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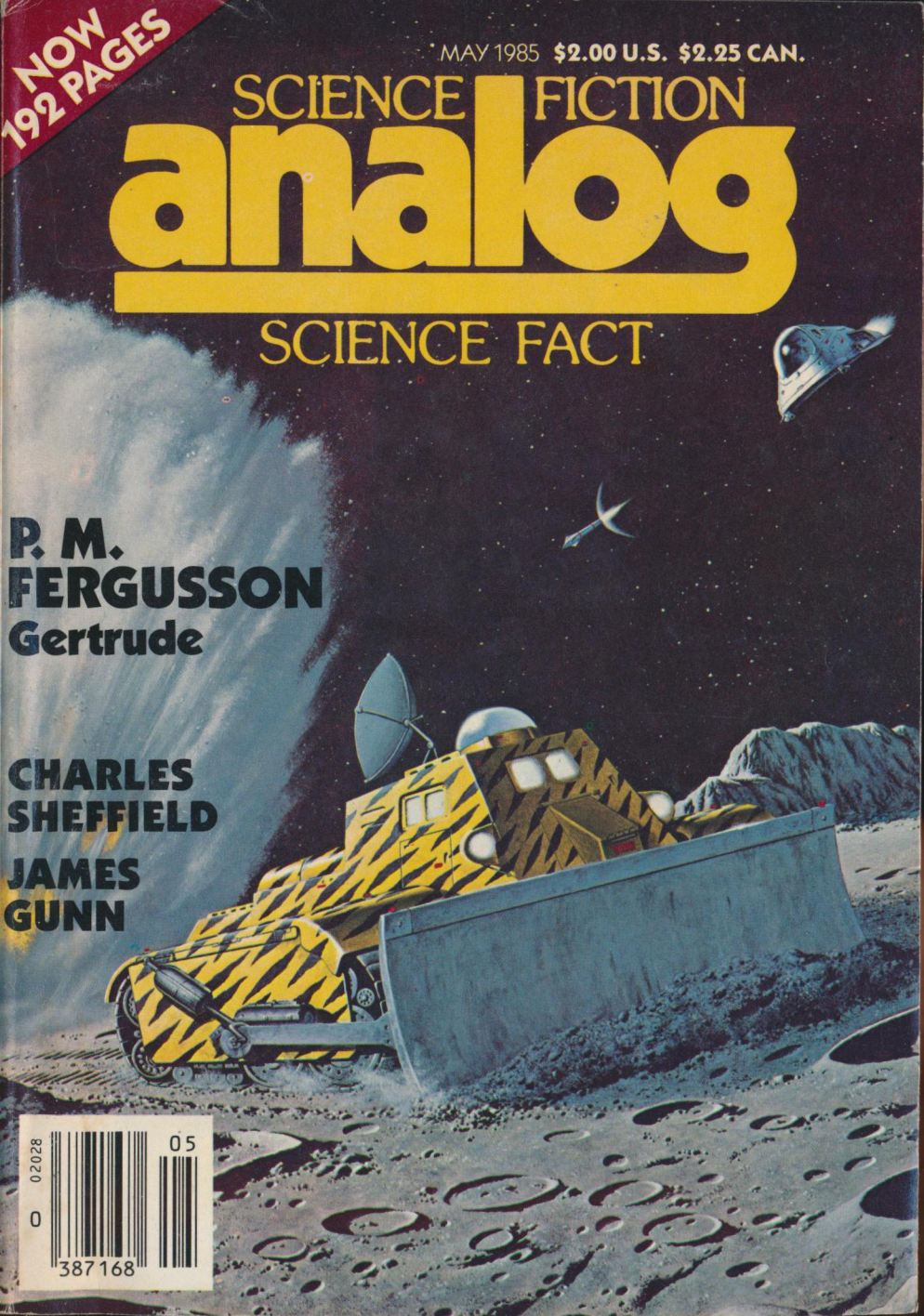

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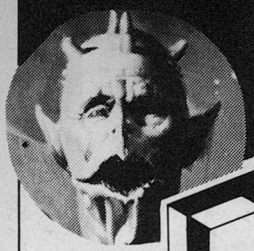

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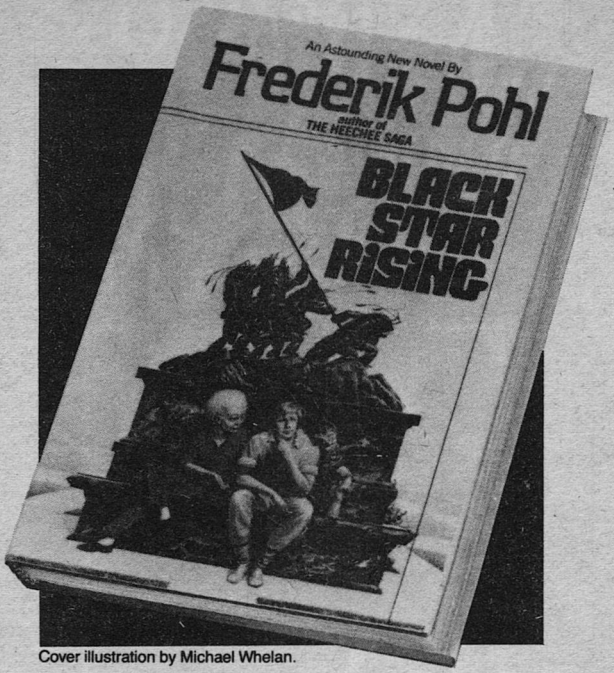

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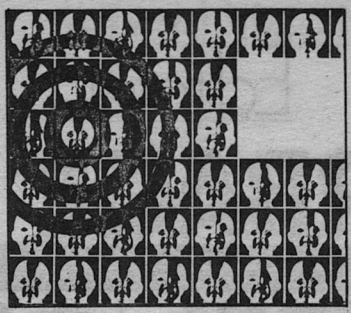

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Editorial

GARBAGE IN, GOSPEL OUT

Stanley Schmidt

The ancient Greeks had an exceptionally convenient way of foretelling the future. A Greek politician or businessman who needed information on which to base decisions needed only go (with appropriate offering) to an oracle such as the one at Delphi, where a priestess delivered personalized prophecies. According to some modern scholars, she was probably drugged; according to the faithful of the time, she had a hotline to the gods. Either way, everybody seems to agree that her prophecies were delivered in no ordinary terms. To the ancient Greek layman, they sounded like incoherent ravings—but no problem: trained priests were on hand to interpret the ravings and provide written summaries of what they meant, in practical terms, to the client. And they were seldom, if ever, wrong (which just may have something to do with the vagueness of the language in which they were couched).

We today also have exceptionally convenient ways of foretelling the future —or, as we prefer to call it, analyzing data and extrapolating trends. We don't have oracles (most of us don't, anyway; some frequent tea leaf readers and such), but we do have powerful and sophisticated computers. Scientists depend on them to determine what research data mean; engineers use them for design techniques that are too time-consuming to do by hand; businessmen and politicians use them for everything from

bookkeeping to demographics and marketing studies. As with the Greek oracles, the question must be put to the machine, and the answer received from it, in specialized language which means little to the uninitiated user of the computer's services. But again this is no problem, for highly trained experts are on hand to get data in and results out in a form the client can understand (in exchange, of course, for a suitable offering).

Elsewhere in this issue of *Analog*, G. Harry Stine has some thoughts about "The Computer Mystique." Actually, I submit, his Alternate View deals with only one aspect of the computer mystique. The parallels I have already drawn between Greek oracles and modern information services suggest others. Perhaps the most important is the common tendency for users of both to treat the information they receive as divinely inspired, infallibly interpreted, and therefore unquestionable.

Unfortunately, it ain't necessarily so. The people who *do* the interpreting usually realize this. They have a saying among themselves that eloquently reminds them that what they get out of a computer is only as good as the data and programming that went into it: "Garbage In, Garbage Out." This motto is so well and widely known that it is often referred to simple as "GIGO." But too many indirect users of computers—and occasionally even direct users who know better but forget themselves—seem to believe GIGO means "Garbage In, Gospel Out." Or, "If it came out of a computer, it's *got* to be good!"

When I broached this thought at a recent convention, a member of the audience came up afterward and said, "Do you really believe anybody actually feels that way?"

"Of course I do," I said. "I've been seeing it every day for years." And so, I suspect, have you. Most of us remember the Club of Rome's *Limits to Growth* study of a few years back, and the bleak resignation with which so many accepted its gloomy forecasts; you may also remember the cheery relief with which many grasped at other studies purporting to refute the Club of Rome. You may have known people who never bother to check computerized bills because they assume the computer will make sure they're right. I remember a case from my own experience in physics research where an experiment with appreciable statistical uncertainties was expected to yield a six-line spectrum, and with some contortion of the imagination it *was* possible to see six lines in the data, though they were of rather bizarre sizes and shapes. The computer obligingly fit six lines to the experimental points—it would fit any number of lines you asked it to—though it was also obliged to apologize for the sloppiness of the fit. It wasn't until quite late in the project that it occurred to anyone to question whether six lines was really the correct number. When we rethought the physics of what was actually producing the spectrum, we realized that what we were seeing was really a superimposition of *different* spectra from nuclei in at least two nonequivalent types of sites.

My skeptical listener at that convention, it turned out, was a programmer, and as such found it difficult to believe that anyone could have unquestioning faith in computer outputs, when so much time in computer work is spent exterminating bugs in both hardware and software. But only people who have actually worked with computers know that. Others may have *heard* about it, but hearing that a thing happens is not even remotely as convincing as experiencing it. If you let somebody else do all your data processing, it's all too easy to believe that the Experts will have all the bugs out before they analyze *your* data. If you believe that, your scrutiny of the results is likely to be a bit perfunctory. You may not bat an eye when a study you've hired a consultant to do comes back with a figure that is not only *wrong* by an easily demonstrable factor of three, but could not possibly be derived from a correct analysis of the questionnaire on which the study was based. Even if you happen to see firsthand one of those rare horror stories we've all heard—like the gas company sending you a bill for $24,921.36 instead of $24.92—it's easy to assume that there was a spectacular fluke, and the rest of the time everything hums along just fine and dandy.

The obvious danger in all this, of course, is that a person who places too much blind faith in computers will base his actions on wrong information and thereby produce results quite different from the ones he wanted. If those results affect only him, it's strictly his problem and his responsibility to solve it. But often such a person is in an influential position where his actions affect many others, and then it's everybody's problem. And the problem is *not* caused by computers, but by people who consult computers with attitudes not very different from those with which people consulted Greek oracles.

There is a real and important difference between oracles and computers, and a less obvious and more insidious danger lies in failure to recognize that. I have never seen any evidence that the oracles *really* had an in with the gods, or any other basis for believing that what the priests extracted from their gibberish had anything to do with reality. But the computer, properly used, can really do powerful, useful, well-defined, testable things that are impractical to do in any other way. It can do calculations with enormous quantities of data in previously impossible amounts of time, thereby making it possible to do realistic physical problems requiring numerical integration of awkward functions, simulations of complicated physical or ecological systems, and so on. I can easily imagine some people losing sight of that fact and deciding that since computers are sometimes trusted too blindly, they should not be trusted at all. (I have met people who already have this attitude.) But that's throwing the baby out with the bath water. We *need* the computational abilities of computers. What we need to make good use of them, without being led astray, is neither blind trust nor blind distrust, but simply a realistic recognition of what a computer is.

A computer is not a god, or even an

oracle. It is, as anyone who works with one is well aware, a *tool*. Like any tool, it will do good and useful things in the hands of a user who understands both its capabilities and its limitations. It will do inadequate work, and sometimes even actual damage, in the hands of someone who doesn't understand those things. Good programmers do; their clients often don't. A good programmer understands that a set of predictions like those in *Limits to Growth*—or any of those challenging *Limits*—is not a privileged advance look at what *will* happen, but a great big "if-then" statement whose predictions are very sensitive to what *assumptions* are made. Not everybody has the time or inclination to be a programmer, but anyone who is going to use the results of programming would do well to learn at least enough about how it's done to have a realistic view of how much trust the results deserve —and to understand that that is seldom, if ever, an "all-or-nothing" proposition.

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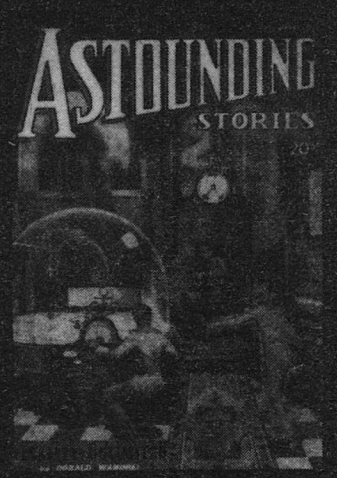
I see one thing happening now that gives me some cautious hope that such an understanding will gradually become more widespread, and that the process has already begun. In the last few years, thanks to the development of microchips, computers have found their way into a large (and still growing) number of homes and offices. Far more people than ever before have actually met computers and conversed with them "face to face." This implies that far more people will have had direct personal experiences both with the impressive things computers can do when they're used well and working well, and with the multitude of ways that both hardware and software problems—as well as human error—can cause them to go wrong. If the popularity of home computers does nothing more than give large numbers of people a clear view of the "god" behind the modern oracle —including the clay feet—it will have done something very useful. And once people have that balanced view, they and their new "partners" should be able to go on to do much more. ■

● Space flight is usually considered a mere expensive race for military advantage and propaganda kudos. To a certain extent this is true, unfortunately, and the undertaking can be attacked on that ground. Some distinguished scientists argue that for the same price we could accomplish far more at home, both in building up our strength and in advancing our knowledge. A few telemetric probes, they say, can tell us as much about the Solar System as we will ever need to know.

This argument is wrong. Militarily, the engineering data that will be picked up in the course of this project are crucial—not to mention the likelihood of learning things we do not suspect at present. As for astronomical research, let us never forget that each planet out there, no matter how barren, is a world infinitely complex and mysterious. No instruments, no television cameras can give us more than a few maddening hints.

Poul Anderson



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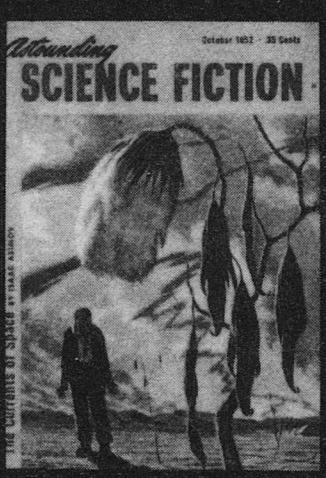

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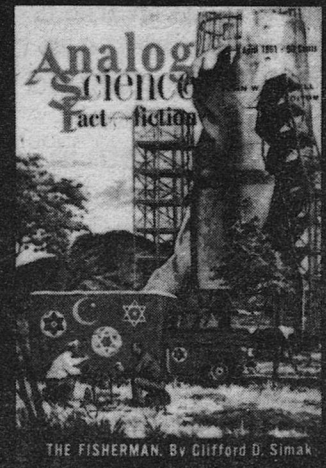

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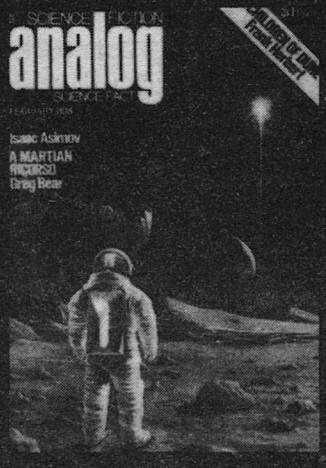

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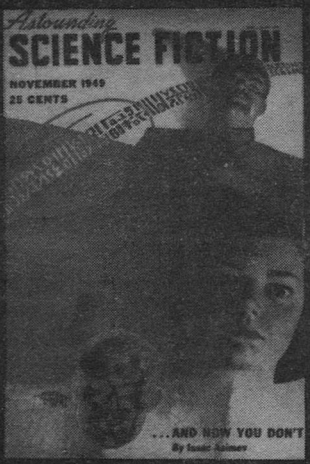

NOVEMBER 1949

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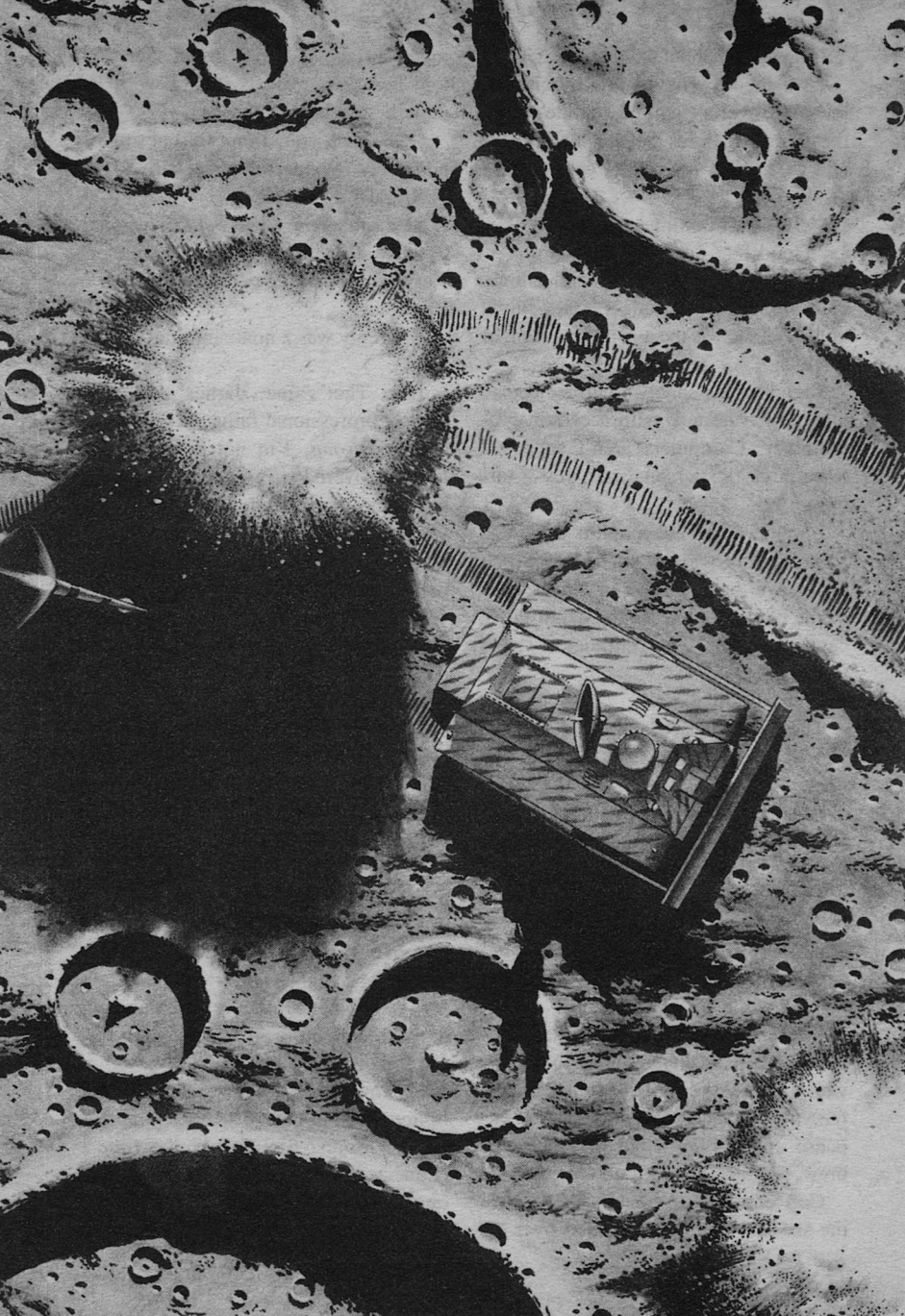
P. M. Fergusson

GERTRUDE

There are those who spend their time grumbling because things don't work the way they're supposed to—and those who learn to *use* the way they *do* work.

Bob Walters



"Bring it right about ten degrees, Gert."

I watched the navigation monitor as the map overlay shifted to line up on the terrain features. When the overlay and the terrain matched I said, "Easy as she goes.

"OK, start cutting.

"Good."

"Of course, Oh mighty and omniscient master." Gertrude's honey blond voice held only the unsubtlest hint of sarcasm.

I ignored the sarcasm but decided to have a private talk with a certain programmer. Computers aren't supposed to be sarcastic: personalized, yes— sarcastic, no.

I watched the cut-monitor screen as a twenty-foot-wide swath of Lunar rock and gravel begin to roll up on the face of the blade. "Increase the depth thirty centimeters in two centimeter steps, Gert."

"You got it, boss."

The cut deepened and the debris began to fold off the right edge of the blade.

"Feels right, Jim. How's it look?"

Gertrude could monitor the displays as well as I could but the personalization program was set to make the controller feel necessary. The manual override controls were there for the same reason. I'd never even heard *rumors* of their being used.

I scanned the monitors, leaned back in the command chair, started to pop the warm-up seal on a bulb of synthetic coffee, then decided to hell with the expense and put on a pot of real, fresh brew, Terran, Blue Mountain.

Coffee in hand I settled in and watched the six foot wide treads crawl over the lunar surface. "Looks great, Gert," I told her, "Keep it as is and we'll be done before beer break."

"Oh thank you, Jimmy. That sounds positively wonderful. You drink the beer and I do the work."

Sarcasm again. I was *definitely* going to have to talk to that programmer. Very, very privately. "Shut up, Gert." I told her.

Her reply was a noncommittal "Yes, Jim."

Jim. That's me. James Arbuckle Carter, professional failure. Hey, don't get me wrong, I'm not complaining. I've discovered being a known failure has some distinct advantages. For instance: except for the occasional professional do-gooder, nobody bugs you too much about *making something of yourself*—and even the do-gooders don't count since to them everyone is a screw-up.

Another bonus is that if you *do* foul something up really bad, unintentionally of course, people tend to blame themselves for assigning the job to you in the first place, rather than climbing your rack for blowing it.

But best of all is that you invariably draw the jobs that let a man relax and think about important things—like how to move some lux fem from the spigot where she hangs out to your tank for . . . oh hell, if you're smart enough to read this, you're smart enough to figure the rest on your own.

So how come a *failure* is running a billion credits worth of heavy equipment on the Moon? Simple. At the time I connected with this job, Lunar development was going bananas. The construction companies were so short-handed

they'd take anyone who could count to four and was breathing. Being recently disemployed, I applied, and two months later I was introduced to Gertrude, all hundred and eighty tons of her.

Bureaucratese being what it is, Gert has a designation about a page and a half long, but to the construction crews she's a smart-blade—a voice commanded, computer controlled bulldozer.

For you readers who have been living in a cave in Southern Baluchastan for the last thirty years or so and haven't seen holos of Mr. Caterpillar's dream machine, a brief description is in order. Gertrude is twelve meters long by six meters wide and powered by a small fusion unit. The motors, two of them, are fifteen hundred horse electrics and move Gert along at a respectable 80 KPH if she's in a hurry. Motors, fusion unit, and life support are mounted between a pair of two-meter-wide tracks. The living and operating quarters sit on top.

