always been with us. The other side of the coin is that, so long as the species *homo homo* exists, they always will be with us. No amount of rational thought or discussion can possibly influence "irrational" humans, any more than it could influence a cat or horse or mouse, and for the same reason—genetically based limitations.

The so-called "human" species is not genetically uniform, any more than the canine or feline species is each one species and uniform. Although they are highly reluctant to publicize it, modern bioscientists have plenty of evidence on hand that shows that the human gene pool still contains elements of every human subspecies that ever existed, including many that supposedly went extinct megayears ago, and including *homo* subspecies whose intelligence level was barely above that of other clever animals. Each "new" human subspecies could and did interbreed with every available "old" species. Could anyone doubt this, knowing the human male penchant for "jumping the bones" of anything he can hold onto for long enough?

Add to this great genetic diversity, this immense potential variety of human form and function, the further variability brought on by environmental mutagens and the randomizing gene-selection mechanism only recently discovered, and it is inevitable that within the species *homo homo* individuals will vary wildly in many ways, including functional intelligence or "rationality."

This variety is a prime species-survival mechanism, but it poses an insurmountable problem when it comes to collective "rational" behavior, or to formulating laws (moral or otherwise) for codifying rational behavior. The human species is simply NOT uniformly rational, as you would define the term intelligently, although for the species — which is all "nature" really cares about —human diversity and "irration-

ality'' is survival. This can sure be tough on individuals, though!

FRANK COX

P.O. Box 963
Moab, UT 84532

Between the lines, your letter suggests an interesting possibility which I started playing with years ago; and I think it still bears thinking about. If wiping out 90% of the human species would do it, so would isolating *the 10% you'd have survive. And it's not inconceivable that space travel will eventually make that possible.*

Dear Stanley:

Some years ago, when the Peaceniks were throwing their tantrums about the war in Vietnam being immoral, I demanded that they define what they were talking about. They were unable to define morality, so I defined it for them.

Morality in general is rules for survival. If one violates any of the Ten Commandments or the Golden Rule some intolerant S.O.B. is liable to kill you. Therefore, if one wishes a long life, one should not violate these rules, or at least be discreet in doing so.

Sometimes, for survival of the group, it is necessary that individuals die. This conflict between survival of the group and survival of the individual is what confused the Peaceniks.

I agree with your editorial. A lynch mob is pure democracy in action. I'm happy to live in a republic where there is protection against the tyranny of the majority. It is immoral to inflame a mob against oneself. Recent events in Skidmore, Missouri, are an example of this.

The Moral Majority is immoral where it pushes too far. Enough nonsense will cause someone to get fed up enough to consider eliminating one or more of its leaders. The ''Moral Majority'' in Iran seems to be having that problem.

PERRY W. OLIVER

St. Joseph, MO

But if you equate morality with survival, a sniper who's a crack shot and clever enough not to get caught is the very epitome of morality! Sorry; I can't buy it. And while there can be conflicts between survival of the individual and survival of the group, don't be so sure that the ''Peaceniks'' were the ones (or the only ones) confused. It has yet to be demonstrated incontrovertibly that that war had much to do with either.

Dear Mr. Schmidt:

Close. You came so very close in your editorial in the January issue that I kept thinking you would put your finger on the key in the next paragraph — until you stumbled into the blind alley of ''hurt.'' True, you recognized the dilemma, but that recognition failed to lead you out.

Neither do I lay claim of originality on the answer; but for a solution to the question you pose, may I refer you to the works of Ayn Rand. She formulated a system of morality that leans not on divine revelation but on the single assumption ''that A equals A—A does not equal non-A.'' That is the one and only assumption in her philosophy. From there absolutely every one of her conclusions follows with flawless logic. And from it she derives a rule for an orderly and moral society.

That is, ''No man (and that means everybody—female chauvinists be damned) has the right to initiate force against another.'' The corollary of this is that ''If a man does initiate force, the recipient has the right (and in many cases the duty) to answer in kind.'' This serves society, since instead of reinforcing the initiator's behavior by gratifying whatever desire that prompted it,

he learns that such behavior makes lumps on his head.

Under such a system the "Moral Majority" would be free to rant from whatever soapbox it could afford to convince people to live the way they deem "right." But they would not be allowed to pass laws that cause the police to use the force of their guns and jails to demand such behavior from others. And your easily offended relative would have no claim to "hurt" unless you bound him in place so that he could not leave and thus avoid your objectionable (to him) remarks.

I submit that the above is the answer to the question you raised, and would be very interested in your thoughts on the subject, either in print or private reply.

ED ORR

Box 396
Jerome, AZ 86331

I wouldn't say it's the *answer (I doubt that there is a single definitive answer), but it's surely another good guideline to keep in mind.*

Dear Dr. Schmidt:

Your January editorial on the "Moral" "Majority" was admirable and I would not disagree with a word of it. However, your reference to the fixed nature of pi reminded me of a little puzzle (or quibble) which might amuse your readers:

Where on Earth is pi *really* equal to 3.000? The answer is dependent on non-Euclidean geometry, but not limited to two tiny points like the poles; it is quite extensive. Give up? It is the two 60th parallels of latitude. The reason is that Euclidean geometry is not really valid on a sphere, except on such a tiny scale that the surface approximates a plane. For an easy demonstration take the Earth's circumference at the equator to be 24,000 miles; then each of the parallels is 12,000 miles long, and its "diameter" measured on the SURFACE is 4,000 miles. Yes, I know the real numbers, but they are messy and these are close enough.