The quarters aren't real roomy: a sleeping/relaxing area, just in back of the command chair, connects to a galley on the right and a head on the left. A small store room connects to the back of the galley. A work shop which doubles as an air lock connects to the store room (I could kiss the genius who thought of the last idea. If you've ever had to wait for a lock to equalize every time you have to go back for a tool or part you forgot, you know why.).

Like I said, not roomy but enough to keep you alive and relatively sane for the four weeks you're in the field.

Gertrude is pretty well armored against normal hazards like land slips, falling rock, and micro meteorites—the big ones you don't worry about for obvious reasons. Even the view ports are armor glass sandwiched between layers of self sealing polymer. The armor also adds to her mass, and you need mass to move mass no matter what your gravity well. In fact, the lower the gravity the *more* you need, proportional to what you're moving, to get traction.

Her external paint job is a distinctive, customized, bright red and yellow tiger stripe. It may be garish but it sure is easy to see and identify—an important consideration in an emergency. It's hard to miss even in the rugged terrain of Luna. Gert may look strange, but she does her job and I love her.

If you still think it's strange that a guy known for being a perennial screw-up would be entrusted with a machine as valuable as Gertrude—don't. Gert is so automated there's not much for me to goof up. I'm there just in case something goes wrong and someone has to yell for help. Besides, the tricky jobs are given to manually controlled blades that can maneuver tighter and faster than the computer units. Which suits yours truly just fine.

We were just about finished with the cut when the company command channel beeped obnoxiously. I immediately got that big hollow feeling. Nonscheduled messages usually mean nonscheduled headaches.

I cleared the com screen of its external view and keyed the circuit. "Carter here."

The face of Harry Grenn, terror of the spigots and my less than beloved supervisor, appeared. Normally, Harry Grenn—we call him Old Thumbsucker among ourselves—displays the person-

ality and disposition of a bear with his balls caught in a trap. Today he was smiling. I stopped feeling hollow and started feeling scared. Grenn only smiles at assassinations, executions, and major disasters.

"Jim. How's it going? 'Bout finished with that cut?"

A *friendly* Grenn? My insides tied in a knot and looked for a hiding place. Oh! Shit! I thought. This is a bad one!

"About a day to go," I told him with some misgiving. "Why?"

"Well," Grenn said with his most ingratiating tone of voice and a smile that made me think of a starving crocodile, "to be truthful, Jimmy boy, we have this little problem, and you are in a position to help us with it, log a healthy bit of overtime, and make a big bonus to boot."

I hate being called Jimmy boy and Grenn's approach didn't do a thing to put me in a helpful mood. I had two days to go on this run before I could head back to a delux model redhead waiting for me in Luna City. "Stuff your problem, Grenn." I told him, "OT and a bonus don't mean Moon twaddle if I haven't anyplace to spend it or the time to spend it in. Find some other mush head to work on your 'little problem.' "

Grenn tried to look fatherly, and managed to look disgustingly obsequious instead. "Believe me, Jimmy boy, if I had anyone else in a position to help I'd have called them, but, there's this time element involved and—"

Sometimes I wonder at myself; why can't I learn to keep my big mouth shut? I interrupted "What time element?" The screw-up factor took over in force and I asked, "What the hell is going on?"

I knew I was in trouble when Grenn took a moment to gloat before answering, "It seems, Jimmy boy, that some dissident element has seen fit to sabotage one of the steel carriers bound for Luna. They managed to foul up the nav program and blow the control receivers. The little darling is now off course and out of control."

Steel carriers are nothing more than bundles of steel beams, a hundred meters long by fifty meters in diameter, with robot propulsion units attached. The foundries in the asteroid belt assemble the loads and launch them, either for orbital intercept for Earth or for the magnetic loop catch stations on the Moon. I'd be fried for an asteroid clam if I could see what a sabotaged load of steel floating somewhere between the asteroids and Luna had to do with me. "So what's the big deal, Grenn? We aren't going to starve because one load of steel ends up in the sun."

"It's not *going* to end up in the sun, Jim." Grenn told me coldly. "In nineteen days, give or take a few hours, it's going to impact in a valley about a day's full speed run from here, full speed for your smart-blade that is."

"So what? Who cares toad squat if it plows up a few acres of Moon dust. There's not even a mining camp within two days of here." If I sounded rude, I felt rude. I was getting a sinking sensation that I was about to be had without even a courtesy kiss.

"Nobody *would* 'care toad squat' as you put it, if it were going to stay in that valley—but it ain't. The computer jockeys, who are supposedly experts at

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working out things like trajectories, figure that bundle of steel is going to hit at a very shallow angle, so shallow it's going to ricochet right over the horizon and right into Luna City.

"Several hundred tons of steel beams tearing through the Luna City dome —about that, we very *much* care."

He had a point. That bundle would most likely break up on impact, and even if the self-sealing properties of the dome's polymer retained most of the atmosphere—and considering the velocity and probable behavior of those beams, that was questionable—what those beams would do to the buildings of Luna City was not to be considered. The effect of such a disaster on the million or so people living under that dome was beyond comprehension.

I was beaten and I knew it. "OK, what do I do?"

"I'm glad you agree, Jimmy boy." Grenn didn't even try to hide the sarcasm—not that I expected him to. "What we need you to do is dig a trench to trap that load of steel."

"Do What?!" I'm no hero, and sitting in the path of that oncoming multiton missile was not my idea of a fun way to spend a weekend.

"Dig a trench. You and Gertrude do that very well."

More sarcasm. I about told him to stuff his trench but he launched into a description before I had the chance.

"There is a slope at the far end of the valley. If we dig a trench of increasing depth from the computed point of impact into that slope, that load will bury itself and we can recover the steel at our leisure."

It takes a while to dig a trench of the dimensions I was envisioning, even for a super blade like Gert. Now I know those carriers aren't moving very fast, but, from the time that bit of sabotage had been discovered and its results computed, to the time it was going to impact—right where I was supposed to be working—couldn't be very damn long. If much time had been available they wouldn't be calling on me. It sounded like a pretty iffy operation and I said so.

Grenn was one step ahead of me. "The big brains figure it's pretty close, but you should have a full day's leeway—if you start now."

Should have? Oh, wonderful, I thought. Oh well . . . I took a deep breath and asked, "How do I get the plots?"

"We'll feed one set direct to your smart-blade's computer, along with the nav data to get you to the valley by the quickest route. As backup, we'll have a fast flitter intercept you with a data cube. We want no chance of data error on this job. The specs of this dig are tight. We just don't have the time to make the trench big enough to allow for much error."

Grenn could irritate a saint. At least he could have used Gertrude's name —*Smart-blade's computer* my rosy red. "Is that all, Grenn? No quaint surprises in store?"

"That's it, Jimmy boy. We're dumping data now."

I stared at Grenn's image, and its version of a smile, for a moment then said, "Fine. I'm gone."

"Good, Jimmy boy. Keep in touch, y'hear. We may get further data."

I told him, "If you do, your tracking

computers will know where I'll be." and cut the connection.

"Data received, Jim." Gertrude's voice came over the speakers.

"OK, Gert. Pick your heading and let's get rolling. I've got no desire to overstay our welcome on this next job."

"There's no need to be so emphatic, Jim. I'm as aware of the hazards as you are."

She left the "probably more so" unsaid—but she implied it. I couldn't think of an apropos reply, particularly since I was staring at a blank comm screen. Talking to a blank screen makes me itch. One of these days I'm going to have Gert develop a graphics image so I can see who I'm talking to.

I felt the lurch as we left the cut and headed for a set of low hills. To hell with it, I thought. Gert can find the way without my help. Me for a snack and a nap. A half-hour later I was full and dozing off to Gertrude's gentle sway.

It wasn't a pleasant nap. I dreamed little green men, with pitchforks and Grenn's face, were chasing me on a moon-shaped treadmill. There was something that SOB wasn't telling me, but I was damned if I could figure out what. I'd eventually find out, of that I was sure, but eventually can be very fatal on the Moon. Thoughts like that don't make for easy rest.

I was sweating through the same dream, a day later, when Gert's voice announced, "We've just arrived on site, Jim."

"Wonderful." I grouched.

"And, there's a flit ship showing on my radar. They time things nicely, don't you think?"

My reply couldn't be printed in a family comm-mag so I won't quote it.

"Here's the data cube, Carter. I'm supposed to wait while the computer runs a comparison. We can transfer your supplies while it's doing its thing."

Harry Murphy was a long-time acquaintance and some-time fellow spigot raider. I gave him a wry smile; Gert would be finished long before we would. "There's fresh coffee in that pot. Have some while I suit up and check out."

Harry hooked a cup and poured, then propped himself on my bunk. "Thanks, Carter. How come you rate fresh brew? I can't even afford that in town."

"It keeps me from going crazy, and gets the job done faster and better. The company pampers me."

Harry raised his cup in a salute. "Thank God for pampering." He took a swallow then added, "But then, they'd supply you with liquid gold if they thought it'd be cost effective."

"Hmmmm." I grinned at him. "I never thought of that. Maybe next time."

"Screw you too, Carter." He saluted again. "Hurry up, will you. I wanna get back to Luna city. I got a hot blond waiting."

I guess the conditions were making me jumpy because I snapped, "So put her on a back burner. I ain't gonna skimp safety to satisfy your lust."

"Temper, temper, Carter. Just joking." He put down the now empty cup and got up. "Turn around. I'll help with the checkout."

"Thanks. Sorry I barked at you."

"*De nada*. This mess has got every-

one jumpy. God help us if the general population finds out."

"You mean they don't know?"

Harry stared at me for a second then said, "You gotta be kidding. Can you imagine the panic? We'd lose more people in the rush to get out of Luna city than if the damn thing hit us."

I finished sealing the suit, gave a last check then said over the comm link, "Yeah, you've got a point. Well, zip up and let's get to it."

An hour and a half later we had transferred the fresh supplies to Gertrude and my empties to the flitter. I stood in Gert's hatch and watched Harry seal up. "See you in a few weeks, Carter. I'll save you a redhead." It was a nice sentiment. I didn't like the look he gave me though: it was the kind you reserve for terminal cancer victims. What weren't they tell me?

"Thanks, Harry." I told him. "Keep your seals tight."

"Will do, Carter." He hesitated then said, "And, Jim—uh—we only have nineteen days left till that thing hits—try not to screw up, huh."

It may have seemed a callous statement but with my reputation I understood. There was no malice in it. "Worry not, Harry. I'll let Gert do most of the work."

Harry gave me a highball and lifted. Time to get to work. I turned back into the storeroom and sealed the hatch.

The first two days were easy going—almost boring; on the third we hit hard bedrock. I can handle explosives as well as the next smart-blade pilot, but things that go boom are not, and have never been, my favorite way to make a living. Even with the super safe modern plastiques unexplainable accidents happen.

Anyway, it was drill, set, boom, and blade for the next two days. Gert's laser drills punched eight holes at a time, then the packing tubes set the charges and primed them as fast as I could load. It was a good run, with only one preemie. Gert's blade took the blast and no damage was done, except to my nerves. A few pounds of plastique going off five meters away—even filtered through all of Gert's shock absorbing shielding—tends to rattle your teeth.

We'd used up twelve of our alotted eighteen days when I found out what they hadn't been telling me.

"I have a flitter on the radar, Jim, about twenty kliks out. It's coming in on the horizon and either it's doing a low level search or it doesn't want to be seen."

I'd been napping but I came awake fast. "Why in the hell would it be doing either? Harry's not due for another two days and nobody in their right mind would be flitting around *this* area for fun."

Gert always tends to the optimistic and she said, "Perhaps it's a survey team."

"They'd have let us know if they were sending a team out. I don't like—"

The explosion blew a fair sized crater in the side of the trench and cut off my thoughts in mid idea. It had to have been one of those small radar invisible missiles or Gert would have spotted it. We both had the same thought at the same time. Gert's voice and mine harmonized with the dying rumble of the blast. "The saboteurs!"


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Gert threw herself into reverse and headed for the deeper section of the trench at top speed.

This may sound stupid now, but back then there were still a large number of very powerful Earthside corporations that thought us Lunatics had no right to independence. They wanted *all* shipments from the Belters to come to orbital stations then be transhipped to either Terra or Luna—with guess who deciding who got what. They were not above hurling a few hundred tons of scrap iron into Luna City and killing a few thousand people. From their standpoint it would be just that many fewer argumentative Lunies to give them problems.

I figured that the guys in this mysterious flitter with the unpleasant disposition were most likely in some Terran corporation's employ. Either that, or fathers on Luna had turned a lot more protective of their daughters' morals.

"Get a mayday to base, Gert—like now."

"Fine, Jim. How? We're in the bottom of a thirty-foot-deep trench, and I'm running deeper as fast as my little tracks will go. If I run up into the shallower end, those yoyos are going to blow the hooha out of us."

"Shit, they're going to do that anyway if we don't get some help."

I hate it when Gert gets that calm, logical, explain-the-obvious-to-the-little-boy tone in her voice. "Jim," she said, "if I stay in the deep part of the trench I can probably dodge their fire if they come in from the side, or duck it if they try coming straight at us. I'm fairly sure my blade can take anything they can throw with no more than a few dents.

"In addition, we can probably run them out of ammunition."

"Fairly sure? Probably?" Boy do I love a positive outlook. "Not good enough." I told her, "Not by half." I was irritated enough to be right. "Compute the odds, Gert—then add in my penchant for disaster. No good. We have to get help."

"I hate to admit it, but you're probably right. I'm not programmed to include non-verifiable data like your so-called 'penchant for disaster,' but I do learn from experience."

I was too worried to gloat over one-upping Gert for a change. I started my brain working instead of panicking. "How about bouncing a message off one of the satellites? We'd do that anyway."

"I can't see any of the satellites without giving our playmates a clear shot."

"Don't they move? How long before you *can* see one and maintain a relatively safe depth? You're the computer—compute."

Gertrude gave a violent sideways lurch and swerved to scrape the opposite side of the trench. A second later a large crater erupted where we had been.

"I thought you said you couldn't see those missiles."

"I can't," Gert said, dropping back to her tutor tone. "But if they can see us to fire, my thermal sensors can see the flare when they launch."

"Sorry I asked. What about the time to a transmission window?"

"Half-hour at the best. Forty-five minutes to be really safe."

It was a nervous forty-five minutes,

but three missiles later (One of which was a real close miss from the rear; Gert got turned and rolling just in time) we got off our mayday. We didn't wait for a reply. We'd broadcast on every band we could hit and we damn well knew somebody heard us. Now all we had to do was wait for help to arrive—and dodge a few more missiles in the interim. This was turning into a real fun Saturday.

"How long till the cavalry arrives, Gert?"

"Not more than an hour. But I'm guessing."

"Computers aren't supposed to be able to guess."

"Jeesh—I'm sorry I misbehaved. Maybe my program has an irrecoverable glitch."

"Stuff your glitch, woman. Are we going to make it?"

"Oh, sure. They can't have many more missiles left."

I just love optimists. The only reply I could come up with wasn't one of my more perspicacious ones and I didn't even try to smother the sarcasm. "Wonderful! For the next hour you play dodge-em with missiles while I have nothing more constructive to do than twiddle my digits."

"You might put on your helmet, Jim," Gertrude said placidly. "It would be very constructive on the off chance I don't dodge quickly enough. Oh, yes. You could also tie down the loose tools rattling around in the store room."

Damn but I hate a smug woman! Even one made up of silicon and rare metals. Especially when they're right. However, this was no time to start an argument so I grabbed my helmet from the rack—the one I should have had on already—and crammed it on my head. It's good practice to wear a suit anytime you're working, and with my affinity for disasters I'm more careful than most about that. My only excuse for not having grabbed the helmet as soon as the hostilities began is that my brain must have been jarred into neutral.

I was up and heading for the store room while I finished the life support checkout. I do not, and I mean never, open an air lock door without being fully suited and checked out—no matter what the indicators tell me about conditions on the other side. Indicators lie and safeties fail. In a vacuum, that can lead to a premature and rather unpleasant demise.

The next half-hour was spent tying down loose gear, grabbing for support as Gert dodged, and trying to chew through my gloves to get to my fingernails. The last is a doubly futile exercise when wearing an armored helmet with a half-inch-thick face plate.

At the end of that half-hour everything happened at once.

Gert whooped, "Here comes the cavalry! And boy do they mean business. Those aren't flitters, they're Lunar Security jump ships."

Gert displayed the three onrushing ships on her auxiliary visuals. She wasn't wrong. Those were heavily armed and armored military boats. No wonder they got here so fast. It's nice to know you're loved.

I started to make some optimistic remark to that effect when Gert used the first profanity I had ever heard from her. "Oh shit!" Her main screen showed our

playmate's flitter charging full tilt down the trench—straight at us.

"Tie down, Jim. I think they're going to ram us."

"Gert, can we survive a ram?" I hate being insecure.

"I think so—but not without damage."

"You think so! What—" Then I saw the missile. Point blank launch.

Gert tried to get her blade up, and she almost made it. The bloody thing clipped the top edge of the blade and blew. Metal tore through the ports hurling chunks of armor glass ahead of them. Air blew icy puffs into the emptiness of the Lunar afternoon. Something hit me in the upper right chest and toppled me backward, still strapped in the command chair.

The saboteurs had pulled their flitter into a straight-up climb to avoid the proximity blast. I watched it through the top port, in slow motion, as it climbed —and climbed—and disappeared in a silent ball of fire as the missiles from the Security jumpers caught it.

My suit still seemed to be intact so I thought moving, getting some patches on the holes, might be a good idea—helpful sort of thing to do maybe, while Gert handled any other problems. I found out fast I wasn't moving anywhere. In fact, a wave of dizzyness and nausea informed me, I wasn't even going to be conscious much longer —maybe not even alive.

Let me tell you, friend, all the stories about pleasant sensations while lapsing into shock-induced coma are bullshit. It's scary. So scary you crap your britches and pee all over yourself, not to mention that your reproductive system goes on auto and makes one last, futile grab for immortality. Worse still—you are intensly aware of the whole episode, and the embarassment adds its own little elements of terror.

The built in sanitary facilities in the vacuum suit may remove the physical mess but they don't do a bloody thing for the mental. Believe me, friend, there is no mercy in a slow demise—none.

There *was* one pleasing occurence as I tumbled into midnight. Gert must have been working on a self portrait and she picked this moment to spring it on me. It appeared on the monitor directly in front of my face. Full color. She was even a redhead. She looked smudged, battered, triumphant, and worried—all at once—like she'd just rassled a pack of hungry grizzlies and won. Her hair flew around her face like a solar flare. Lord, she was beautiful.

"Don't you dare die on me, you obstinate son of a bitch! Not now!" she squalled.

Two profanities in less than five minutes. Sheesh!

I tried to give her a reassuring smile. I think I made it but I blacked out before I could be sure.

I woke up two weeks later in the Luna City hospital, encased in a cast from neck to waist. Oh joyous return to awareness—I pried my eyes open, realized someone was shoving his face into mine, and focused on Grenn's ugly leer. I wondered what the fastest method of losing consciousness again was.

"Jimmy boy! Glad to have you back among the living!"

Jimmy boy, my rear. If I could have moved I'd have smeared his fat nose all

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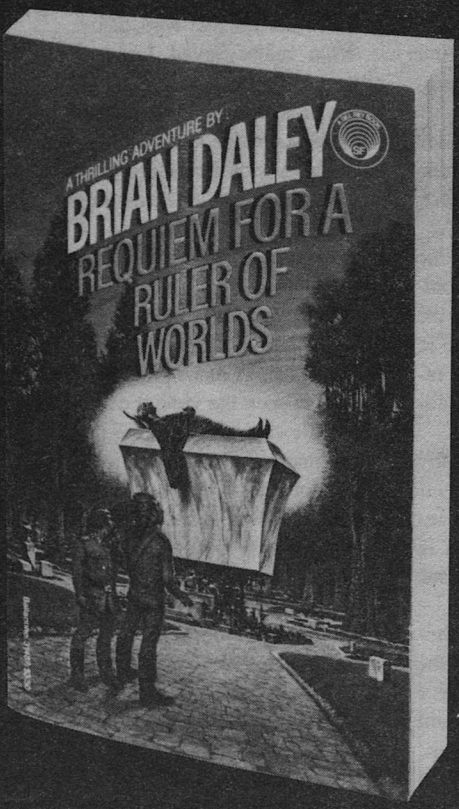

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over his fat face. The SOB could have warned me that the saboteurs were on Luna and might try to stop the trench.

Instead I croaked, "How's Gert?"

"Gert? Who's . . . Oh! That smart-blade of yours. Oh, it's fine. We have it in the shop for a full overhaul." He was trying to be friendly and reassuring—I guess. He managed to be irritating and alarming.

"If you've touched one byte of her program I'll out lock you—and the programmer!"

I don't know what I looked or sounded like but it must have been radical. Grenn backed up like I'd hit him with a stock prod.

"Easy, Jim!" His hands waved like a saint warding off the devil. "The computer checked out just fine. Even the peripheral data was intact. All we're doing is giving her a new blade, replacing the damaged cabin, and installing the latest working hardware."

I *must* have shook him up—he finally called Gert "her."

Gert's personality was intact. I relaxed and said, "Luna City is still in one piece, huh. I guess the trench worked."

A nurse stuck her head in and motioned Grenn to leave. I didn't like the look on her face. She had that *have I got a hypo for you!* expression. My butt hurt enough already.

Grenn distracted my negative train of thought. "No, the load didn't hit Luna City." The nurse took a firm grip on his elbow. "I'll tell you about the rest later," he said as she pushed him out the door and turned back toward poor helpless me. God! I hate nurses when they smile like that.

* * *

I'd love to be able to finish this with a description of how, dispite not being able to finish the trench, Gert's and my effort was still enough to stop the carrier and save Luna City. I'd love to be able to say that we ended up heros, wined, dined, and honored over the whole of Luna. I'd love to, but I can't. Murphy's law don't work that way, baby.

What really saved Luna city was either the carrier's colliding with a small piece of space junk—small but large enough to change its trajectory—or the smart boys with their mighty computers screwed up the initial calculations and misfigured the point of impact. I'll leave it up to you to decide which explanation is the more likely.

Whichever, the carrier ended its erroneous journey against the side of a hill fifty kliks short of its predicted landing side. I've seen the vids; it came in tumbling sideways and blew the peewaddin out of that hill. From what it did to that baby mountain I'd guess that our little trench would have had all the effect of a sand grain in a tsunami.

Screw it! Gert and I made one hell of an effort—even if it did end up another failure on our logs.

At any rate, we did get *something* out of it. Grenn hadn't been kidding about the latest in working tools. Gert was as up to date as technology and security acts would allow. They're doing amazing things with bioelectronics these days.

One of the things they're doing is in the field of robotics. They are making robots so bloody lifelike it's hard to tell them from human, and they are quite practical. Anything that keeps a smart-

blade and pilot in the field, and happy, for three months or longer is very, very cost effective. Yeah, I know a lot of the guys gripe, they claim it's little better than a plastic dolly, but I ain't one of them—not when Gert did the layouts for the physical appearance of that robot, and is hooked into it via a tight comm link.

I also know that computers can't be self aware, can't even have real intelligence, let alone human personalities—but don't try telling Gert that. You'll get laughed at or decked, depending. And, believe me, I'm not the only blade pilot wandering around wearing a sneaky smile.

I wonder if they can develop a functioning reprodu—nah, too many complications. Besides, I just ain't ready to get hooked on perm. But, then again. . . .

EPILOG

"What I still don't understand, Sir, is why a smart-blade team like that was assigned to such a critical job in the first place." The junior executive of Luna Construction Inc. waved the bottle of cognac he was holding in frustration. "I mean look at their record. Carter fouls up everything he tries, and the smart-blade's record is even worse. Before it was assigned to Carter, that unit was in the shop more than it was in the field. Hell, the breakdowns almost killed two drivers.

"Why would we ever assign such a disaster-prone team to such a critical job? There were a lot of others available."

"Junior, stop waving that bottle around and pour," the senior exec told his as-

sistant. "You're giving me a headache wondering if you're gonna drop the thing—and what I'll do to you if you *do* spill it. That's a damn fine Terran cognac you're juggling."

"Yes sir. Sorry sir." The junior stopped waving and poured, handing one snifter to his boss.

The senior took a satisfied sniff then sipped and said, "Now, Junior, sit down and listen. You may learn something."

The junior sat.

"You have been spouting the records of that team before they became a team."

"But, sir," the junior interrupted, "their record as a team is just as bad. Just look at this list of incompletions and screw-ups."

"Shut up, junior. As usual, you're wrong." The senior took a long, appreciative sip of the cognac and grinned at his befuddled assistant. "Every one of those so called screw-ups has ended up as plus profit on the books. That team's mistakes are *always* to our benefit. No matter what they do, it comes out right—however bad it seems at first."

"But, but, the records."

"Records can lie. Why do you think I assigned that team in the first place? I knew they'd foul up. I knew, beyond any doubt, that something would go wrong—and that whatever it was, it would save Luna City's ass."

The junior exec let his jaw droop, then rescanned the records in his hand.

"Close your mouth, Junior. You look like a frog chasing flies."

The offending jaw snapped shut and a faint rose tinge colored the assistant's cheeks. Junior executives are good at recovering, however. It was only moments before he said, "I see what you mean, sir. But if that's the case shouldn't we tell them, or at least investigate the phenomenon? I mean the science staff would love to—"

"Junior," the senior exec cut him off. "You say one word of this to any one and you'll be digging tin on Pluto—with your teeth. I know you've got a brain—start using it. Think! Murphy's law causes us enough trouble as it is. When it starts working in our favor for a change, it just ain't smart to ask a lot of damn, silly, questions."

The senior leaned back in his chair and grinned at his deflated assistant. "This, Junior, may be the only case in history where two wrongs make a right —and I'll be out locked for toad squat if I'm going to upset *that* apple cart!" ■

● As recently as 1926, rocket flight to the moon was pronounced impossible. A futurist view more consistent with history is that, since starflight is not physically impossible, it is inevitable.

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G.F.R. Ellis and Tony Rothman

THE GARDEN OF COSMOLOGICAL DELIGHTS

I. Fairy Tales

Recently, at a New York cocktail party, a young physicist was asked how he made his living and he replied that he was by specialty a cosmologist. While it might be debated whether cosmology constitutes a "living," his host remained undeterred and immediately inquired if it would be possible to make an appointment for a manicure and a haircut. The physicist explained that cosmology is the study of the large-scale structure of the universe and that he—alas—knew very little about nail polish, split-ends, and all those other things a cosmetologist presumably deals with. Both the physicist and his host had a good laugh, after which the host meekly retired with a faint "oh," apparently convinced that cosmology was incomprehensible.

A complementary but equally dismissive view was once expressed in a lecture by Nobel Laureate Hannes Alfvén who remarked that present cosmological theories have "the character of ancient Indian myths, with turtles standing on elephants standing on . . . very beautiful fairy tales."

The cocktail party host and Alfvén expressed two views that characterize quite accurately the nonspecialist's view of cosmology and the theory on which it is based—general relativity. Either it is the most grandiose enterprise imaginable, combining supreme *chutzpah* and unintelligible mathematics, or it is not physics at all but rather esoteric mythology.

It strikes us that there is some truth in both the Cocktail Party View and the Indian Mythology View, but that the discipline of cosmology really falls somewhere in between. Because cosmological theories make many predictions that are not yet testable by experiment (and may never be), it is by its very nature highly conjectural and a fertile ground for speculation. Yet, in some areas, our present theories make

remarkably good predictions and are so esthetically pleasing that it is difficult to believe there is not some truth in them.

In this article we are going to speculate. Too often, in the free press, all attention is devoted to the so-called "standard cosmological model" with the tacit assumption that the standard model is correct and we know everything there is to know about the universe. Here, we are going to ask the question, "What if the standard model is wrong? Are there any alternatives?" Indeed there are. Even if there weren't, the case for the standard model would be logically much stronger if we could show all the alternatives were incorrect. After all, you can't logically conclude the standard model is *the* model if it is the *only* model you've invented. In fact, this is one of the most important reasons for examining other possibilities. But before we tackle these difficult "eccentric" models, let us start the reader on the beginner's path with a review of the old standby, standard big-bang cosmology.

II. The Standard Model

"Dull as Dishwater"

We should first explain what a model is. Einstein's equations *do not* specify the universe, rather they may be considered a general framework within which you can construct many different model universes. These model universes may have absolutely nothing to do with the real one—and usually they don't—but ideally they should represent the large-scale distribution of matter in our universe and the curvature of space-time caused by that matter. Such curvature is, for instance, manifested in the famous bending of light around the sun and other celestial objects like black holes. (See "Demythologizing the Black Hole," by R. Matzner, T. Piran, and T. Rothman, *Analog*, September 1980.) In addition, the model should also describe the history or evolution of the matter in the universe and hence the history of the universe itself. Now, which model is "correct" can only be determined by self-consistency and comparison with the real universe, and this is where experimentalists come in. In our field, experimentalists are usually called astronomers. Of course, you are quite at liberty to throw out Einstein's equations and write your own—some people do—and this procedure brings about the proliferation of even more models.

For about the last twenty years, one cosmological model has carried the title "standard." It also goes by the name of the Friedmann cosmology, or the Robertson-Walker cosmology, often the Friedmann-Robertson-Walker cosmology and occasionally the Friedmann-Lemaître-Robertson-Walker cosmology, depending on which nationalities are disputing priority. (Friedmann was Russian, Lemaître Belgian, Robertson American, and Walker English.) In any case, the FLRW cosmology is the model popularly known as the Big Bang. There are, in fact, any number of Big Bangs, so we will stick with the acronym FLRW when speaking of the *standard* Big Bang.

Before tearing apart the standard model, it is only fair to explain why most cosmologists are its ardent supporters. First of all, the FLRW Big Bang is the simplest of all Big Bangs and physicists are highly attracted to the Principle of Simplicity. We will explain exactly what we mean by "simplicity" a little later, but because the concepts involved are somewhat abstract let us start with the more famous and concrete successes of the standard model.

The FLRW cosmology has made two startling predictions. The first of these is that the light isotopes, most importantly helium and deuterium (heavy hydrogen), were formed roughly three minutes after the Big Bang when the universe was at a temperature of about one billion degrees, much hotter than the center of the sun. When the temperature dropped far below one billion degrees this "primordial nucleosynthesis" stopped and, according to the standard model, there remained roughly 25% helium by mass and 2×10^{-5} parts deuterium.

It may seem like a miracle that astronomers in fact *do* measure about 25% helium in the real universe, but it is a miracle squared that they also measure something like 2×10^{-5} parts deuterium. This must be counted a great success of the standard model.

The second prediction of FLRW is that there should exist relict radiation left over from the cosmic fireball, just as gamma rays are left over from a nuclear explosion. For technical reasons the radiation actually seen comes from about 100,000 years after the Big Bang when the Universe became transparent; but, in any case, the radiation also cooled as the universe expanded and should be observable today not as gamma rays or even visible light but as lower-frequency microwaves. Indeed, in 1965 the famous "cosmic microwave background radiation" was discovered by Penzias and Wilson at Bell Labs and explained by Robert Dicke's group at Princeton.

Because these two predictions are so decisive, they are often used to compare one cosmological model to another and we will refer to them frequently. Actually, it is so difficult for a model to predict both the light isotope abundances and the cosmic microwave background that most alternative models have been of the Big Bang type. This fact will become more evident as we go along.

Now, we mentioned that the FLRW was the simplest Big Bang model. In order to do useful work, the physicist must translate words like "simple" into mathematical concepts. We will now explain what simple means to a cosmologist. These concepts are, unfortunately, more abstract than helium and microwaves and the reader is advised at this point to mix a vodka tonic. Lime, please.

The FLRW assumes that at some finite time in the past, the universe started to expand from a *singular* state of infinite temperature and density. Furthermore, the density of material (say neutrons, protons, electrons, photons, etc.) is assumed to have been *uniform*

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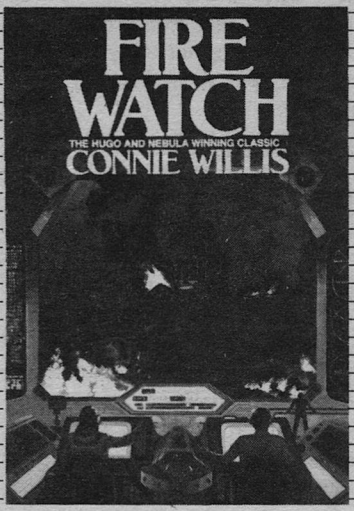

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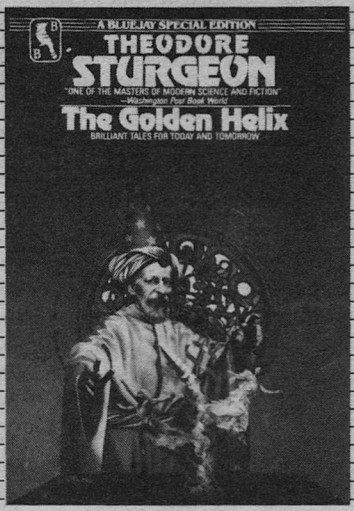

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throughout the universe and the expansion of the universe is taken to be *homogeneous* and *isotropic*. Let us illuminate some of these terms. A singularity is a point of spacetime where some quantity becomes infinite. In the FLRW universe—alas—virtually everything becomes infinite at the instant of the Big Bang itself, which is thought to have occurred between ten and twenty billion years ago. If you think a singularity must be a breakdown of sorts, you are absolutely correct. We will have more to say about this later.

The term *isotropic* refers to a system that looks the same in all directions or, in technical language, is "rotationally symmetric." You might imagine yourself standing at the edge of the Grand Canyon and turning around. The abyss before you does not look like the desert behind you so the area surrounding the Grand Canyon is certainly *not* isotropic. On the other hand, if you stood like a lizard in the middle of the desert, it might very well look the same in all directions, so we would say the desert *is* isotropic.

By contrast, the term *homogeneous* refers to a system that looks the same at any point or, technically speaking, is "invariant under translations." For instance, if the Grand Canyon were idealized as being very straight and of uniform width, we could walk along it and at any point it would look exactly as it had a moment before. *We could not tell we had moved.* Yet, we could still turn around and see the desert, which appears very different from the canyon. So here we have a situation which is *an*isotropic but homogeneous. Since the terms are very important in cosmology, it is best to remember them: homogeneity means no change in landscape when one walks; isotropy means no change when one spins. See Figure 1 to understand that isotropy everywhere implies homogenity but *not* vice-versa. (Philosophical exercise: is life homogeneous?)

Thus, as foretold, the FLRW cosmology is about as simple as one can get. We may visualize the universe to be filled with radiation such as photons, quarks and neutrinos, as well as more ordinary matter such as protons and neutrons. This material is absolutely uniform everywhere and in all directions, that is, homogeneous and isotropic. Furthermore, the requirements of homogeneity and isotropy ensure that the universe is expanding at equal rates in all directions and that annoying things like bumps and shock waves do not exist.

Observationally, we cannot actually verify that the universe is homogeneous simply because we cannot travel very far from Earth. Even if we could travel 1000 light years we would still be seeing everything from the same region in our galaxy. Isotropy implies that we cannot point in any particular direction and say "we have seen the center of the universe over there," which is the same as saying, "the universe is very different that way." This isotropy seems to exist approximately in the real universe if we ignore irregularities such as mere galaxies and only consider size scales of galactic clusters and above.

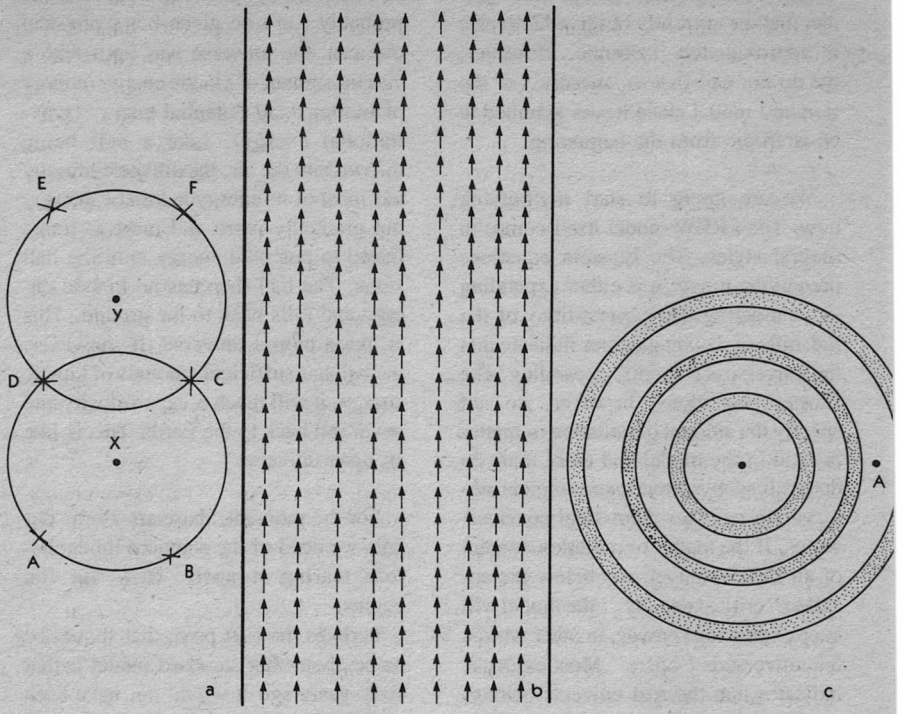

Figure 1

a) Isotropy implies homogeneity. Suppose the universe is isotropic around point X. Since isotropy means "no change as one spins" then, by definition, points ABCD must all have the same properties. Similarly, if the universe is also isotropic around point Y, then points C, D, E, and F must have the same properties. By transitivity ABCDEF are all equivalent. Because the Universe is the same, having moved from A to B to C to D to E to F, the universe is homogeneous at these points. Extending this argument all over space shows that isotropy everywhere implies homogeneity.

b) Homogeneity does not imply isotropy. Suppose you lived on an infinite field covered with identical arrows all pointing North. If you walked anywhere, it would be impossible to tell you had moved since the landscape has not changed. Hence this universe *is* homogeneous. But if you look South you see arrowheads while if you turn North you see arrowtails. There is a preferred direction and so this universe is *anisotropic*. (These arrows could represent temperature gradients, galactic or particle velocities or any other property of spacetime.)

c) An inhomogeneous universe. Here, the galaxies are not distributed uniformly but concentrated in rings. This universe is clearly inhomogeneous. If you stood at an average point A, it would also appear anisotropic. However, if the observer *just happened* to be located at point E, the universe would appear isotropic, but only from this point.

Any cosmological model must predict that the currently observed universe is approximately isotropic. However, we do not call this a "success" of the standard model since it was assumed to be isotropic from the beginning.

We are going to start multiplying now. The FRLW model itself comes in several styles. The Einstein equations predict the universe is either expanding or contracting and observations of the redshifts of distant galaxies indicate that the universe is presently expanding. The Einstein equations, however, do not specify the amount of radiation or matter present in the model and these must be determined by direct astronomical observation or other theoretical considerations. If the matter or radiation content of an FLRW universe is below the so-called "critical density," the model will keep expanding forever. In other words, the universe is "open." Most evidence indicates that the real universe belongs to this "no frills attached" variety. There are, however, available extras. Massive neutrinos may exist (see "The New Neutrinos," by R. Matzner and T. Rothman, *Analog*, May 1981.), as well as photinos, gravitinos, Higgsinos and a host of other new exotic particles which we fortunately cannot discuss here. (Physics has gotten out of hand.) If these particles contribute a sufficient mass density to the universe, the expansion of the universe will eventually halt and the universe will recollapse. Such a universe is often termed "closed."

It is time to ask a stupid question: why is the universe expanding at all? A satisfactory philosophical answer probably can't be given but a physical one can: the universe was born with a certain amount of kinetic energy (energy of motion) and potential energy (gravitational energy). Like a ball being thrown into the air, the universe initially has most of its energy in kinetic energy, but gradually more and more is transferred to potential energy until the ball stops. The ball then has no kinetic energy and falls back to the ground. This is like a closed universe. If, however, the ball has sufficient amounts of kinetic energy, it will reach escape velocity and never fall back to the Earth. This is like an open universe.

For the moment, these are all the details we need of the standard model before tearing it apart. Now the fun begins.

Perhaps the first point that should be made about that standard model is that sixty years ago it would not have been considered standard at all. For philosophical reasons Einstein originally felt that an ideal universe should be neither expanding nor contracting, but *static;* and his first cosmological model of 1917 was exactly that. Now, in order to produce a static model of the universe from his equations, Einstein was forced to add the famous "cosmological constant." *This constant may be thought of as adding a term to the potential energy of the universe equivalent to a repulsive force or pressure.* Einstein chose a value for the constant that just brought the kinetic energy of the universe to zero. The ball always

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"hovered" at the top of its flight. (A more accurate analogy would be a pencil balanced on its point.) Such a situation may seem impossible: and indeed, Eddington showed in 1930 that a static universe was unstable and tended to contract or expand. In any case, by that time evidence for the expansion of the universe had been discovered and in 1931 Einstein dropped the cosmological constant as the "biggest blunder" of his life. (We all make mistakes.)

Recently, models with cosmological constants have come back in vogue (see Section V) and are now classed as non-standard models. So the moral of the story is that, like Tchaikovsky and high heels, cosmological models come in and out of fashion. This is the theme of our essay: one should be careful what one calls standard, for tomorrow there may be a replacement. Therefore, the reader would be wise not to forget cosmological constants.

There are more serious objections to the standard model than changing fashion. We mentioned that the FLRW cosmology begins with a singularity. This is a much more serious breakdown than a flat tire or a cracked engine block. It is, in fact, a physical impossibility—a region where the laws of physics break down altogether and even spacetime itself comes to an end. Avoiding the singularity is probably the main reason cosmologists search for other models.*

There are other conceptual problems with the FLRW Big Bang. Recall that we said it was exactly homogeneous and isotropic. Physicists who follow the Principle of Simplicity are attracted to this model because it is indeed the simplest conceivable cosmology. On the other hand, physicists who rely on the Principle of Greatest Probability (also known as the Principle of Minimum Serendipity) are disturbed. Just how likely is it that the universe was created in an exactly uniform fashion with strict homogeneity and isotropy? Such a birth seems at best implausible but this is exactly what FLRW claims. Doubts such as these led to the creation of anisotropic and inhomogeneous models which we will discuss in Section III.

There is a further problem with FLRW. If the universe is open, then it is truly infinite in extent. There may have been a Big Bang fifteen billion years ago, but one must regard the Big Bang not as occurring at one point but all over space, not as one pebble dropped in a pond but a pebble plopped at each point. The Big Bang took place everywhere and if the universe is open this everywhere knows no bounds. The question is: how seriously do we take infinity? We can only observe a small part of the universe (see Figure 2). If we *do* take homogeneity, isotropy, and infinity seriously, we are claiming we know *exactly* how the infinite universe behaves *everywhere* by observing our one tiny little patch. This is worse than an ant climbing atop a grain of sand in the Sahara and claiming the entire world is made of similar grains.

The difficulties with infinity are further illustrated by an amusing example concocted by one of us (G.F.R.) and G.B. Brundit. We may assume that the probability of life arising in our sector

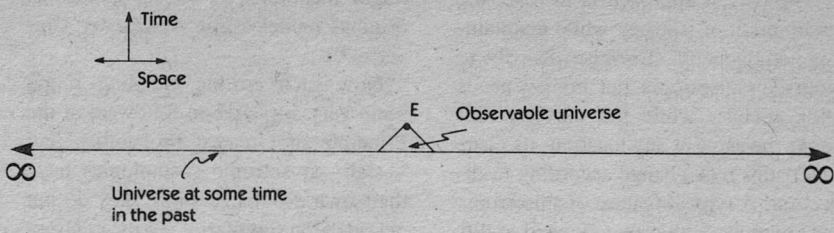

Figure 2
An infinite universe. Because nothing can travel faster than light, we can only study that part of the universe from which light has already reached us. In a relativistic spacetime diagram like the one here, light travels along 45° lines. If the Earth is now located at point E, the observable universe is that area within the "past light cone" as shown. (The long horizontal line represents the state of the universe at some time in the past, say at the instant of the Big Bang.) But if the universe is truly infinite in extent, then there is an infinite amount we have not seen. Can we justify the assumption of isotropy and homogeneity by observations only within the past light cone?

of the universe is nonzero. For illustrative purposes, let's say the odds are 1% that life arises in our vicinity. If the rest of the universe is exactly the same then the probability that life arises in any other sector is also 1%. Thus, if we take at least 100 sectors, the probability of finding life approaches 100%. We are not done. We are assuming an *infinite* universe with an infinite number of sectors. Hence, there must be an *infinite* number of occurrences of life. Now, again assuming uniformity, other life will be based on DNA and DNA can only produce a *finite* number of configurations (say 10^{78}). Therefore, in an infinite universe there should be an infinite number of genetically identical species! In fact, each one of us has not *one* genetically identical twin out there, but an infinite number of them. Do you believe this? No? Then we leave you to provide your own answer. We provide a few possibilities in the following sections.

III. Shake and Bake: Anisotropic and Inhomogeneous Models.

In the last section, we mentioned that followers of the Principle of Greatest Probability find it difficult to believe that the universe was created with exact isotropy and homogeneity. By 1968 this very conceptual objection led Charles Misner at the University of Maryland to propose an alternate scenario: that the universe was created in chaos and later assumed the uniform, isotropic appearance we observe today. The question is, what form did chaos assume and what

mechanisms brought about the isotropization of the universe?