By the way, I started on *Astounding* just about 50 years ago while a student at Cal Tech—you surely have come a long way! Keep up the good work.

ALAN BEERBOWER

San Diego, CA ■

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30 July - 1 August
SPACE: 1999 CON at Springfield Marriott Hotel, Springfield, Mass. Registration—$18; ($12 for those under 14). Info: Chris Landry, 12 Maplewood Terrace, Springfield MA 01108.

6 - 8 August
GALLIFREY ONE (Doctor Who convention) at the Holiday Inn, Ottawa Centre, Ottawa, Ontario. Registration—$20. Membership limited. Info: Gallifrey One, 64 Piedmont, Touraine, P.Q., Canada J8T 1W2.

6 - 8 August
SUMMER MEDIA FEST, multi-media fan convention, Rosslyn, Va. Registration limited; $10 plus three S.A.S.E.s. Info: Summer Media Fest, Glendale Lake Apts., 10019 Greenbelt Rd. #303, Lanham MD 20706.

6 - 8 August
OMACON (Nebraska-area SF conference) at New Tower Inn, Omaha, Neb. Guests of Honor—Frederik Pohl, Jack Williamson. TM—Wilson Tucker. Artist Guest of Honor—Steve Gray. Info: Omacon, Box 14105, Omaha NE 68124.

13 - 15 August
CON-GENERIC (Oregon regional SF conference) at Greenwood Inn, Beaverton, Ore. Guest of Honor—Marta Randall. Registration—$7 in advance, $9 at the door. Info: CON-GENERIC, P.O. Box 12728, Portland OR 97212. 503-236-1366.

13 - 15 August
VUL-CON IX, science fiction and fantasy convention, Airport Hilton, New Orleans, La. Info: Vul-Con IX, Box 8087, New Orleans LA 70182.

15 - 19 August
ASME Second International Computer Engineering Conference and Show at San Diego, Calif. Info: Irwin Berman, Foster Wheeler Development Corp., 12 Peach Tree Hill Road, Livingston NJ 07039.

2 - 6 September 1982
CHICON IV (40th World Science Fiction Convention) at Hyatt Regency Chicago Hotel, Chicago, Ill. Guest of Honor—A. Bertram Chandler; Artist Guest of Honor—Frank Kelly Freas; Fan Guest of Honor—Lee Hoffman. Registration—$15 supporting at all times. Attending—$50 until 15 July 1982, higher 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: Chicon IV, Box A3120, Chicago IL 60690.

—Anthony Lewis

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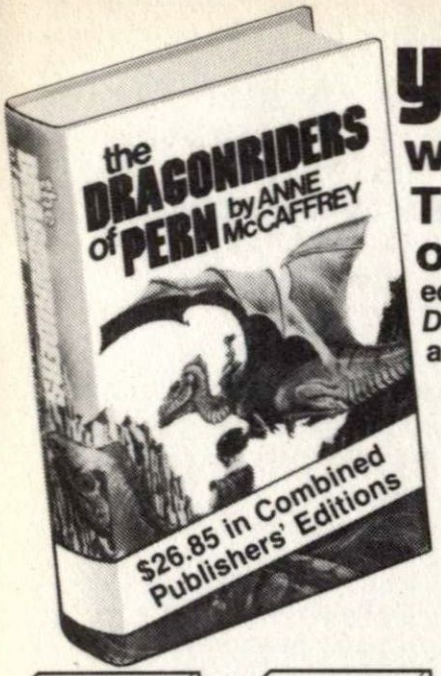

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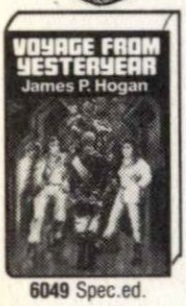

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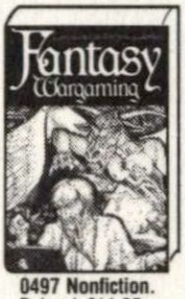

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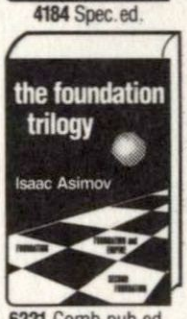

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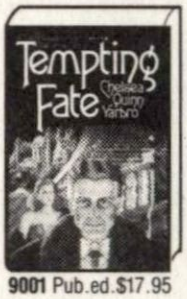

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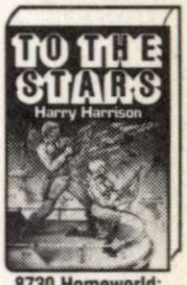

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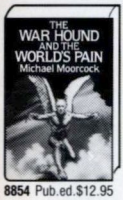

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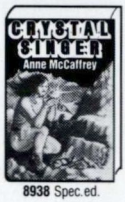

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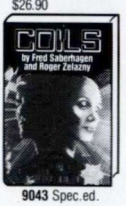

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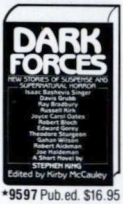

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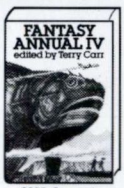

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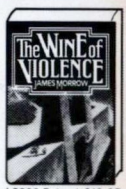

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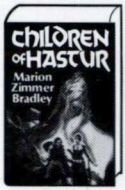

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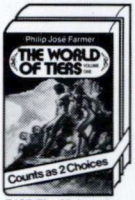

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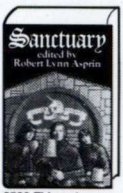

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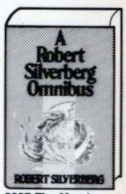

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