The easiest approach is to relax the assumption of isotropy while maintaining homogeneity. (Exercise: describe to yourself anisotropic but homegeneous milk.) Thus, while the universe still looks the same at any location, its characteristics now change according to direction. A typical feature of anisotropic cosmologies is that they expand at different rates in different directions. As a not-very-accurate mental picture you might imagine an isotropic universe expanding like a sphere and visualize an anisotropic universe expanding like an ellipsoid (an American football) or even an object that keeps changing shape (technically an ellipsoid whose major and minor axes continually change direction),

Whereas in an isotropic universe the average flow of particles is the same in all directions—outward from the point of observation—in an anisotropic cosmology the various expansion rates cause particles to stream with many different velocities—and hence energies—that now depend on direction. These streaming particles will collide at early times and transfer energy among themselves, until they all finally have the same energy and the universe is more isotropic. The so-called viscous damping of anisotropy is very much like what happens when you open a window from a warm house onto a cold day. The situation is anisotropic (and inhomogeneous): the cold particles outside have a lower energy than the hot particles inside. But they mix and transfer energy until the house is at the same temperature as its surroundings—isotropy. (We might mention that Misner called his original model "The Mixmaster Universe.")

Now such cosmic blending might seem very attractive to followers of the Principle of Greatest Probability, but —sigh—anisotropic cosmologies have their own problems. First, they do not get rid of the singularity. To the contrary they make it worse; if you imagine the universe to be collapsing as we go backward in time—instead of expanding as we go forward in time—a collapsing anisotropic universe forms a singularity faster than an isotropic universe. (For more details, see "On Cosmology," by L.C. Shepley and T. Rothman, *IAsfM*. July 1979.) Furthermore, there is a problem with element production. Beginning with the work of Kip Thorne in 1967, it has generally been thought that even a small amount of isotropy *raises* helium from the amount produced in the standard model above the 25% observational limit. In the last few years, other investigators have claimed anisotropy *lowers* helium—drastically. The most detailed study of this question has recently been completed at the University of Texas by Richard Matzner and T. Rothman and the conclusion currently seems almost unavoidable that anisotropy indeed raises helium—and more sharply than previously thought. ("Currently," in physics, means about the lead time for publication—from 3 weeks to 6 months.) To keep helium below the 25% limit imposed by astronomers requires that the universe was

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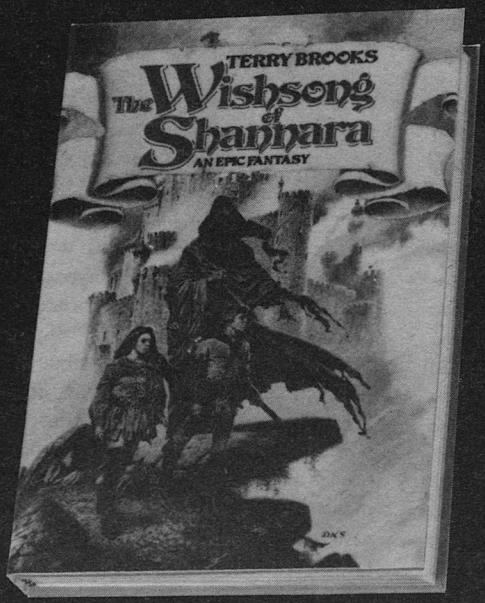

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highly isotropic at the time of element formation.

In addition, observations of the cosmic microwave background are continually becoming more refined. Recent work by Fixen, Cheng, Wilkinson, Lubin, Epstein, and Smoot, among others, shows that the microwave background is extraordinarily isotropic now. If one projects these observations back to the time of element creation, one reaches the same conclusions that we drew from the nucleosynthesis study just mentioned—the universe was *highly* isotropic at three minutes after zero.

At this point, the reader might justifiably feel the observations demand that anisotropic cosmologies be thrown out. Yet, there is a paradox involved. While the universe appears to have been isotropic even at three minutes, it may be that we are compelled to use an anisotropic Big Bang to explain the existence of certain particles such as photons. There is no denying photons exist, and in great quantities too. There are approximately one billion photons in the universe for every proton. Now according to quantum theory, particles may be created from the "vacuum." One should not think of this vacuum as empty, but as a storehouse of energy from which particles may arise. However, according to an argument originally put forth by Leonard Parker, particles like photons and neutrinos *cannot* be created from the vacuum in an isotropic universe.

Thus, if we believe that all particles originated from the vacuum, we may be forced to assume the universe started anisotropically. Well then, what happened? Reasoning along the lines of Misner, Ya. B. Zel'dovich suggested in 1970 that these particles created in the anisotropic universe collided with each other in the way described above for Misner's Mixmaster and quickly isotropized—all within 10^{-43} seconds!

This is a rather attractive idea: the universe begins anisotropically, photons and other particles are created, and the very creation of these particles causes the universe to become isotropic. While the idea is very reasonable and may be The Answer, we must confess that the actual calculations purporting to verify this phenomenon strike us as severely limited, if not inconsistent, and to claim the universe became isotropic within 10^{-43} seconds is a bit premature. Actually, we must confess that the new inflationary scenario may bypass the whole problem completely. Inflation is briefly discussed in Section V.

We have spoken at length about anisotropic cosmologies. What about inhomogeneous universes? Because the world may now have different properties at any point, inhomogeneous cosmologies are very difficult to study—few assumptions can be made—and less is known about their behavior. (See Figure 3 for a new result and a good example of inhomogeneity.) Nonetheless, inhomogeneous cosmologies have one great feature in their favor—the Principle of Greatest Probability. That is, unless some other principle overrides our conception of what is probable and what is not, we would expect the initial state of the universe to be inhomoge-

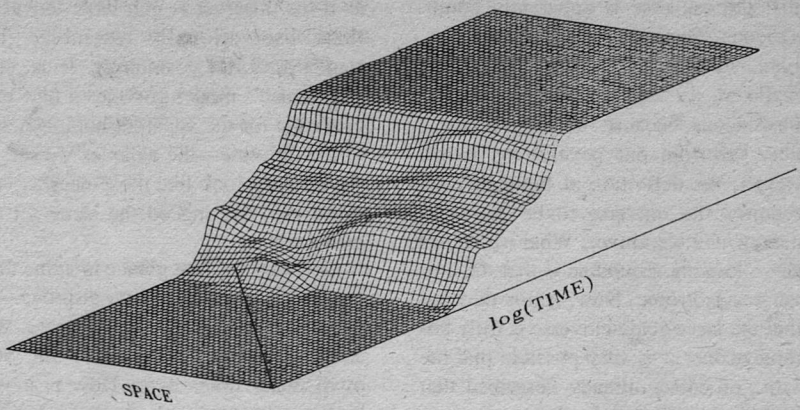

Figure 3
The first numerical calculation of primordial nucleosynthesis in an inhomogeneous cosmological model by Joan Centrella, Richard Matzner, Jim Wilson and T. Rothman. The universe is divided into many cells along the "space" axis, and conditions vary from cell to cell (inhomogeneity). At time equals three minutes on the "time" axis, helium formation begins. The amount of helium is measured on the vertical axis. You see the variation of helium from cell to cell as it is being formed. After several hundred seconds helium synthesis ends and the graph flattens out. The helium produced in this model varies from a minimum of 22.4% to a maximum of 25.8%, though the variation from cell to cell at the end of the graph is not visible. In a homogeneous model there would be no ripples and no variation in helium.

neous. What's more, inhomogeneous models have some intriguing differences from the standard case that are worth looking at. Particularly, since the universe is now unruly and inhomogeneous, the Big Bang could occur at *different* times in *different* places—the singularity could conceivably be going off *now* somewhere in the universe. Indeed, several Soviet physicists have suggested that such delayed "Little Bangs" could be the power source of quasars. However, this proposal is not an essential feature of inhomogeneous cosmologies—such models might very well be inhomogeneous at early times only.

This brings us to an interesting point.

How can we reconcile an inhomogenous model with the astronomical evidence that the universe is apparently homogeneous? There are several possibilities. First, as we said earlier, we cannot really verify that the universe is homogeneous because we cannot move very far from our position on Earth. (recall, the definition of homogeneous requires the universe to be the same *everywhere* we move.) What we do observe looking around us is that the universe is isotropic. Now, *if* it is the case that the large-scale universe is truly homogeneous, it is very possible that the same processes already described that damp out anisotropies, also serve to smooth out inhomogeneities—and they may do so in a very short amount of time.

A second explanation for the apparent homogeneity of the universe is quite different and also alluring in many ways. It requires that we live in a small inhomogeneous universe that we have already been round many times. To visualize this, imagine standing with a small group of people in a room with mirrors on all the walls. Looking around, you will then see images of thousands of people stretching away into the distance in all directions. Now consider instead a set of, say, one million galaxies in a large region of space, surrounded on all sides by mirrors. The appearance will be that of a nearly homogeneous, isotropic collection of many *more* millions of galaxies stretching into the distance. This is exactly the observational situation in a small universe that is closed on itself in space: virtually whatever the distribution of galaxies and matter in the small, basic cell, it appears as if the observer is in a large universe that observationally resembles the standard, FLRW cosmology. Thus, this "funhouse" model provides a nice explanation for the apparent homogeneity of the universe—the galaxies we see in the distance look like those near us because they are indeed the same set of galaxies!

One might at first glance imagine this hypothesis would be easy to disprove—if we really lived in a hall of mirrors, we could see each galaxy (including our own) many times over. How is it we have not detected such a state of affairs? The answer is that detection would be far from trivial. Because light travels from the galaxy to the observer along different paths, the various images from this galaxy would depict it at various times in its history and therefore at different states of its evolution. Each image might intrinsically be a different color or brightness, or perhaps even a different shape from the others. This situation would already make it difficult to recognize the various images as actually originating from the same object. The confusion is compounded by the fact that intergalactic and interstellar absorption might vary along the different paths of observation as well, changing the image further. Moreover, the images of this galaxy will all have different redshifts, usually a key indicator of distance. Clearly, in practice, it is very difficult to tell if we have seen the same galaxy, or even cluster of galaxies when looking in different directions. So, in

our hall of mirrors we have an intriguing and attractive way to reconcile the Principle of Greatest Probability (and hence inhomogeneity) with observational similarity to the standard model. It is a possibility that needs further investigation.

To conclude this section, we emphasize that we are not at present able to determine whether any of these inhomogeneous models is a better model of the real universe than the FLRW. However, we are able to maintin that these are at least conceivable alternatives that need investigation, and that a scientific approach to cosmology must be based on a consideration of all the alternatives, not just the one family of models that happens to be the simplest to consider.

IV. Science or Numerology?

Variable-G Theories

In the last section we talked about alternatives to the FLRW universe which changed the *geometry* of the spacetime. We asked what would happen if an isotropic universe became anisotropic or inhomogeneous and discussed the results. Of course, nothing prevents us from leaving the geometry unaltered and tinkering with other aspects of the universe. One popular alternative is to allow the fundamental constants of nature to change. Not surprisingly, many physicists regard the values of the natural constants to be God-given and refuse to take seriously any theory in which they vary. Nonetheless, one should be open minded abouts such things; we do not yet have any theory that predicts the values of the constants of nature (see, however, "Coincidences in Nature . . ."), and there is no *a priori* reason—except the Principle of Simplicity—to assume they are constant. For instance, in the laboratory we *measure* the value of the Gravitational constant G to be roughly 10^{-7} cgs units, but we have no idea why this should be so. We also have no *a priori* reason to claim G always had this value. On the other hand, is there any reason to suspect the value of G has changed over the eons? Indeed, there are two distinct philosophical arguments which motivate "variable-G" theories. Unfortunately, the two arguments get jumbled up even in the scientific literature; we will try to keep them straight here.

The first motivation comes from the famous "Large Number Hypothesis" of Dirac, first put forth in 1938. It had long been noted that the ratio of the electrostatic force between an electron and a proton to the gravitational force between the same two particles was approximately equal to the ratio of the size of the universe to the size of an electron. It is easiest to write this coincidence in symbols so, if you forgive us,

$$\frac{\text{Force}_{\text{elec}}}{\text{Force}_{\text{grav}}} \sim \frac{\text{Size}_{u}}{\text{Size}_{e}} \qquad (1)$$

or

$$\frac{e^2}{Gm_e m_p} \sim \frac{m_e c^3 t_u}{e^2} \sim 10^{39}$$

In these expressions, $\sim$ means "approximately equal"; the size of the universe $= ct_u$, where c = speed of light, t_u = age of universe; the size of an electron $= e^2/m_e c^2$, with e = charge of electron, m_e = mass of electron; m_p

= mass proton; G = gravitational constant.

Now, if the reader bothers to work out the units in the above expression (1), he will find they have all cancelled out, leaving the two ratios "dimensionless." (They had better cancel; a force or a size over a size has no units.) The result is rather startling because in physics most naturally-arising dimensionless numbers are of order one, yet here we have two, both of an almost inconceivable size, 10^{39}, and both approximately *equal*. The other thing to notice is that, except for the age of the universe t_u, all the other quantities are fundamental constants. Why should the age and hence size of the universe have anything to do with the size of an electron? Maybe nothing. The approximate equality (1) could be just a coincidence and we are at liberty to dimiss it as such. Dirac took it seriously and suggested that for mysterious reasons this relationship always holds true. If so, we immediately have that G is proportional to $1/t_u$, or G t_u^{-1}. In other words, *the value of G decreases as the universe gets older*. The reader is objecting: why should we not hold G constant and let m_e, m_p, or e vary? One could, but notice that m_e, m_p, and e are *atomic* constants, that is, they govern phenomena in atoms, whereas G governs gravitational phenomena—phenomena on the scale of planets and galaxies. In order not to create an entirely new atomic theory, Dirac chose G to be the variable.

Let us proceed. The total number of protons in the observable universe—call it N—is found to be about 10^{78}. Note that 10^{78} is just the square of 10^{39}. Another coincidence? Perhaps. But again Dirac assumed it to be true. Using (1) immediately gives

$$N \sim \left(\frac{e^2}{G m_e m_p} \right)^2 \qquad (2)$$

Since G is proportional to $1/t_u$, expression (2); then tells us that the number of protons is proportional to t_u^2 [$N \propto (1/G)^2 \propto t_u^2$]. This means that the number of protons in the universe is increasing with time; in the Dirac theory *matter is created*.

Now, it turns out that the Dirac theory is just one of a class of theories termed "scale-covariant" theories that have been extensively developed, most notably by Victor Canuto and his collaborators. In some of these theories matter is created, in others not. In addition, one is free to specify how G varies with time, that is, the relationship need not be $G \propto t_u^{-1}$.

While mysterious cosmic coincidences are fascinating and consequently many theories are based on them, it must be stressed that there is absolutely *no* solid evidence that indicates G varies with time. What's more, you would expect a change in G to affect the size of planetary orbits and anything else where G appears in the equations. One must be careful here because, it turns out, the effect of a variable G in scale-covariant theories is often more subtle than one would naively expect. Nonetheless, the naive Dirac theory is apparently already ruled out by observations of the orbital periods of the planets. Tests on other scale-covariant theories are difficult to

make because one does not know how G varies with time and there are many possibilities. But, for instance, the amount of helium formed during primordial nucleosynthesis depends on how fast the universe expands; this in turn depends critically on the value of G at that time. It is difficult to believe that a larger value of G in the past would produce values of helium consistent with observation. Actually, T. Rothman has investigated this problem for at least one choice of variable-G theory and found that at three minutes after the Big Bang, G must have been essentially what it is now.

We mentioned that there is a second motivation for variable-G theories. This is Mach's Principle, which states that absolute motion does not exist and only motion relative to the bulk of the matter in the universe is meaningful. For example, inertial forces, such as the centrifugal force we feel when a car rounds a corner, would not exist if the fixed stars were absent. Using Mach's Principle one can show in a crude way that the following relationship ought to hold:

$$GM \sim Rc^2 \qquad (3)$$

where again G is the gravitational constant, M is the mass of the observable universe, and R is the radius of the universe. Now, relationship (3) is also seen to be approximately true in the real universe. It has often been called a cosmological coincidence like (1) and (2) but it is firstly a prediction and secondly involves two cosmological quantities (M,R) whereas the other coincidences each only involved one. Using $R = ct_u$, relationship (3) can be rewritten as $G \sim c^3 t_u/M$. If we believe G is a constant and assume c is as well, then this says that t_u/M must be fixed by the theory. It is not obvious that the age of the universe divided by its mass should be a constant. The only alternative is that G must vary with time.

This argument was first given in 1953 by Dennis Sciama as the basis for a variable G theory. Similar reasoning in turn led to the famous Brans-Dicke theory of 1961, which also has a variable G. Unfortunately, the Brans-Dicke theory has been constrained so much by observations of the binary pulsar's orbital period that it is virtually the same as standard relativity. Probably the last believer in the Brans-Dicke theory died at the Port Authority Bus Terminal five years ago. Thus, as the sun slowly sets in the west, we bid a fond farewell to variable-G theories and turn to more profitable pursuits. Onward.

V. Singularities and Potpourri

We have frequently said the singularity is the Big Stop, the conceptual cataclysm, the ultimate barrier. This is true. To avoid the initial catastrophe is the primary reason many, if not most, alternative cosmological models have been developed. Once again, the best way to think about this problem is to imagine the universe to be running backward and ask what possible mechanisms might prevent it from collapsing into one mathematically-sized point.

Once upon a time it was hoped that anisotropic models would prove to be

WHAT KIND OF P.B.M. PLAYER ARE YOU?

DO YOU LIKE TO WAIT QUIETLY FOR THE RIGHT TIME TO MAKE YOUR MOVE? LET THE OTHER PLAYERS MAKE THEIR POINTS WHILE YOU SEEM TO BE DOING NOTHING, AND THEN STRIKE FEAR IN THE HEARTS OF THE PEACEFUL PLAYERS? DO YOU ENJOY LETTING THE OTHER PLAYERS WONDER AND SPECULATE ON WHO YOUR VICTIMS WILL BE? THEN YOU SHOULD BE A **VENGEN** OR **HATEMUCH**.

DO YOU LIKE AN UNUSUAL AMOUNT OF CONTACT? WOULD YOU LIKE THE OTHER PLAYERS TO BE DEPENDENT UPON YOU FOR THEIR SUCCESS, AND BY HELPING THEM, PILE UP POINTS FOR YOURSELF? THEN YOU SHOULD BE A **MOVALL** OR **TRAVALL**.

WOULD YOU LIKE A WAITING LIST OF CUSTOMERS NEEDING YOUR SERVICES? WOULD YOU LIKE TO HAVE OTHER PLAYERS DOING YOU FAVORS, JUST TO KEEP ON YOUR GOOD SIDE? YOU SHOULD BE A **SELLER**.

DO YOU PREFER JUST A COUPLE OF FRIENDS AND ALLIES? WOULD YOU HAVE THEM BEGGING YOU FOR PROTECTION? PERHAPS FIGHT THEIR WARS AND HELP THEIR SIDE? THE **BADHUN** ROLE IS YOUR CUP OF TEA.

HOW WOULD YOU LIKE THE CHALLENGE OF BEING CHASED AND HUNTED? HAVE THE OTHER PLAYERS TRYING TO FIND OUT YOUR IDENTITY, BEFORE YOU HAVE TOO MUCH OF A LEAD? AND IF THEY DO DISCOVER YOU, HAVING TO USE WHATEVER FORCE OR DIPLOMACY AVAILABLE TO SURVIVE? THE **SEEKER** WOULD INTEREST YOU.

WOULD YOU LIKE TO BE CONSIDERED A NUISANCE TO THE OTHER PLAYERS? JUST KEEP COMMING TOWARD THEM, AND DARING THEM TO STOP YOUR EXPANSION? HAVE THEM DESTROYING THEIR OWN POPULATIONS IN THE HOPE OF SLOWING YOUR PROGRESS? YOU SHOULD BE A **MINDBEND**.

PERHAPS YOU WOULD LIKE TO BUILD AN EMPIRE, AND HOLD IT AGAINST ALL THE BAD GUYS THAT WANT WHAT YOU HAVE. COMPETE FOR EXPANSION. TRY BEING A **GREEDEX**.

MAYBE YOU WOULD LIKE TO BE THE **PREHIST**. HAVING OTHER PLAYERS ACTUALLY GIVING YOU ENTIRE PLANETS, JUST SO THEY CAN USE YOUR BASIC PRODUCT. THE OTHER PLAYERS SEE YOUR POINTS GOING UP, BUT THEY NEED YOU TOO MUCH TO BOTHER YOU UNTIL YOU ARE TOO FAR AHEAD, AND TOO STRONG. THE **PREHIST** IS MADE TO ORDER FOR YOU.

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the solution: since particles are streaming in all directions, they might somehow "miss" the singularity. But as stressed in Section II, anisotropic models contain *worse* singularities than the standard model.

Another possibility would be to come up with a source of negative pressure that would halt the universe from collapsing into singularity and instead cause it to "bounce." Believe it or not, there are several ways of doing this. The first is to reinvoke the cosmological constant. Recall we discussed how Einstein added such a constant to his equations to make his universe static. This constant could be thought of as containing a repulsive force just strong enough to balance the universe between expansion and collapse. Well, if you made the constant larger and more repulsive, it might keep the universe from collapsing into a singularity.

The good news is that you can indeed make the cosmological constant large enough to "bounce" the universe. The bad news is the cosmic microwave background. Astronomers are virtually certain this radiation was produced about 100,000 years after the Big Bang when the universe was roughly 1000 times smaller than it is today and at a temperature of about 3000°K. Now, if the cosmological constant caused a bounce, say from a previous collapse, this bounce had to occur at an *earlier* time than the microwave background was created. If not, we would simply have no background radiation. To accomplish this, the constant would have to be *so* repulsive that we would currently see the universe *accelerating* rapidly outward, whereas if anything, we observe exactly the opposite—the expansion of the universe is *slowing down* due to the gravitational attraction of all the matter within it. The problem is even more serious when one considers primordial nucleosynthesis. If the supposed bounce took place after the three minute mark of element formation (meaning the universe never got hot enough for nucleosynthesis) then we must explain the origin of the elements in some other way. If the bounce took place *before* nucleosynthesis times—allowing element formation in the standard way—the constant would have to be 10^{24} times larger than in the microwave background case and we would observe all the galaxies madly accelerating away from each other.

Large cosmological constants may be passé, but there is at least one recently famous theory that acts as if it had such a constant or negative pressure. This is the so-called "Inflationary" scenario first proposed in 1980 by Alan Guth and in a more recent form by Andy Albrecht, Paul Steinhardt and A. Linde. In Guth's theory the huge negative pressure drives the expansion of the universe exponentially fast for a brief period of time at around 10^{-35} seconds. This solves a number of problems in the standard model that have puzzled physicists for a long time. For instance, why is the observed matter density of the universe so close to the critical density needed to close it? Why is the ratio of photons to protons the large number

10^9? We do not have space here to give an adequate treatment of inflation, and refer the reader to the article by Guth and Steinhardt in *Scientific American*, May 1984. We only remark that, first, many questions about inflation itself currently remain unanswered; and, second, in many ways, the model is just a return to the Steady State Theory introduced in 1948 by Bondi, Gold, and Hoyle.

The Steady-State theory was based on the "Perfect Cosmological Principle," which states that the universe should be homogeneous and isotropic not only in space but in *time* as well. In other words, the universe must have looked the same in the past as it does now. But since the universe *is* expanding and galaxies *are* getting farther apart from one another, the gaps must be filled in to ensure that the universe *now* looks the same as it did *then*. Using words we have uttered before, matter is created.

How does Steady-State manage this sleight of hand? Well, with a cosmological constant. Always remember that the cosmological constant can be regarded as an extra energy term in the Einstein equations (resulting in the negative pressure). Specifically, it is a constant energy per unit volume. So, as the universe expands, its volume increases and therefore its total energy does too. Since matter and energy are really the same thing, by introducing a cosmological constant we must create matter.

Unfortunately, the Steady-State theory finds it virtually impossible to explain either the light elements or the cosmic microwave background, both of which require the universe to have been much different in the past than it is today—namely, very hot. For this reason, all but the most rabid fanatics gave up the Steady-State theory around 1965 with the discovery of the microwave background.

A final note on Steady-State and Inflation. We do not want to leave the reader with the impression that the two theories are identical. They aren't. The inflationary epoch supposedly ended at about 10^{-30} seconds while Steady-State is supposedly good now. But they both require an effective cosmological constant, both have matter creation and both describe the expansion of the universe in the same way. In the Steady-State theory there is no initial cosmological singularity—by assumption, since the universe always looked the same as it does now—and the cosmological constant is truly constant. The inflationary scenario does not directly address the issue of the singularity and, moreover, the cosmological constant, while once very large, is now zero.

So what do we finally do about the singularity? Inflation doesn't solve the problem, Steady-State conflicts with observational evidence as do other Big Bang theories with large cosmological constants. There may be a way out. One might simply assume the existence of matter with negative energy—in other words, matter that is gravitationally repulsive. This in turn would produce the large negative forces needed to bounce the universe instead of letting it collapse into a singularity. At first glance such

an idea might seem absurd, as all matter we observe in the universe is gravitationally attractive. But what is absurd at first glance may not be at second. It is thought that when the universe was very young—less than 10^{-43} seconds old, and very hot—10^{32}°K, quantum effects would come into play which would effectively cause matter to have negative energy. If this is actually the case, then it is quite likely a singularity can be avoided. But here we are standing on the edge of a deep abyss of speculation because a coherent theory of quantum gravity has yet to be developed.

We have presented the reader with a number of cosmological models: isotropic, closed, open, anisotropic, inhomogeneous, halls of mirrors. Variable-G with constants, without constants, Big Bang and Steady-State, Inflation and Quantum. Each has its attractive features and each has its failings; undoubtedly the reader has a headache. In the end we must simply say we don't know. But before the end, we should remind our audience that the Garden of Cosmological Delights is very large. Someday you may run into tired light (the universe is not expanding at all—light gets "tired" as it travels and this causes the redshifts astronomers observe); or Kaluza-Klein (the universe has eleven dimensions); what abut other supergravity theories? (the universe has any number of dimensions); then there are early dust-like stages and scalar fields, GUTS and Susie GUTS . . .* The list could go on almost indefinitely. But for the time being we have run into a singularity and will call a very abrupt halt. ■

**Editor's note: In fact, if you've been reading* Analog *regularly, you've already met some of these in recent issues.*

● Paul DeHart Hurd, professor emeritus of science education at Stanford University, says more than half of all children complete the sixth grade without ever having experienced a well-taught science class. By the end of third grade almost half the children say they would not like to study more science. And by tenth grade two-thirds are not confident of their ability to learn science.

Fred M. Hechinger,
The New York Times

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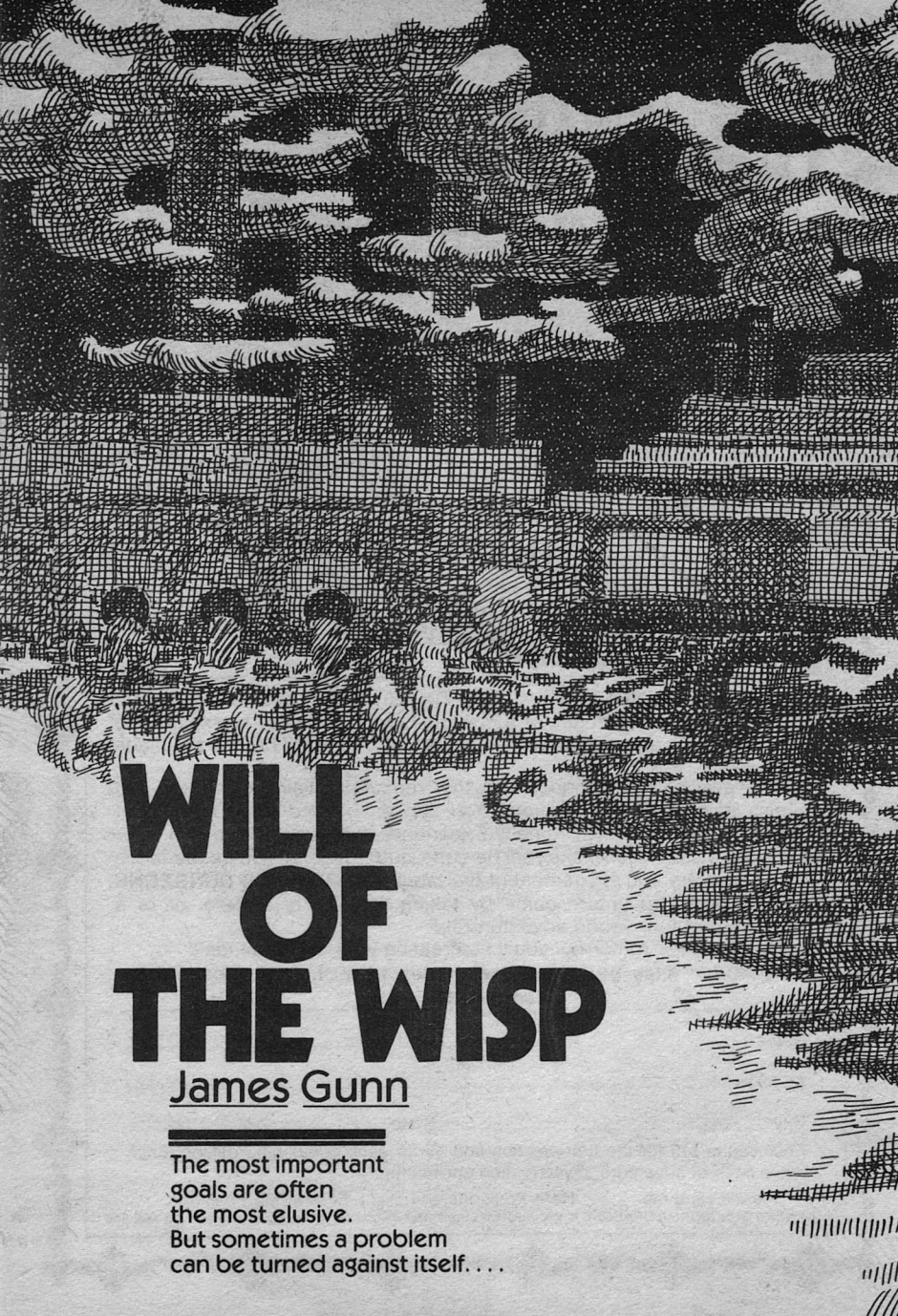

WILL OF THE WISP

James Gunn

The most important
goals are often
the most elusive.
But sometimes a problem
can be turned against itself. . . .


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The sun rose behind the mountains like a bloodshot eye peering after the fleeing bus. Dawn should have revealed a fair prospect of fertile farms and grazing animals, but haze lay across the plain and the bus dived into it as if trying to escape a pursuing Polyphemus.

In a seat next to a window, the man who had no name stirred and opened his eyes. They were dark and strangely empty, like the eyes of someone who has been awakened from a dream and does not remember who or where he is. His face was honey-colored and pleasant, good looking but not memorable. He was not a boy, but his skin was smooth, unlined by time, unmarked by events.

He sat up straighter in his seat and adjusted the gray tweed jacket. A wince crossed his face as if his body had reminded him of a night spent trying to lie flat in a place that inclined only a few degrees from the vertical.

The man looked around the bus at the heads of the other passengers. Most of them were sleeping or had their eyes closed, but a few stared stonily at the back of the seat ahead of them or with unseeing eyes out the window beside them.

The turning of the wheels on the interstate highway beneath them enclosed the passengers in an environment of unrelenting sound and vibration. The odor of urine and feces soured the air. The man looked toward the rear of the bus where an enclosed cubicle indicated a toilet that had been pushed beyond its capacity.

The man sank back in his seat and looked out the window. The mist swirled as the bus passed. Occasionally it lifted to reveal brief glimpses of the countryside. It looked like a battlefield after all the soldiers had been buried.

Harvest was over. A few stalks of corn stubble remained in the baked fields. But, by the evidence of the scattered stalks, the harvest had been meager. Occasionally, back from the road could be seen a discouraged farm house and deteriorating outbuildings. Rusting machinery or the remains of old cars littered barnyards and the corners of fields. A few animals, bony cattle and horses, forlorn sheep and ever-hopeful goats, tried to forage in dry pastures or licked mud from the bottom of dry ponds.

The man staring out the window looked pained, as if he were gazing not at the landscape passing but beyond that into a circle of the inferno. Even after the fog closed around the bus again, and nothing could be seen, he continued to stare, until finally, as if he had seen too much, he turned away and began to search through his pockets.

Finally, in his inside jacket pocket, he found a ticket envelope with neat words printed precisely across it in pencil.

"Your name is Bill Johnson," he read. "You have saved the woman who will be the single most important factor in saving the world from overpopulation, and you don't remember. You may read stories in the newspapers about her accomplishments, but you will find no mention of your part in them.

"For this there are several possible explanations, including the likelihood that I may be lying or deceived or insane. But the explanation on which you must act is that I have told you the truth;

you are a man who was born in a future which has almost used up all hope; you were sent to this time and place to alter the events that created that future.

"Am I telling the truth? The only evidence you have is your apparently unique ability to foresee consequences —it comes like a vision, not of the future because the future can be changed, but of what will happen if events take their natural course, if someone does not act, if you do not intervene.

But each time you intervene, no matter how subtly, you change the future from which you came. You exist in this time and outside of time and in the future, and so each change makes you forget.

"I wrote this message last night to tell you what I know, just as I learned about myself this morning by reading a message printed on a piece of cardboard, for I am you and we are one, and we have done this many times before."

The man who now had a name, Bill Johnson, stared down at the envelope as if he were trying to deny its existence and then, with a kind of revulsion, he tore it into small pieces and tossed them into the litter on the floor. He turned to look out the window again. The fog lifted for a moment.

The highway was passing beside a broad river, but the water was mud-colored, as if it had swallowed a thousand farms, and its surface had a gray-green sheen. Nothing moved in or above it. The countryside had given way to shacks that had grown up like toadstools on the flat land alongside the river. Sad-faced children stood among them, clothed in rags, bellies protruding, watching the bus pass their small corner of the world, appearing out of nowhere, disappearing into the unknown.

The shacks evolved into more permanent dwellings; once decent houses, their owners had long since ceased to care about appearances. Their walls looked as if they had never seen paint, and the bare soil around them was littered with abandoned junk, old boxes, and discarded papers. Factories raised their concrete and sheet-metal barricades along the river bank and, in stinking gushes, exhausted their wastes from big pipes into the sullen flow beneath.

As Johnson watched he saw a remarkable phenomenon: the river began to burn. Flames licked across the surface like red and blue sprites dancing on the water. It was like a sign from whatever fallen angels ruled this particular region. From a distance it seemed marvelous, but as the highway drew the bus closer to the river Johnson could see oily smoke ascending into the clouds hanging close above, before the fog closed in again.

Johnson shut his eyes and leaned his head back against the seat as if he were trying to forget what he had seen, but then, as the bus slowed, he opened them again. The bus stopped, and the universe of sound and vibration in which the passengers had existed for so long suddenly ended. People stirred and irritated voices demanded to know what was going on.

"Are we there?" an older woman asked.

"Breakfast stop, twenty-five minutes," the bus driver announced gruffly.

"That's hardly long enough to wash our hands," a man complained behind Johnson, "much less get rid of enough

of this bus stink to be able to eat anything.''

''Twenty-five minutes,'' the bus driver repeated. He opened the door, and the stench of the world outside poured in. It had not been fog but smog, filled with smoke and other irritants, seen and unseen.

''I wasn't hungry anyway,'' the man said behind Johnson.

But Johnson shifted and stood up. He started down the aisle, and then, as if by afterthought, reached back and took a suitcase out of the rack above his head.

''Just a stop, mister,'' the bus driver growled as he saw the suitcase.

Johnson looked at the diner on the frontage road beside the burning river. It was not in much better repair than the shacks and decayed houses they had passed. ''EAT,'' read a sign above the front door. ''Fine Food,'' said an unlighted neon sign in a fly-specked window. Whatever fine foods had ever existed inside the building had long ago turned into wastes.

A double row of gas pumps lined a cracked concrete island where the bus stood, and a small building housed a sleepy attendant and a couple of doors that said ''Men'' and ''Women.'' ''Thought I might clean up,'' Johnson said. ''Maybe even change.''

''Thirty-five people gotta use them johns,'' the driver snarled.

''I won't be long,'' Johnson said, and brushed past, walking toward the door marked ''Men.'' But he kept walking and found himself beside the riverbank where a trail had been beaten through weeds and brush. On his left was the burning river. On his right was an impenetrable forest of scrub trees.

The purposefulness with which Johnson had left the bus deserted him there, as if he had only enough will power for a single act. His shoulders drooped, and he stared without expression at the dirt path as he put one foot in front of the other.

He came upon the dump along the riverside about midday. The city had grown around him. The skyscrapers were still in the distance, but the buildings on the other side of the river and those he could glimpse above the river bank on his side were larger and more permanent. The dump was an area where the bank had widened or been dug out. Trucks pulled up to the road above and let loose small avalanches of trash. Dust billowed. Pickups and cars contributed their sly plastic sacks. The place had a stink of rot and moist decay that was different from the general odor of industrial effluents and machine exhausts. The dump odor was so omnipresent that it became the way the world was and was soon forgotten.

Johnson put down his suitcase and rubbed his elbow. He was about to sit on the suitcase when a voice spoke behind him.

''Welcome to Hell!'' a man said easily.

Johnson turned. Behind him stood a small man in the remains of what might once have been a gray business suit. But he had no tie on the ragged collar of his white shirt, the suit was torn and droopy, and he carried a shopping sack. He was white-haired and had several days' growth of white beard on his face, but his eyes were blue and bright and he gave the illusion of being dapper.

"Thanks," Johnson said. He smiled briefly.

"Are you abandoning hope," the other said, "or just slumming?"

"I don't know," Johnson said.

"A bit of indecision never hurt anybody in this place," the other man said. "Most people don't arrive with suitcases, however," he went on. "A few got knapsacks or bedrolls. What you got in there? Going to share? Or hide it out?"

"I don't know," Johnson said. "I mean I don't know what I've got in here." He knelt down beside the suitcase and opened it. "I'd be glad to share."

The little man gave him an odd glance. "You're a strange duck," he said. "Stranger than most." Then he gave his attention to what Johnson was revealing in the suitcase: a few shirts, underclothes, pairs of socks—all serviceable but worn. "Thanks," he said, "but I'll keep my own. Fit better, too. Some might steal those, however, even here, where people are honester than usual. Better keep them close by."

Johnson closed the suitcase and laid it flat. Then he emptied his pockets on it: a few coins, a pocket comb, a bus ticket to Kansas City, and a billfold that contained five bills—two ones, two fives, and a ten. He also had a plastic-encased social security card made out to Bill Johnson and a Visa charge card made out to the same name.

"Help yourself," Johnson said, gesturing at the little pile of belongings as if he had no sense of ownership.

The little man leaned over and gently extracted one dollar bill from the heap. "More would lead me in the wrong direction," he said cheerfully. "I'd begin to want things again. You'd better put the rest away where they won't easily be found. Particularly that." He indicated the charge card with his toe. "A person could do a lot of damage to himself with one of those."

When Johnson had stowed things away, the little man said, "Now that we've got rid of the preliminaries, maybe we should introduce ourselves. I'm Sylvester Harding Vines, Jr. But people around here call me 'Duke.' "

"Bill Johnson," Johnson said.

They shook hands formally.

"What did you do before—?" Johnson looked around the dump.

Duke raised a small, white hand. "You can get away with a lot of things around a place like this, but one question nobody asks is what you did before or why you're here. All of us got reasons, some guilty, some painful, and people who go poking around are considered antisocial."

Johnson didn't say anything.

"Having said that," Duke went on brightly, "I must add that you seem a bit confused. Something you need help with?"

Johnson took a deep breath as if he was about to speak and then shook his head. "I don't know."

"If it comes—" Duke said comfortably. "Meanwhile, maybe you'd like a bite to eat." He fished around in the shopping sack and came out with a couple of apples. "Got a bruised spot or two," he said, "but you can eat around those if you're particular."

Johnson picked up his suitcase and they walked along in the direction Johnson had been going, toward the city,

munching on their apples. Johnson pointed at the flames on the river. "How long has that been going on?"

"Off and on for the past ten years. It burns out in a few hours—and then the pollution starts building up again. Nobody seems to care. Seems to be happening more often now."

"Nobody does anything about it?"

The little man shrugged. "Gets rid of the pollution better than most things. Oh, used to be the fire boats would get out here and try to smother it with chemicals and such, but that seemed to be worse than letting it burn. Bother you?"

"I look at it and see a world dying in its own wastes," Johnson said, as if he were a million miles away.

"No worse than a lot of things," Duke said. "But I can see that it might depress somebody who had a future. You got a future?"

"I don't know," Johnson said.

"A whole lot of things you don't know," Duke said, giving him a sidelong glance. "But that's your business. Come on. I'll introduce you to some of the guys."

They sat with their backs against a clay bluff that had been blackened and hardened by old fires whose odors still lingered, but they were difficult to distinguish from the fire over which the communal evening meal had been cooked. The fire still burned fifteen feet away toward the river, and a large, sooty pot still hung from an improvised metal support above the fire. The pot had been salvaged some months ago, Johnson had been told, by Smitty, a tall wiry man of indeterminate age who was the luckiest junk picker of the whole group. In the pot was some mulligan stew left over after everybody had eaten his fill out of old tin cans and assorted metal objects beaten into the shape of plates and cups.

Almost everyone had contributed something to the meal except Johnson: a few potatoes here, a couple of carrots and turnips there, an onion, a clove of garlic, a piece of meat into whose origin and age nobody inquired, a battered can of tomatoes opened with a hunting knife, a few shakes of salt and pepper from a hoarded store, and other assorted seasonings.

"That was good!" Johnson had said, as he wiped up the last of his meal with a piece of stale French bread.

"Meals eaten in the open air and all that," Duke had said.

Johnson had met some of the other dropouts. Most of them were men, and all except one or two were middle-aged or older. The young ones had something wrong behind their eyes. The older ones had simply given up on any kind of future. They wanted to think no further ahead than a few minutes. But those minutes they filled with useful activities.

Many of them searched for usable items in the trash dumped by the big trucks. These they cleaned as best they could and sold to second-hand stores for pennies; some they repaired with surprising skill and used themselves. One craggy old man spent his days turning objects he found in the trash into strange sculpture, which he left along the river bank until mischievous boys or high water destroyed them. He did not seem to care. He contributed little or nothing

to the evening meal, but he was fed anyway.

Some scavenged through the dumpsters of nearby supermarkets and restaurants for edible materials too damaged or old or stale to sell. They would return, like Santa Clauses, with their sacks of plenty. The women seemed particularly good at this. The women were all old. They had the swollen joints and painful movements of arthritis, but they seemed otherwise in good health.

None of them spent money for anything but medicine or tobacco. When food ran short, they went, reluctantly, to soup kitchens and other charities.

The rest of them had now scattered to different parts of the area adjacent to the dump. Actually, Duke had explained, it was over the dump. This part had been filled up and covered with dirt. Beneath was a midden waiting for some future archeologist to unearth its treasures.

The river had stopped burning, but Johnson still stared at it as if it held an answer he was seeking.

"Is this what you were looking for?" Duke said.

Johnson stirred. "No. But maybe it's better."

"There's worse. That's for sure." The distant campfire cast a ruddy glow against Duke's face. He looked as if he were thinking about a place that was worse.

"What do you do in the winter?"

"Some go south like migrating birds. Some find an old building to hole up in. There's a lot of those around. Nobody fixes things any more, and it costs money to tear them down. Some just tough it out here, with boxes and shanties. A few die, some from exposure. But there's always replacements, and everybody dies sooner or later."

"Nobody tries to help?"

"Once in a while a social worker will poke around, once in a while a do-gooder will remember the forgotten people and try to rescue us, once in a while a church will try to redeem us. More often the cops will bust our heads and try to send us somewhere else. We always come back, because this is home. Is this home for you?"

"I wish it were," Johnson said.

"There's always room. If you aren't particular, you can make out on what society throws away."

"I can see that," Johnson said, "and it's very attractive. But I think there's something wrong with me."

"There's something wrong with all of us here, at least the way the rest of the world looks at it. We've given up, and it feels good."

"No, there's something wrong with me the way people here look at it," Johnson said. Then, as if changing the subject, he asked, "Can you look out there and see how things are going to be?"

"Not if I don't want to," Duke said. "And I don't want to. That's why I'm here. I got tired of worrying about the way things were going to turn out: kids, marriage, career, the stock market, the economy, the country, the world. . . . Once you start worrying there's no place to stop unless you just stop entirely."

"I can see that," Johnson said. "Maybe it's just me."

"You really see things?"

Johnson put his right hand in front of his eyes. "I look out there and see a

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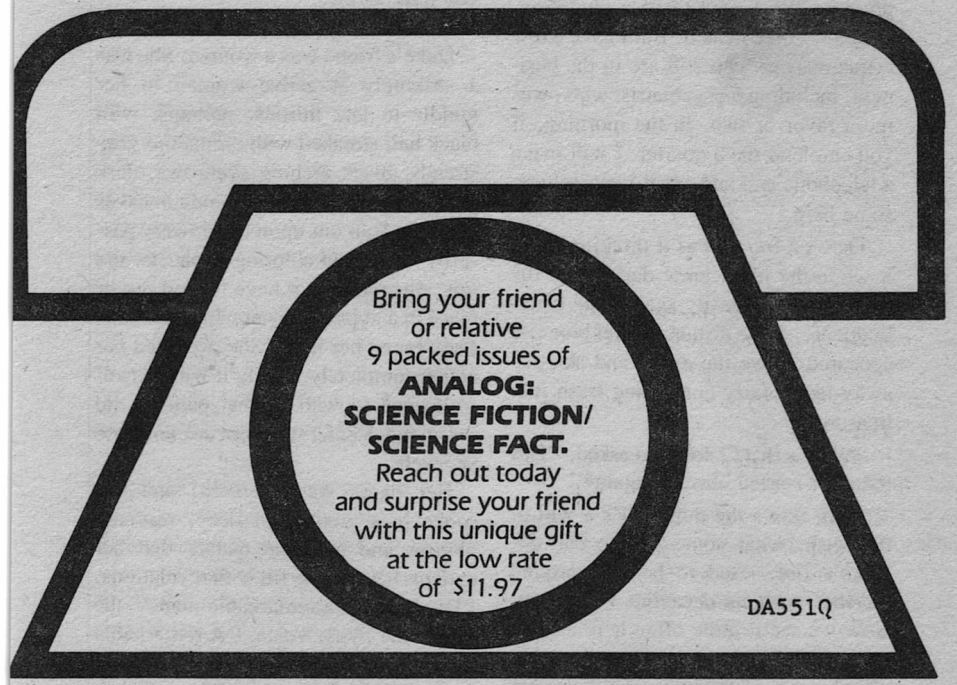

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world that can no longer even breathe: people choking, gasping for air, and each breath sears their lungs. The food is poisoned and the water is ruined; the world is burning up with heat it can't get rid of.''

''You really see this. You don't just imagine it.''

''I really see it,'' Johnson said, ''and I have a desperate need to do something about it.''

''You do have a problem, friend,'' Duke said. ''I'll tell you what: in my previous life I used to be a physician. I couldn't cure myself. But I have a few acquaintances who still are in the business, including a psychiatrist who owes me a favor or two. In the morning, if you can lend me a quarter, I will make a telephone call and see if I can get you some help.''

They sat for a bit as if thinking about it while the night grew darker and the river sloshed greasily against the bank. Suddenly, in the distance, brief blue fire appeared above the dump and skipped away like a fairy converting trash into treasure.

''What's that?'' Johnson asked. ''Has the river started burning again?''

''No, that's the dump. It's a will of the wisp, what some people call St. Elmo's fire. Used to be seen around marshes with its decaying vegetation. Now we see it quite often here as garbage, newspapers, and other vegetable matter is converted into today's version of marsh gas.''

''What's marsh gas?''

''Methane. Also called firedamp when formed in mines. CH_4. The principal ingredient in natural gas. Some places are digging gas wells in old dumps to recover the usable methane.''

'' 'Will of the wisp,' '' Johnson mused.

''Also means an elusive or deceptive object. The story goes that people used to pursue it across a marsh until they drowned.''

''Yes,'' Johnson said, as if he were agreeing how easy it would be. ''Do you think your friend can help me?''

''Well, now, I don't have much faith in 'help' any more. The question is: do you have faith?''

Duke's friend was a woman. She was a strikingly attractive woman in her middle to late thirties, perhaps, with black hair streaked with premature gray strands, black arching eyebrows, dark brown eyes that seemed to hide in caves and then leap out upon the unwary passerby, and vivid coloring in cheeks and lips. She would not have looked out of place in a gypsy caravan with a bandana tied around her head. She occupied her office completely, filling it with herself from wall to wall so that patients did not so much enter the room as come into her web.

Her name was Roggero, and she spoke in a mixture of deep, resonant phrases and pregnant pauses that her patients hastened to fill with revelations. ''Dr. Vines is a remarkable man,'' she said in her gypsy voice. ''A remarkable man. He is not an old man. Did you know that? No older than his late fifties. He likes to let people think he is older, because the world does not expect as much of them. Society lets older men alone. But he is still a better man than anyone I know.

"He was a man of great personal power. He was not just a physician. He could cure people, yes. But he shaped people's lives. He shaped government and industry. He shaped this city. He was the force behind the building of this complex. He worked to make life better. He helped people. He is responsible for my being here. The ghetto family that took care of me after my parents were killed in an accident brought me to him for treatment and he saw the anger in me, and he got me schooling and training and channeled that anger into helping others. He has had much tragedy in his life, and if he is where he is today, that is his decision and his story to tell. What you should know if I am to help you is that I would do anything for him. Anything.

"Some people do not understand our relationship: This little, white-haired man and this young woman of strong passions. But they do not know him. No one really knows him, even I, and no one knows what a man is like with a woman. But I know him best. So, I will help you. Dr. Vines has asked me to help you, for what reason I do not know and I do not care. There will be no talk of money.

"Now, tell me what troubles you."

So Johnson, who had listened to her colorful confidences with the attentive face of someone who is good at listening, told her what troubled him. They sat in her office in a tall building in the center of the city, she in a padded chair behind a darkly gleaming desk that had nothing on it except a pad of ruled, yellow paper and a gold-colored fountain pen, and he in an upholstered armchair beside the desk. He talked in a low, clear voice about his experience of waking up the morning before in a bus and not knowing who he was or where he was going, of staring out the window at the desolate countryside, of finding a message.

"Do you have that message with you?" she asked.

"I tore it up and threw it away."

"Why did you do that?"

"It suddenly seemed too much."

"In what way?"

"I could not believe what it seemed to tell me."

"And what was that?"

"That I came from the future. That I intervened in the problems of the present to solve them, to make the future better. That whenever I changed things I forgot who I was, and that was why I kept leaving messages. That this had happened many times before."

"If you looked around at the world, you would not see much evidence that someone exists such as you describe."

"Yes, it's crazy."

"On the other hand," she said, "the world is in a bad condition. Someone like that would be a godsend."

"There's no reason to think he could exist."

"No," she said. "That is the difficult part. But it is easy to understand why a person looking out at the world might feel compelled to do something about it."

"Yes."

"Might even feel in some way selected."

"You're saying that my delusion is natural."

"No delusions are natural. They are a failure to recognize and cope with real-

ity. Sometimes, when conditions are bad and no solution seems possible, delusions may be an understandable response. People with systems of delusions are often happy and can even function normally so long as those delusions do not come into conflict with reality. You are troubled because your belief system has come into conflict with what you believe to be reality."

"What I believe to be reality?"

"There are all kinds of realities, and none of us can be sure we share the same one, if there is one. But we have not established yet that you have a delusion."

"What else could it be?"

"That is what we must determine before we can treat it. But you must have some evidence to support what that note told you, or you would simply have dismissed it."

"I have—visions," Johnson said with a helpless spreading of his palms. "That is what the note said, and it seemed like confirmation."

"What kind of visions?"

"Like a glimpse of another view of what I've been looking at. But it's grimmer. Darker. As if it's the future, or the way the future will be unless someone does something about it. It's disorienting. Makes you dizzy at first, like a briefly glimpsed scene that's the same but different, thrown into the midst of a movie you're watching; and then you get used to it, or at least I did. You learn to ignore it for practical purposes. But it's what the vision implies that is disturbing."

"What does it imply?"

"At first I thought everybody saw visions like that, but I've asked, and nobody admits it."

"You think they're lying?"

Johnson slowly shook his head. "I hoped they were. Do you ever see such things?"

"I'm sorry. Are you seeing them now?" Johnson nodded. "What do you see?"

Johnson looked away from her and stood up. He walked to the window and gazed down toward the street far below. Yesterday's fog had lifted, but the air was hazy and tinged with yellow. Vehicles moved like brightly colored beetles along the street, adding their exhausts to the general level of pollution.

"The smog thickens," Johnson said in a monotone. "The automobiles dwindle, like dinosaurs dying out. Garbage and trash pile up in the streets. Nobody takes it away. Children and old people die in the streets. They fall over. They gasp. They stop breathing. People are robbed and raped and murdered. Plagues break out. People flee, but the countryside is only a little better. Finally everything is still."

Dr. Roggero was silent for several minutes. "And you want to stop seeing these things? You want to be relieved of the compulsion to do something about them?"

Johnson turned back to her. "Oh, very much," he said.

Dr. Roggero's office building was one of a group of buildings clustered around a plaza. The group included a theater, a conference center, a hotel, and a collection of shops, all of them served by an underground garage. In the center a fountain sent plumes of spray high in

the air, and occasionally, when the wind was strong, sprinkled the nearest benches or passersby.

The plaza was clean. Uniformed attendants moved between the benches and the stone trash containers with broom and hose, with polishing cloth and plastic bag. The plaza was like an oasis in the midst of a desert, but even here the air itself was visible as fumes rolled through it from the street and smoke and fog blew in from the river.

Johnson stopped just outside the entrance to the office building as if adjusting from the air-conditioned fantasy he had left to the reality ahead. He was neat. Dr. Vines, Duke, had shown him how to use the public restrooms to make himself presentable and admired the fact that he didn't need to shave. "Vinya won't care," he said, "but the people in uniform, the elevator attendants and the receptionists, may give you trouble. Always watch out for people in uniform. It gives them delusions of power."

As Johnson was crossing the plaza heading back toward the river, a woman's voice came ringing across the concrete and stone. "Bill!" it called. "Bill Johnson!"

Johnson turned. Behind him, hurrying across the plaza from the conference building, was a woman. She was cool and blonde and beautiful in a gray, summer-weight dress. She carried a folder under one arm and had a gray leather bag slung over the other. Her eyes were gray and appraising as she got closer.

"Bill," she said breathlessly. "I thought it was you, but I couldn't be certain."

He looked at her courteously but without recognition. "Do we know each other?" he asked.

And at the same moment she said, "You don't recognize me, do you?"

She laughed with just a trace of embarrassment and broke off and looked at him. "You haven't changed," she said. "Maybe a little sadder."

"I'm sorry," he said. "I should know who you are, but I seem to have forgotten a great deal. It's a mental problem. I'm seeking treatment."

She put a hand on the sleeve of his jacket. "Oh, Bill," she said. "You told me that you would forget me, and I didn't believe you. I couldn't believe you. We were very close once. I left you a tape recorder with a message on it, don't you remember? Of course you don't remember.

"Look, I'm rattling on, I know. I'm not like that usually. I don't act flustered and helpless, but I never thought I'd see you again. I was hurt and angry and then sad, after what we'd been through —and now you don't know me. It's all too much."

"I know," he said.

"It must be worse for you," she said. People were beginning to stop near them and stare curiously at this unusual couple. "Oh, no, not worse. Just different." She caught her lower lip between her teeth as if to stop the words from coming out. "You don't know how many times I have thought I saw you and called or run after a man, only to discover he was a stranger. And now, of course, to you I am a stranger. If we could just have a few moments together—but it wouldn't be any good now. I'm too upset, and I—"

She paused as if trying to pull herself

together and talk calmly. "You are Bill Johnson, aren't you?"

"Yes."

"I accept the fact that you don't know me. My name if Frances Miller. I'm the managing editor of the Associated Press, and I'm here for a conference. On what else? Pollution. I'm staying in the Hilton there. Remember the Hilton? In New York? No, of course you don't. I've got to rest. But I want you to promise me something: come see me tonight when I'm myself. In memory of what we did together, even though you don't remember it."

"I'll try," he said.

"Oh, God!" she said, turning away. "I know you'll try. But will it be enough?" And she almost ran toward the entrance of the hotel.

They sat once more with their backs to the bluff, Johnson and Duke, watching the river burn in the dusk. Sometimes the colored sprites ran across the water and onto the land, and sometimes the will of the wisps seemed to dance to the water's edge and hesitate, as if their magic ended where the river began, and then skip out to join the water spirits.

"A marvelous woman, Vinya," Duke said. "A little fiery at times. A bit overpowering perhaps. But I don't mind that in a woman. Some might."

"I liked her," Johnson said.

"But is she going to help you?"

"She says she is."

"She's confident, too. Maybe too confident. But then she hasn't had to face up to failure. You have to be confident, though, if you're going to succeed in the help business."

"I can see that," Johnson said. "If I really believed in my delusions, if I really thought I was in the help business, I'd have to appear confident, even when I wasn't. Faith is what it's all about."

"That's true."

"And the pollution business, that's one big problem."

"If you can see how it ends up, the way you do," Duke agreed. "But then the things you can't do anything about, you don't want to think about. That includes most things."

"What if you could do something about it, though?"

"That would be a difficult situation, wouldn't it?" Duke said. "But pollution isn't like that. It's a natural consequence of industrialization. It starts off small, when it doesn't matter, when the 'sinks'—the oceans and the air—seem bottomless, and then it builds until the sinks are filled up."

"Can't people stop the way they start?" Johnson asked. "People don't want to die. They don't want to run out of air or water or food. They don't want to kill birds and fish and animals."

"Not unless they can enjoy it or profit from it. Trouble is, the profit comes from doing it, and it costs too much to stop. Any one person who stops doesn't solve the problem; he just goes broke himself. It's what a man named Garrett Hardin calls 'the tragedy of the commons.'

"When people share something like a pasture, where they can graze their animals as much as they wish, if too many cattle are added to the pasture it will be overgrazed and destroyed, and nobody will be able to use it. But adding one more animal, or two or three,

doesn't injure the pasture. But it increases individual profits, so the rational act of each herdsman is to increase his herd, because the effect of his actions are minimal on the pasture but improve his personal situation significantly. It's like that with the world."

"What about government? Shouldn't it think about the welfare of the group?"

"It should, and there was a period in the '60s and '70s when government was doing something about it, and conditions were improving. But government isn't just people. It is industries and corporations and smaller units of government, and the constituencies for the general welfare are never as vocal or as well financed as the special interests. And people have never been good at putting off a present benefit for a future good. The general welfare is abstract and unfocused; making a profit or avoiding a loss is specific and sharp.

"No," Duke said, and laughed. "I'm reminded of a reply that Ralph G. Ingersoll, the famous agnostic, made to the fundamentalist minister who baited him with the question as to how he would improve the world if he were God. 'Why,' Ingersoll said, 'I'd make good health catching instead of sickness.' I reckon we won't get rid of pollution until we can make a profit out of it."

They looked out past the firelight toward one of the old man's sculptures. It had been put together from driftwood and automobile parts, and it looked like a crucified robot.

Once more they sat in Dr. Roggero's office. She was like a goddess presiding over the altar of her desk, he like a worshipper in the chair beside it.

She toyed with a slender metal letter opener as she studied his face and said, "Dr. Lindner reported a case that later become famous in which he cured a patient by falling in with his delusions and then convinced him of the fallacies of his logic."

"But I already know the fallacies of my delusion," Johnson said.

"Exactly. And you merely want to be rid of them. What if I told you to forget about them, and merely go on with your life, accepting the fact that you have this mild delusion that seems to do no harm?"

"I could do that," Johnson said. "But what about my visions? And what about my feelings of guilt?"

"Why should you feel guilty? You know that you did not come from the future."

"Certainly the likelihood is very small," Johnson said.

"But it is still a possibility?"

"Isn't it?"

"Of course. But then so are the bases of every other delusion. The problem is, if we act upon them, we run into inconsistencies."

"My delusion has no inconsistencies. It is only unlikely. What can one man do in the face of so many problems? How can one person make a difference when pollution is so omnipresent?"

"If everybody felt like that, nothing would ever get done."

"The fallacy of the irrelevant individual makes a nice complement to the tragedy of the commons," Johnson said. "But I have heard of such things as catalysts, substances that make chem-

ical reactions possible without participating in them. If they are present, the reaction proceeds. Without them, nothing happens. Maybe there are comparable situations among people. Maybe it takes only one person to get something going, to make a difference. It's ridiculous to think that I am that sort of person, but knowing how bad situations are going to become, or the possibility that I know, means that I must feel guilt if I don't act."

"Do you know what your situation reminds me of? 'For God so loved the world, that he gave his only begotten son. . . .' "

"You think I have a Christ complex?"

"You suffer for the sins of mankind," she said drily.

"Not on purpose," Johnson said. "I don't think of myself as Christ. I'm just a poor suffering bastard caught in a psychological trap not of my making. And I'd like to get free."

" 'Lord, if it be thy will, let these things pass from me,' " she said.

"I don't feel in any way special," Johnson said. "Except that I have this vision. I don't feel divine. I don't feel like the son of God or the son of man. But how can one see the condition of the world and not feel guilty?"

"A certain amount of guilt is healthy," Dr. Roggero said. "It keeps us from committing crimes. It's society's way of teaching us how to be good citizens and our parents' way of teaching us how to be good people. A person without guilt is a monster. It's only when we feel unnecessary or excessive guilt that it becomes neurosis. To feel guilty about conditions you did not create and cannot change is unnecessary and excessive."

"Thanks," Johnson said, "but it isn't enough."

"I do not like to recommend radical measures," Dr. Roggero said, "but this is a special case. You are impatient, and I do not have the kind of time to devote to this case as might be necessary if we were to proceed with discussion and analysis. Successes have been reported, however, by such brute means as electrical shock or chemical counterparts."

"Would they work?" Johnson said quietly.

"There is a good chance," she said, studying his face.

He took a deep breath. "I want to go ahead with it."

"You will have to sign papers, authorizations, maybe commitments."

"I'll sign them."

"You realize that you may not be the same person afterwards."

"In what may?"

"It isn't customary to put it this way, but the kind of person you are will not exist afterwards."

"What kind of person am I?"

She looked at him as if she were seeing him not as a patient but as a person. "You are a kind and thoughtful person, a reasonable man, a good listener, a responsible person. You are a good man who may be overly concerned about doing good, but that is a benign condition. The world would be a better place if there were more people like you. There is a legend that Charlie Chaplin went to a psychiatrist for treatment, and the psychiatrist refused because curing the neuroses might destroy the underlying motivations of his art.

Do you know I might feel guilty if I helped you do this?''

''If I were the kind of person you describe,'' Johnson said slowly, ''I might be able to cope with it. If I could really do something about pollution—''

''How do you know you can't?''

''It just seems so—'' He sighed. ''—Overpowering.''

''There is one other possibility.'' She seemed to hesitate, as if she did not want to give him false hope. ''There must be people who knew you before you lost your memory. There must be records, social security records, credit records, birth records, school records. We go through the world leaving trails on paper, like so many snails. . . . If you could discover something that would confirm or deny the information on the piece of paper in your pocket—''

''Yes,'' he said, looking up. ''I could do that. That would help, wouldn't it, if I knew.'' He stood up suddenly as if he had just thought of something. ''Doctor, I've got to leave, to find somebody. Could you get in touch with Duke, with Dr. Vines. Ask him to come here to your office—Are you free over the lunch hour?''

''Yes. But I don't know—''

''That's two hours from now. If you can't find him, then I will search him out. But I would like him here. And thank you—thank you for your patience!''

She looked up at him, clearly surprised at how the office over which she presided so completely had been removed from her control, and then she nodded, accepting his independence.

When Johnson returned he had a woman with him. She was cool, blonde, tailored, and puzzled. Dr. Roggero was seated at her desk, but her attention was directed toward the couch against the wall. On it Duke was sitting, but he had shaved, cleaned his suit, and combed his hair. He looked almost like the physician he once had been. He grimaced apologetically at Johnson. ''I could not let Vinya see what a bum I had become. But you have a lady with you—''

''This is Frances Miller. She says she knew me once.''

''What's going on?'' Miller demanded. She turned to Johnson. ''You didn't come to see me last night.''

''I thought only pain would come of it. I was so wrapped up in my own problems that I couldn't see yours.''

''And now you grab me as I come out of a meeting and pull me upstairs like this—'' she continued.

''He needs you,'' Dr. Roggero said.

At that, Miller's face changed from anger to concern.

''He is a troubled man,'' the psychiatrist said.

''What's the matter?'' Miller said, turning to Johnson.

''I need to know,'' he said with intensity. ''What did we do?''

She looked at the vivid woman behind the desk and the white-haired little man sitting on the sofa. The man smiled and nodded. The woman stared at her. ''You want them to know?''

''You said, when we met in the plaza below, 'in memory of what we did together.' That wasn't the way you would have described a personal experience.''

''No,'' she said, looking down and then up at his face. ''But it may create problems for you.''

"They must be better than the ones I have," he said. "I think I'm crazy."

"Oh, no," Miller said. "You're not. You're—" She stopped again.

"What did we do?"

"We stopped World War III," she said. "You and I and a young fellow named Tom Logan."

Dr. Roggero's office had been audience to many revelations, but the implications of Miller's statement produced a silence that may have outdistanced any of them.

Duke broke it. "Johnson, my boy, you're not crazy. But you may have a more serious problem."

Johnson grinned lopsidedly as if he recognized the truth of Duke's remark. "Which would I rather be? A crazy Don Quixote? Or a sane one?"

"Are you going to tell me what's going on?" Miller demanded.

"In a few minutes," Johnson said, "I will go with you to a quiet spot where we can talk, and I will tell you everything I know. It isn't much, because all I remember about myself starts two days ago. It can't be the same between us as it once must have been. If we were intimate—" She glanced away and then directly into his eyes. "—I cannot hope for that again. I cannot even imagine it. But I can answer your questions, as you have answered mine and perhaps will answer more."

"We can make it the way it was before," she said fiercely.

"I like you," he said admiringly. "You are a person of conviction and accomplishment. But I must do something now that will destroy what few bridges we have been able to rebuild."

"No," she said.

But he turned to Duke and said, "When Dr. Roggero mentioned solving the pollution problem, I suddenly had a vision of a world free from wastes. Things I saw, things you said, began to fall into place."

"What kind of things?" Duke said. "I certainly didn't intend to be a problem solver. I'm not one of the help people."

"Oh, but you are," Johnson said. "You pretend not to be, but you can't keep from being the kind of person you are."

"That's what I keep telling you, Sylvie," Dr. Roggero said. "All the pretending in the world can't conceal that even from someone who has known you only a few days."

"You helped me. You helped Dr. Roggero. You have helped thousands of people. You help the dropouts at the dump. And now it's time to put yourself back in the help business officially."

Duke's face turned hard. "Never! You don't know what you're asking. There are things in my life—"

"Would you trade it for mine?" Johnson asked. "Would you like to forget everything every few days?"

Duke was silent.

"The will of the wisp," Johnson said. "A symbol of pollution. But some places, you said, were using marsh gas to do useful work. The dropouts at the dump. They exist by turning refuse into usable materials. They live on the wastes of society. Let's turn them into a resource."

"What do you mean?" Duke asked. He was skeptical, but he was listening.

"Let's turn wastes into a resource," Johnson said. "Wastes are only mate-

rials that nobody has found a use for. Let's set up viable commercial operations to find uses for wastes. You said that pollution would not be cleaned up until it became profitable. Let's find a way to make it profitable."

"That's a big job," Duke said.

"It's a job for scavengers. You can give people like that a purpose. Maybe a scavenger is only a person who hasn't found what he or she is good for. Give them a purpose. Give them status. Give them a job: cleaning up the environment."

"Not everything can be cleaned up that way," Duke said.

"I know it can't," Johnson said. "You believe the motivation to make a profit is more trustworthy than the motivation to do good. All right. Find a way to make a profit. It doesn't have to be a big profit. But there's another part to the profit motive: the desire to minimize loss. That's where Frances Miller comes in."

"Me?" she said.

"I'm sure your meetings here have discussed Federal legislation, and most of that has focused on forbidding pollution in various ways and various degrees. Mostly polluters have tried to find loopholes or lax enforcement."

"That's true," Miller admitted, "but I don't see what—"

"Let the polluters pollute," Johnson said, "but charge them for the privilege."

"How can any fee compensate for polluting everybody else's environment?" Dr. Roggero said.

"Wait!" Miller said. "Let him talk."

"You adjust the fee so that in the end it is cheaper not to pollute. It works better than absolute abolition because it is cheaper to enforce and leaves the decision about anti-pollution measures to the polluter, who is in the best position to know what to do and how to do it."

"But what about Duke's group?" Dr. Roggero said.

"And all the others like it," Johnson said. "Because this is a way to redeem not only material but human wastes. The fees that are collected from the polluters will go to subsidize the products of Duke's operations until they are self-supporting."

"Do you think it could work?" Duke said.

"If somebody makes it work," Johnson said.

"It might work," Miller said. "I'd be willing to help, and other news media could be persuaded to work on public awareness and political action."

"You could do it," Dr. Roggero said to Duke.

" 'We make money on what you throw away,' " Duke mused. "Might make people think about what they're throwing away. 'Your byproducts are our raw materials.' It could be interesting."

"You'll do it, then?" Johnson asked.

Duke did not answer directly but said, "What about you? It's your idea. You could do it."

"If things work out according to the message I read a couple of mornings ago," Johnson said, "I will start a new life tomorrow. A new challenge. A new crisis. A new vision of what might be, or what ought to be."

"No," Miller said faintly. Her hand went out to him.

"It must be difficult for those whose lives touch mine," Johnson said, "but my existence only looks painful from the outside. I can never see it from there. Each few days I earn the balm of forgetfulness. Only when I doubt—"

"I can fix that," Miller said.

Johnson sat on his suitcase beside the shabby diner at which he had disembarked three days ago. He looked out over the river. It was not burning now. It would burn again, no doubt, but less and less often, perhaps, as Dr. Vines's operation and the anti-pollution fee-system began to take effect. Discarded wastes still were everywhere. The odor of decay still filled the air. But the fog had lifted. No doubt it was a coincidence, but already it seemed as if the air was clearer and more breathable.

Johnson looked down at the ring on his finger that a jeweler had prepared to Frances Miller's specifications. It was made of gold. On the flattened surface was the word: "Crisis!" On the inside of the ring, if Johnson had removed it to look, were engraved the words: "It's up to you."

Johnson waited without impatience to resume the journey he had interrupted to a destination he no longer remembered. ■

● "As the King learns from the complaints of prelates and magnates of his realm . . . that workmen (in kilns now burn) sea-coal instead of brush wood or charcoal, from the use of which sea coal an intolerable smell diffuses itself throughout the neighboring places and the air is greatly affected to the annoyance of the magnates, citizens and others there dwelling and to the injury of their bodily health."

(England, 1307)

(The King forbade the use of sea-coal, but that didn't seem to work. The forges and kilns could not go back to wood. England had been importing wood from Norway since 1230 due to the shortage, and the price was still climbing. It was high-sulpher coal they were burning, and to people familiar with wood-fire, coal-fire raised new and perplexing problems.

(Oh well, that's all history, dead and gone. It could not possibly be relevant to any modern problems involving, say, oil or uranium.)

—Michael F. Flynn

on gaming

Dana Lombardy

Paranoia is one of the most unusual role-playing games published to date ($15 at your local store, or direct from West End Games, Inc., 251 West 30th Street, New York, NY 10001). As the title implies, this SF game about a future society controlled by a deranged computer is deliberately designed to make the players feel insecure about the safety of their characters in the game, about the reliability of their playing "partners," and about the intentions and motives of the referee or gamemaster. The box cover advises: "Stay Alert. Trust No One. Keep Your Laser Handy." This is good advice if you want to survive in this "role-playing game of a darkly humorous future."

Although the character you play in *Paranoia* may have a low life-expectancy, this is one of the few games in which you'll laugh at how your character is killed. In most role-playing games, your character can survive by exercising caution, and earns experience points and accumulates useful artifacts and treasure through adventures. *Paranoia*, on the other hand, pushes role-playing to the other extreme—caution often goes unrewarded, items you work hard to obtain are arbitrarily taken from you, and if it appears that your character is becoming too important . . . report to the nearest termination center.

This is very frustrating, and you do feel paranoid the more you play the game. It may seem odd that this can be called "fun," but *Paranoia* plays fast and is very funny.

The best way to explain what *Paranoia* is like as a game is to show what happened in an introductory scenario I was involved in.

There were three players and a referee for this introductory scenario. Each player's character in the game had eight dice-acquired attributes which gave percentile chances of accomplishing an action attempted during the adventure, such as jumping across a wide trench. These eight attributes were: strength, agility, manual dexterity, endurance, moxie (the ability to choose the correct course of action in inexpected situations), chutzpah (defined as "the quality of a man who kills both his parents and then pleads for mercy because he is an orphan"), mechanical aptitude (ability to understand machinery), and power idex (mutant power strength).

We three players were "troubleshooters" serving the needs of The Computer. Our mission was to retrieve equipment, weapons, and robot brains left in an area ambushed by "traitors." All the attacking traitors and all the loyal citizens in the area were killed. Our job was to go get the valuable articles and bring them back.

"Beware! Traitors are everywhere! You must immediately report any treasonous behavior or any suspicion of treasonous behavior to The Computer.

(continued on page 111)

J. Brian Clarke

EARTHGATE

The system was fully functional, except that the most important part of it was "locked off." And nobody knew what either the lock or the key might look like. . . .

"We have a problem," Peter Digonness said.

"Don't we all." Gia Mayland was in no mood to be sympathetic. She was still smarting because of the abrupt recall that had brought her from a beach in the Bahamas.

"It's about our search for the Earthgate," the Deputy Director of Expediters went on. "It seems someone does not want us to find it."

Gia raised a delicate eyebrow. "Now isn't that interesting."

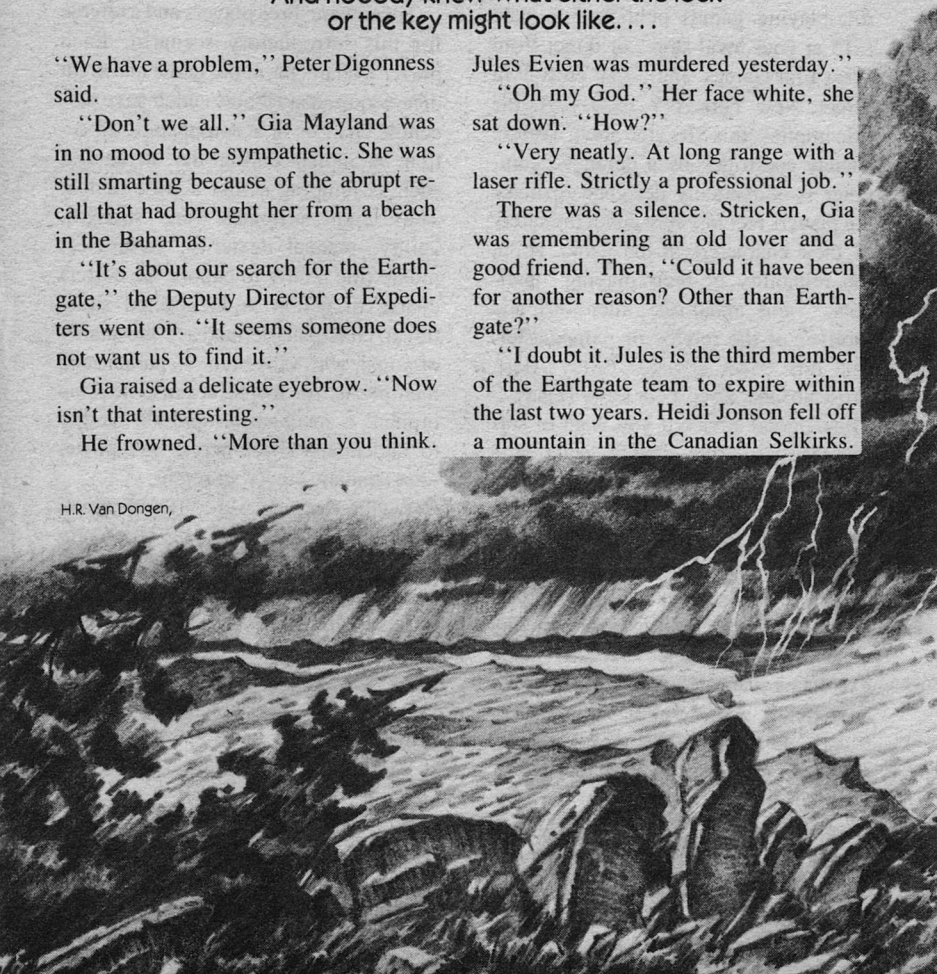
He frowned. "More than you think. Jules Evien was murdered yesterday."

"Oh my God." Her face white, she sat down. "How?"

"Very neatly. At long range with a laser rifle. Strictly a professional job."

There was a silence. Stricken, Gia was remembering an old lover and a good friend. Then, "Could it have been for another reason? Other than Earthgate?"

"I doubt it. Jules is the third member of the Earthgate team to expire within the last two years. Heidi Jonson fell off a mountain in the Canadian Selkirks.



H.R. Van Dongen,

Lynn Quoa died of apparently natural causes in a Denver hospital. Three out of the original seven who drew the assignment.'' Digonness shook his head. ''Pretty long odds, Gia.''

''But that makes Jules's murder a pretty stupid blunder, doesn't it? Now you are suspicious enough to wonder about what happened to those other two.''

''The murderer was pressed for time. Three days from now, Jules is scheduled for deep sleep aboard the *Farway*. I told him I thought we had been concentrating too much on the Earth end, and he agreed. He was going to set up an investigation on the Shouter.''

Brown eyes blank with thought, Gia slumped back in her chair. The Shouter, the instantaneous gateway to nearly twenty thousand destinations throughout the galaxy, was six hundred light years and twenty six months travel time from Earth. For Earth's sorely crowded billions, the Shouter was the access to unrealized dreams; a way to empty lands under clean skies and by unpolluted seas. But the waiting time was long; currently nearly twelve years to gain passage on one of the few dozen phase ships capable of making the trip. Millions more would undoubtedly apply if they did not have to wait a large portion of a lifetime just to get on a ship. So as long as that transportation bottleneck existed, the dream of Earth's being able to reduce its population to something less than bearable limits would remain a fantasy.

Her eyes strayed to the famous ''Earthgate Summary,'' framed and hung on the wall above the D.D.'s desk. Ornately lettered and presented to Digonness before he was transferred back to Earth from the Shouter, the Summary was a constant reminder that:

Item: Someone, somewhen, somehow, established the terminal for an instantaneous galactic transport system almost exactly between the home worlds of the only two known star-faring races.

Item: It takes more than two years for even the fastest ships to reach the Shouter from either of the two worlds.

Item: Of the nearly twenty thousand gates on the Shouter, there are two which do not lead anywhere.

Conclusion: That AAs 6093 and 11852 are the gates to Phuili and Earth.

Questions: Which of the two is Earth's? On Earth, where is the corresponding ''Shoutergate''? And how is the system activated?

Neat, concise and definitely logical. But like most of her colleagues in Expediters, Gia accepted the Summary as much on faith as on reason—because if there was any justice in the universe, it simply had to be true. If it were otherwise, populating the thousands of available worlds would be comparable to transferring Earth's deserts a few hundred grains of sand at a time.

Out of nowhere and completely irrelevent to her train of thought, a name popped into Gia's mind. ''Transtar,'' she said.

''I beg your pardon?''

Her eyes widened. ''That's it. The motive! Except for a few ships servicing the old worlds, Transtar has committed just about all of its resources to the Shouter run. So if Earthgate is opened up, it'll ruin them. The giant of the busi-

ness will become a corporate has-been overnight! Can you imagine a better reason to stop our finding Earthgate? Even if it involves murder?''

''Frankly, no,'' Digonness admitted smoothly. ''But with a motive that obvious, Transtar—*if* they are guilty—will have concealed their involvement behind false leads and middlemen enough to drown an entire army of investigators for years. So forget it, Gia. I did not bring you here to play gumshoe.''

''Neither did you bring me here just to tell me bad news!'' she shot back. ''Or did you?''

He looked at her. After a few moments, Gia's eyes dropped from his steady gaze. ''Sorry. I should not have said that.''

''No,'' He said briefly. ''You shouldn't.'' He did something behind his desk and the room darkened. A circle of light appeared and expanded. In the center of the field, set in a red-hued desert under an infinite sky, a huge saucer was balanced horizontally atop an incredibly slender pylon. Above the saucer, a pale sphere of flickering light. ''You know what that is, of course,'' Dignonness said.

Gia smiled into the darkness. ''You'd fire me if I didn't. Even kinder-schoolers can recognize a stargate.''

''Officially still an AA, alien artifact,'' he reminded her. ''That happens to be AA One, my own favorite.''

Gia nodded as she remembered the story. Peter Dignonness had been one of the early recruits to Expediters; the organization set up to ''expedite'' scientific cooperation. In the same way a translator facilitates verbal communication, a trained expediter can join a cacophony of scientific specialists into an efficient unity; often in the face of mutual suspicions and misunderstandings. Assigned to the Permanent Earth Research Unit on the Shouter, the young expediter triggered events involving PERU and the nearby Phuili base which were still reverberating across three worlds and into the galaxy. Within days of his arrival, Digonness not only proved to the condescending Phuili that humans are much more than primitives with a lopsided aptitude for technology, but in Partnership with one of the Phuili he also convincingly demonstrated the true purpose of the gigantic AAs—by flying

into the light above AA One and instantly arriving at a lovely world now appropriately known as Serendipity.

It made him famous of course. Which was not to the liking of this mild mannered man, who elected to remain on the Shouter while manned and unmanned vehicles began probing the thousands of worlds beyond the AAs. But talent often pushes an individual further than he wants to go, and after unrelenting pressure from Expediters Central on Earth, Dignonness finally —though reluctantly—returned home to take charge of the Earthgate search.

He pointed at the holographic image of the AA. "That is the main reason I am convinced we are wasting our time, Earthside. Three kilometers high and two wide—if such a thing exists on this planet, then every human being has been blind for—how many thousand years? OK, so perhaps it's disguised as something else, though God knows what. A thing that big would have to be concealed inside a mountain. The point is, if we don't know what we are looking for, then what are we looking for? If there is an answer at all, it can only be on the Shouter. Which, young lady, is where you come in. I want you to go in Jules's place."

Gia was not surprised. She and Jules were the only two who had been recruited into Expediters from the World Union Council's Security Service, so it was natural that the Deputy Director would seek her investigative talents. Nevertheless she decided to play cautious.

"To do what?"

"I would think that is pretty obvious. I want you to find out how to open the Earthgate."

She frowned. "Not what I would call a modest assignment."

Digonness folded his hands together and leaned forward on his desk. His gray eyes were intent, probing. "Believe me, if I could assign this mission to myself, I wouldn't hesitate. I have friends on the Shouter, of both races. But in their wisdom, the powers that be have decided the answer is on this planet, and that I must continue to direct the search. But at least I was able to persuade them to assign one of *Farway*'s sleep tanks to Expediters, so you won't have to put up with two years of boredom aboard an interstellar people-freighter. And because you have no close relatives—"

"—or emotional entanglements," Gia interrupted with a smile. "But you know that, don't you?"

Digonness looked slightly embarrassed. "I could not be sure of course. But I'm glad you confirmed it."

"That's nice of me," the girl said sadly.

"Dammit Gia, I'm offering the opportunity of a lifetime! Whoever or whatever put the AAs on the Shouter obviously intended them to be used. Which means that in some logical way there must exist a switch to turn on one of the two blank AAs to Earth. I'm even willing to lay down hard money that that switch is there for the eye to see, in full view. So please girl, use your special talents to find it, huh? Turn on the Earthgate!"

Sleep tanks were such hugely expensive and complex pieces of equipment,

most emigrants to the new worlds still had to suffer through more than two years of confined existence aboard one of the fleet of ships built specifically for the Shouter run. So when Gia Mayland was revived a week before the *Farway* arrived off the Shouter, she was not surprised at the hostility of her fellow passengers. The fact she was an expediter made little difference. That once glamorous profession was now merely respectable, another way to make a good living. But the hostility was not really a hardship. The crew were cooperative, and in any case Communications had a backlog of tachyon-wave messages for her. Most were routine, though the most recent one from the Deputy Director was ominous.

UP TILL RECENTLY WE HAVE REMAINED COMPLETELY BAFFLED IN THE MATTER OF EVIEN'S DEATH. BUT LAST MONTH'S ARREST OF A KNOWN ASSASSIN ON AN UNRELATED CHARGE HAS VERY DEFINITELY RE-OPENED THE CASE. NOT ONLY HAS THE MAN CONFESSED TO JULES'S KILLING, BUT HE REVEALED ENOUGH ABOUT THE MANNER HE RECEIVED PAYMENT TO LEAD US TO A PERSON NAMED JOPHREM GENESE, WHO IS EMPLOYED BY A SALES ORGANIZATION WHICH HAPPENS TO BE A SUBSIDIARY OF—YOU GUESSED IT—TRANSTAR INTERSTELLAR. BEYOND THAT, THE ONLY INFORMATION I HAVE IS THAT GENESE HAS NOT BEEN SEEN OR HEARD FROM SINCE EVEN BEFORE THE ASSASSIN COLLECTED HIS FEE. SO HE COULD BE ANYWHERE ON EARTH. OR PERHAPS OFF IT.

GIA, AS I REMINDED YOU BEFORE YOU SHUTTLED OUT, YOUR PRIMARY MISSION CONCERNS THE EARTHGATE. BUT PERHAPS IT WOULD BE WISE TO LOOK OVER YOUR SHOULDER ONCE IN A WHILE, EVEN TO EXAMINE THE LISTS OF YOUR FELLOW PASSENGERS. I HESITATE TO ADVISE MORE, BECAUSE IN THAT GAME YOU ARE MORE QUALIFIED THAN I.

P.D.

It was a complication the young expediter would rather have done without. But she appreciated Digonness's warning to "look over her shoulder" occasionally, especially during the weeks until *Farway*'s complement of settlers were shipped out to their various destinations across the galaxy. If nothing untoward happened while the hundreds of families were being processed and prepared for their great adventure, then it was probable nothing would. Unless there is a crowd to merge into after he has earned his pay, a careful assassin would probably prefer to wait for a safer assignment.

The day before disembarkation, Gia determinedly deposited her worries in temporary storage and settled into one of the observation blisters on the side of the orbiting ship. A few hundred kilometers away, the Shouter's Mars-like landscapes rolled grandly by, the sparks of the stargates resembling randomly scattered tinsel. Even as she watched, she knew aircraft were plunging into those sparks of light and emerging hundreds, thousands, perhaps even a hundred thousand light years away on the far rim of the galaxy. Or perhaps returning, bearing crews who only minutes before had said farewells to those who even now were turning to a new life under an alien sun.

Sunk in revery she did not notice the man who quietly entered the blister and joined her contemplation of this strang-

est of worlds. "Fascinating," he said. "Quite facinating."

Startled, she turned. It was not, as she expected, a crewman. He was a drably dressed civilian; plump, totally bald, and with a wide, pink-cheeked smile. Incredibly the smile broadened. "They don't like me either. I'm the other tanknaut."

Gia blinked. Tanknaut? Suddenly his meaning caught on, and she laughed delightedly. "So you are the one? I wondered who I have been sleeping with."

He blushed, like a small boy accused of liking girls. "Sorry we were not introduced. Endart Grimes of P.L.S. —Penders Life Support Systems." He added, as if apologetically, "Once in a while we do use our own products."

She accepted his hand. His grip was firm. "Gia Mayland. I'm with Expediters."

"Ah." He looked at her with interest. "Expediters. Wasn't Peter Digonness one when he—?" He gestured at the planet.

"He was. Now he's my boss." Curiously, Gia asked. "Are you heading for one of the new worlds?"

He shook his head. "Unfortunately no. I am merely an unattached person who can afford a few years away from Earth while I check out a few refinements in our . . . ah . . . process." He frowned. "Too bad it remains so damned complicated and cumbersome as well as expensive."

"Can't that be changed?"

The fat man shrugged. "Naturally we are trying. Trouble is, the system is not only innately unreliable, it is field unserviceable. So we have split it into eight replaceable modules. With a life expectancy per module of only a few months, that of course means a lot of spares. On this trip for instance, there are thirty such replacement units in the system. *Farway*'s two sleep tanks are, in fact, wired and piped to about one hundred and eighty thousand kilos of equipment. Did you know that?"

"My God." Gia was shocked. "No wonder the colonists are unfriendly!"

Grimes regarded her thoughtfully. "A few days of social ostracism is a small price, I think."

He was right of course. Twenty-six months of communal living in a crowded steel shell was tough for even the most ardent gregarian. So Gia dismissed guilt in favor of gratitude for her good fortune, and settled down again to watch the unfolding scene.

Grimes said, "I understand it is called the Shouter because the emissions of the stargates make it one of the most detectable objects in the galaxy. True?"

"True," Gia agreed.

"Then why isn't the Shouter detectable from Earth?"

Gia sighed. *The ignorance of some people.* She pointed at a nebula-hazed cluster of stars rising beyond the planet's rim. "The Pleiades. Draw a straight line from here to Sol, and it passes exactly through the middle of those stars. For some peculiar reason, their nebulosity is opaque to the frequencies emitted by the stargates. So the Shouter was not detected until *Far Seeker* cruised out from beyond the Pleiades' shadow back in twenty-four-oh-six, thirty years ago."

Grimes gazed at the legendary star cluster, so familiar despite its reversed configuration of suns. Then, quietly:

"So perhaps the Pleiades is the reason there cannot be an instantaneous transport link to Earth. An Earthgate. What do you think, Ms. Mayland?"

It took eight shuttle trips to Ferry *Farway*'s hundreds of passengers down to the surface, which again did not endear Gia to those who knew she had ridden one of the P.L.S. tanks and now saw her assigned to the first flight. But she had become used to their resentment, though she wished she were free to disclose her mission so she could turn some of that hostility into friendship. Even Endart Grimes, despite his affability, had seemed oddly distant—a bland exterior that did not match what she sensed was behind the man's pale blue eyes. In any case he was not on the shuttle, so she supposed he had surrendered his priority so he could tinker within the maze of plumbing and electronics that served the two life suspension chambers.

A few minutes after the shuttle rode its jets down to a gentle touchdown, two pressurized buses coupled to the exit locks and everyone cautiously filed into the transparent-topped vehicles. As her bus began to bump along the graveled road toward the semi-underground complex of the Colonization Authority's Reception Center, Gia gazed across a rocky plain at the domes and pyramids of the Phuili base. Some of those graceful structures were centuries old, yet they all gleamed a crisp white under the light of the Shouter's distant sun. About halfway between the base and the Center, incongruous in its straightlaced economy of construction, the four-story home of PERU rose slab-sided against the sky.

Somewhere there was a throaty roar, and suddenly a broad-winged shape rose into sight from behind the Center. It accelerated swiftly, climbing higher and then banking toward the sun. Shading her eyes, Gia saw the incredible structure toward which the aircraft was heading: the vast saucer, the almost line-thin pylon that supported it. The sun was too bright for her to see the sphere of light that was the actual stargate, and for the same reason she did not see the aircraft enter. But the rumble of jets ceased as if cut by a switch, and Gia knew yet another load of passengers had arrived at a distant world.

"Where did it go?" shrilled a child's voice. "Mamma, where did it go?"

"To a place called Serendipity, dear."

"Is that where we're going?"

"No, dear. We are going to New Kent."

"Why aren't we going to Serendiddy?"

"Because it's not New Kent," the mother replied testily, and left it at that. But in her mind, Gia continued the explanation,

Because Serendipity was the first world to be reached through a stargate, humans and Phuili jointly decided that it would remain as they found it, unsettled and unspoiled. Scientists were on that aircraft, perhaps a few media people and even some tourists. But they will not be allowed to stay. In weeks, or at the most, months, they must reemerge out of AA One just as Peter Digonness and his Phuili companion did eighteen years ago. It's not such a bad

trade, really. One world for thousands. . . .

Genevieve Hagan, the Assistant Research Administrator of PERU, was a small woman with intense green eyes. Rumor was that she and Peter Digonness had had something going during his years on the Shouter, and somehow Gia thought that quite fitting. Aside from her undoubted charm and keen intelligence, the A.R.A. also had an outgoing femininity that would have been the perfect complement to Digonness' reputed reserve.

After instructing the new arrival always to address her as "Jenny," the A.R.A. returned behind her desk, shuffled a few papers and shyly asked, "How is Peter? Is he holding up behind that Earth-bound desk of his?"

"He's trying to. But he did tell me he would prefer to be on the Shouter."

Jenny nodded. "We wish he could be." Gia noticed the unconscious emphasis of "We." *I think she still misses the man. Even after more than three years!* Abruptly the softness firmed and the green-eyed woman became the cool professional. "Now then. You received Peter's message about Jophrem Genese?"

"It was given to me after I was revived."

"Then you understand why I ask this question. Did anyone aboard *Farway* seem particularly interested in you?"

Gia smiled. "The other tanknaut."

"Tanknaut?"

"The man in the other tank. Endart Grimes of P.L.S."

"Oh, I see. Yes, I know about Grimes. But I was thinking more along the lines of someone connected with Transtar."

Gia frowned. "That's a bit unlikely, isn't it? If Transtar wants to stop us finding the Earthgate, their agent is hardly likely to advertise his connection by being listed as one of their own."

"He'd have no choice. Other than Grimes and yourself, the only people from the *Farway* who don't work for Transtar are the colonists. And they will be confined to the Center until they are shipped out."

"So if Genese—or whoever—was aboard, he has to be a member of the crew. Is that it?"

The older woman pushed a file across the desk. "Here are the idents of all fifty-two crew members. Also a likeness of Jophrem Genese, facsimiled from Central a few months ago."

Gia flipped open the file. On the top, a head and shoulders picture of a thin faced man with dark skin and slightly protuding eyes. She leafed through the rest of the sheets, each a single page summary with a small picture of the person described. The only one who even slightly resembled the thin faced man, was a female crew member.

"Not much help, is it?" Jenny said.

Gia closed the file and handed it back to the A.R.A. "I am here to find the Earthgate," she said firmly. "I don't intend to be diverted by some hypothetical mystery man."

Thoughtfully, the A.R.A. studied the young expediter. "I'd take Peter's warning quite seriously. Whatever else he is, he is definitely not the paranoid type."

"I know. And believe me, I intend to take all the basic precautions. But

beyond that, I will be working full time on my primary assignment."

"Well, it's your decision of course." Jenny balanced the file in one hand for a moment, then dropped it into a drawer and closed the drawer with a slam of finality. "Now that's done with—I hope—let's you and I get down to specifics. How can PERU help Gia Mayland find the Earthgate?"

"For a start, Gia Mayland needs updating," Gia replied promptly. "I have been somewhat out of touch during the last couple of years."

Jenny chuckled. "So you have. OK, two words. Nothing new."

Gia was astonished. "Nothing? Nothing at all?"

"What did you expect? Digger continues to spend government money looking for what he knows cannot be found, while on the Shouter we don't have the resources even to start looking. But I am glad you are here, because I also happen to agree with Digger that the answer—if there is one—is on the Shouter. Which is, I am afraid, my devious way of telling you not to expect too much from us. With all the teams going out from here, PERU is already spread far too thin.

Gia shrugged. "Which means we'll do what we can with what we've got, I suppose. Which is—?"

"Use of our T-Com facilities, of course. I have already arranged fifteen minutes of open channel for you once every day at sixteen hours. It's expensive, but at least you will be able to keep in touch with Peter and the rest of the high-priced talent at E Central. Further to that, I have assigned someone to be your guide and helper. Meet Galvic Hagan."

He must have been waiting outside, because he walked in almost before the A.R.A. had released the key on the intercom. He was young, sturdy, and red haired. And his grin was infectious. "Is this the lady, Ma?"

The A.R.A. sighed. "Don't you think that joke's getting a little thin?" She looked apologetically at Gia. "He is not even related. But somehow he has got half the people here thinking I am his mother." She shuddered. "God forbid."

"Poor lady doesn't know what she's been missing," the young man said, shaking Gia's hand. He stepped back and eyed her critically. "Have you eaten lately?"

Gia knew what he meant. "The sleep tanks are not one hundred percent efficient," she explained. "I guess I lost a little weight."

He nodded. "Then I suggest we go down to the commissary and put some substance back on that nice bod of yours. Between mouthfuls you can ask any question you like, and if we're both lucky I may come up with some right answers."

"Good idea," Jenny agreed. "Gia, take it easy for the rest of the day. Have Vic show you around the facility and introduce you to people. And then get a good night's sleep. Tomorrow, you will meet David."

"David?"

"Oh, didn't I mention him? He is your Phuili opposite number here. His job is to find the Phuiligate."

"David" was short and humanoid,

with a pink-fleshed canine head. Gia's first reaction to the little alien was to be nervous and at the same time curious, though negative feelings soon evaporated under the scrutiny of the large eyes, which were violet in color with a hint of humor in their depths. Also, the clasp of the rough-skinned hand with its two fingers and two opposed thumbs, was friendly. "I am Davakinapwottapellazanzis," he announced in a rapid flow of syllables. "But to human fwiends, I am David."

Gia licked her lips. *How does one make conversation with a being who looks like an upright bull terrier?* "Er . . . have you been on this assignment very long?"

"Since five of your monz. I come to Shouter after not finding gate on Phuili."

"Do you think there is a gate on Phuili?"

"If zere is gate on Shouter, zere is gate on Phuili. But not get much help on Phuili."

For a moment Gia did not understand. Vic looked just as uncomprehending, while Jenny merely shrugged and allowed herself a slight smile. They were in the A.R.A.'s office, the alien perched awkwardly on a low stool brought in to accomodate his dimunitive short-legged frame. Trying to ignore the two interested spectators, the expediter looked directly into the violet eyes. They stared back unwinking. "Do you mean that other Phuili are not interested enough to help? Or that there was direct opposition?"

David looked puzzled. At least, it was the impression given by a slackening of his flexible muzzle. "Not understand. What mean opposition?"

Gia carefully explained. "If the Phuiligate is found, there will be no further need for the ships and crews that journey between your world and the Shouter. Wouldn't those who run the ships want to stop you?"

The "puzzlement"—if that was what it was—deepened. "If gate found, ships go ozer places. Cwews go where ships go."

Is greed peculiarly human? Gia wondered, ashamed of her race's larcenous instincts and envious of Phuili innocence. But romantics do not make good expediters, and she quickly realized that simplistic judgements are self defeating as well as downright silly. Because the Phuili were subject to the same natural laws as humanity, then somewhere down the line they had undoubtedly learned the same lesson: that angels are for the next universe, not the harsh realities of this one.

It was as if David were reading her thoughts. "Phuili develop over long time. Phuili young few, so planet still have much woom. Old ways not need to change. Yet gate will change old ways because much will come fwom outside. Humans cwowded, zey need new worlds. Not Phuili. We go only to look. Not to stay."

Even Genevieve Hagan was surprised. In her years of dealing with the Phuili, never could she remember such a confession of unease; like a hermit fearing his castle of solitude is about to be invaded by hordes of tourists. Undoubtedly David's "much will come in fwom outside" was a reference to humans, those—by Phuili standards—unpredictable beings with their unholy devotion to change. At the same time,

however, the little alien's disjointed statement was also a contradiction.

The A.R.A. was not the only one who recognized the contradiction. "If the Phuili did not want the gate," Gia said puzzledly, "then why, David, do you seek to open it?" Even as she asked the question she sensed distress where earlier there had been humor. It was a strange feeling. Even with people, she had never been able to sense mood like she seemed to be doing with this little alien.

David's reply echoed the mood. "Humans use gate even if Phuili not," he said sadly. "Soon zis zen become human galaxy. Maybe Phuili ways saved, but Phuili people lost."

Phuili people lost. Perhaps it was his awkward use of the human language, but nevertheless it conjured a poignant image of an ancient race relegated to a galactic backwater. Gia was beginning to appreciate the dilemma faced by the Phuili, the "go" or "no go" situation which was almost Aristotelean in its terrible simplicity. Either to accept the challenge offered by the gates and as a consequence endure the shattering effects of change on the fragile underbody of their monolithic society, or to turn inward and eventually be humbled into obscurity by a species that was still living in caves when the Phuili culture had already matured into something resembling its present form.

The expediter moved closer to the Phuili and the mood of distress intensified. It surrounded him like an invisible aura, a form of communication as alien as he was. Telepathy, she wondered? *David, do you understand me? Can you read what I am thinking?*

There was no answer. Only the sorrow.

Despite Vic Hagan's protests, Gia borrowed a runabout and went out on her own the next day. After bordering the shuttle landing complex, the graveled road terminated a few kilometers farther on below the huge bowl of AA One. The bowl was supported by a three-kilometer pylon that was so slender it seemed barely capable of supporting itself, let alone the mass that loomed incredibly overhead. For a while Gia sat in the artifact's shadow, not thinking of anything in particular but letting impressions soak gradually into her brain. At this stage she did not expect to learn anything scientists on at least three worlds did not already know, but she knew this small pilgrimage marked the true beginning of her mission. Finally she clambered out of the runabout and wandered around for a while, uncomfortable in her pressure suit but happily enjoying the same feelings of awe Peter Digonness had undoubtedly experienced when he first came.

It was difficult to think of appropriate superlatives. The sheer scale of the enormous artifact was such that, though the pylon seemed incredibly frail from a distance, the close-up sixty-eight meters across its base suggested the comfortable solidity of a concrete monument. It had already been explained to Gia that the faint marks impressed on the smooth gray surface up to about the three-meter level, were in fact as much as Phuili science could do in an attempt to remove a material sample for analysis. It was while she was marveling at this unbe-

lievable resistance to even the sun-heat of a laser torch, that Gia became aware of a second vehicle parked near her own, and a stolid human figure trudging toward her. She waited, irritated at this intrusion yet curious as to the stranger's identity.

"How do you do," a familiar voice puffed in her helmet phones. "Guess we're both doing what all the new people do when they first come to the Shouter. Right, Ms. Mayland?"

She smiled. "Right, Mr. Grimes. When did you come down?"

"On the early morning shuttle. And please call me Endart. Or even En if you like to be so informal. I don't mind."

Is he kidding? "And I'm Gia," she said politely. She waited as Grimes stared at the AA, then agreed as he voiced an appropriate expression of awe. Suddenly something reminded her of a remark he had made yesterday, in the *Farway* observation blister. Strange it had not registered before, but how in blazes had he known about the Earthgate? She asked him.

The question puzzled him. "Why is Heaven called Heaven? You may not believe in it, but it has to have a name just so you can identify what you don't believe. Right? Anyway, I know I saw "Earthgate" mentioned somewhere. Or heard it. I'm a bit of a sucker for that kind of thing, you know. Ghosts, Atlantis, UFO's, even the Bermuda Triangle. Nonsense of course, but fun. Guess I'm a bit of a romantic at heart."

It was a very human explanation. Not too glib and therefore having a ring of truth. So Gia decided not to pursue the matter. In any case Expeditiers did not own title to the somewhat unimaginative term "Earthgate," which to the uninformed could mean a lot of things, real or otherwise. It seemed Digonness's warning about the mysterious Jophrem Genese had affected her more than she realized, and she wondered if she were becoming paranoid.

Not if I can help it, she told herself grimly.

However, the subject was not so easily dropped. Grimes's curiosity had been piqued. "Why did you ask that? Is it possible there is such a thing as an Earthgate? Are you somehow involved?"

Gia tried not to overreact. "Of course not. As you said, it's nonsense. My job is to expedite, not to spend public money chasing fantasies."

He seemed relieved. "How glad I am to hear that. So what are you currently . . . ah . . . expediting?"

The man was becoming a nuisance. "Not very much at the moment. We're waiting for one of the teams to come in, from Gaylord. It's apparently one of the better worlds, though no decision to colonize will be made until we have evaluated the team's report. Believe me, Endart, being a sort of scientific mediator is only part of my work. The rest is mostly dull routine, as in any profession." Gia began to walk back to her runabout, and after a moment's hesitation Grimes hurried after her.

At the vehicles, he turned again to the towering AA. "Such a shame really," he murmured. "All those thousands of worlds, as accessible from the Shouter as stepping through a doorway. While on our poor, overcrowded Earth . . ." Shaking his head, he clambered into his

runabout, waved and drove off. Like a careless tourist he had forgotten to turn off his transmitter, and his muttering remained even after he was no more than a cloud of dust.

". . . such a shame. Such a terrible, *terrible* shame . . ."

Gia asked for photographs. Of AA One, and of 6093 and 11852. Galvic Hagan delivered them to her and watched curiously as she spread the prints in three groups on the library table. "Comparing?" he asked.

"No, I just like looking at pretty pictures," she said irritably after she had arranged the collection to her satisfaction.

"It's already been done, you know."

Gia picked up one of the prints and held it closer to the light. "So?"

He spread his hands. "So nothing was found. Every AA on this planet is exactly the same as every other AA. Same dimensions, same markings, even the same spectral signatures."

"Hmm." Though she was not about to admit it, Gia knew the young man was right. She had slept badly the previous night and was feeling physically and mentally sluggish. At that moment fresh ideas seemed as rare as a Sahara iceberg. Again she looked at the print in her hand. It was of 6093, one of the two non-functioning AAs. "Vic."

"Yes ma'am."

She pointed at the light above 6093. "Have you flown through that? Or through the one above eleven-eight-five-two?"

He nodded. "Several times. Through both."

"What does it feel like?"

He shrugged. "Same as any other AA. We just didn't get anywhere, that's all."

"Vic, I have only heard Digger's description of the sensation. I want to know if it is the same for everyone. So let me repeat the question. As you are transported through a stargate, what does it *feel* like?"

"OK. Now I get you." Vic considered a moment. "It's being torn apart and then squeezed together again. that's what it feels like. But like everything else you get used to it."

"Are you a pilot? I mean, of an aircraft?"

He blinked at the abrupt change of subject. "Sure. Where do you want to go?"

She glanced at the wall map. "To six-oh-nine-three, I think. It's the closest, isn't it?"

"A tad under six hundred klicks. About seventy minutes flight time."

"Arrange it as soon as possible. For tomorrow, if you can. I would also like to take David along."

Vic shook his head. "Sorry. Both ships are already booked for tomorrow." He glanced at his watch. "But what's wrong with now? There is still time to give you two or three hours of daylight at the site." As he spoke he turned to the com unit and punched a three-digit number.

"Phuili," said an alien voice.

"Is that David?"

"Not David."

"This is Hagan. I am about to fly Gia Mayland to six-oh-nine-three. She wants David to come."

"David come." There was a click as the Phuili broke contact.

"Just like that?" Gia asked, surprised. "Don't they even think to ask him if he's free?"

Hagan chuckled as he held the door open. "That is something else you'll have to get used to. Though to us the Phuili may act like individuals, sometimes they seem parts of one organism."

She stopped close to him. Though he knew she was at least ten years older, he felt a sudden protectiveness. He swallowed. "They're aliens," he said.

She nodded, thoughtfully. "As we are to them."

David met them as they pushed the aircraft out of the hangar. Clad in a silvery pressure suit with an elongated helmet, he looked more like a cuddly space toy than a member of a species older than man. But his assistance as he and the young human male unfolded and locked the wings was that of an experienced professional. Which was not surprising considering the machine was a human adaptation of an original Phuili design. Finally the ill-assorted threesome strapped themselves into the narrow cockpit, and with a surge from its jets the *Eloise Three* floated smoothly into the thin air.

Though seemingly a frail assembly of tubing and stretched plastfilm, this was actually a rugged and durable craft that had already proved its worth on hundreds of flights. Nevertheless Gia found herself breathing a little easier as they approached the slender column below AA 6093. "Can we spiral downward from the bowl?" she asked the pilot as she readied her camera.

"No problem," Vic replied, resetting the controls. As they entered into the enourmous bowl's shadow, he tilted the machine into a slow descending circuit. Gia started taking her pictures, carefully spacing the shots to encompass all four sides of the pylon from bowl to base.

"You zink you find what ozers not find after doing same?" David asked interestedly from the rear seat.

"The pictures I have seen were all taken from the ground," Gia said, clicking away. "Nothing from this close, or from this angle."

"Still same," the Phuili commented.

He was probably right. Though the camera was the state of the art in electronic imaging, Gia suspected the ground based holograms contained as much information in four shots as she could obtain with dozens. But such was the strangeness of this world, she had decided that yesterday's truth is not necessarily today's. Digonness's own early experiences on the Shouter had demonstrated the fragility of several rigidly-held absolutes, and Gia was immodest enough to allow the possibility that she could also fracture a few. Especially if she found the Earthgate.

As they finally sped away from the pylon a few meters above the barren ground, Vic guided *Eloise Three* into a wide climbing turn. "Do you want to go through the light?"

"Of course. It's one of the reasons we're here, isn't it?"

"OK. But be warned. For first timers, it ain't pleasant."

"I'm aware of that." Gia remembered how Digonness had described it. *It's being exploded apart, spread all over the universe and then being imploded together again.* She turned to the

other passenger. "Have you done this before?"

"Not wiz zis one. AA One only. Because zis AA not work, I wonder if hurt same. I come to compare."

Still same, Gia was tempted to say facetiously, having already been told by just about everyone in PERU that the "hurt" was equally unpleasant whichever AA one went through. But that was only the human experience. Perhaps to Phuili senses there would be a difference, though how that knowledge could help the search was problematical. In any case, how does one describe a subjective impression to an alien? She doubted David could do that anymore than she could.

Again she remembered Digonness. *I'm willing to bet hard cash the switch is there to see,* he had told her. Well, maybe. But if he was right, then something had recently changed. Otherwise, she did not doubt the magic toggle would have been found long ago. She patted the camera. So perhaps her picture-taking made some sense after all.

They were above the bowl now, about a kilometer away and turning toward the pale radiance that shimmered above it like concentrated electricity. The bowl's inner surface was the most intense black she had ever seen, an effect infinitely more than a mere absense of light. Despite her heated suit, Gia shivered. Nevertheless, even before Galvic Hagan's exuberant "Tally Ho!" as he dove *Eloise Three* into the light, she was already taking more shots, hoping the camera could cope with the incredible contrasts of the unreal scene. Her concentration was so intense, it was almost unexpected when everything vanished in a sudden blaze of radiance.

". . . ohhhh—!"

Seconds, minutes, or perhaps years later—her confused senses seemed momentarily flung aside from time—AA6093 was behind them as the aircraft hummed smoothly through the thin air. Digonness, and more recently Vic, had tried to describe how it felt, but Gia now knew that words would always be totally inadequate to describe what she had just experienced. In real space and time she supposed they were a few kilometers and two or three minutes beyond the gate, in the same sky and above the same desert where they had entered. But deep inside herself Gia knew without doubt that they had been *elsewhere*, that within the span of a moment they had journeyed beyond the universe and returned.

"Shall we do it again?" Vic asked cheerfully.

"Yes," Gia replied, surprising herself. "Yes!"

He swung around in his seat, and even behind the helmet visor he saw his astonished face. "You're kidding!" Then, plaintively, "Aren't you?"

"I too want do again," David said. "But also I zink we stop inside light for while. You have auto?"

Even Gia was shocked by the request. To extend that ultra-schizoid splitting to a virtual infinity of moments would be worse than the most malevolent concept of hell. That the Phuili could be such a masochist . . .

"When we in six-o-nine-zwee, we go ozer place and come out again. No time between, so in and out one moment. But if auto stay us, zen in and out separ-

wated by short time. Hurt not differwent, just two smallers. We twy?''

. . . or on the other hand, a useful friend to have around. We need a few of his kind in Expediters. Her thoughts whirling at David's penetrating logic, Gia asked, ''Can it be done?'' *My God, perhaps the other place is Earth. Deputy Director Digonness, are you in for a surprise!*

The pilot began setting switches. ''In, stop, hover for about fifteen seconds, and then out again. If I could set it for as low as five seconds, I would. At least she'll stay on an even keel for a while, long enough for me—hopefully—to regain my senses. Dammit David, are you expecting this to be the quick way back to Phuili?''

''Iss not logical? But if human world, not matter. Ozer AA zen lead to Phuili.''

Fifteen minutes later *Eloise Three* was parked on the desert a few kilometers from AA 6093. Aboard the aircraft, its pilot and two passengers sat quietly. But their thoughts crackled like lightning.

. . . telepathy for God's sake!

. . . it is what happened to my next level ancestor after he and the human named Digonness first went through AA One.

. . . David! It was your father who was Digger's companion?

. . . it is true. It is also true the thought-speak faded rapidly after they returned to the Shouter. So I suggest most strongly we exchange our impressions before we are also returned to the inadequacies of speech.

. . . I agree. Question. Where were we?

. . . God knows, the pilot thought. *But it certainly was not any place I know. Or am likely to.*

. . . Galvic dear, it was just too easy to persuade you. Which makes me suspect we were being influenced even before we re-entered the gate.

. . . damn right! By every standard I can think of, what we did was insane. But we survived, and now we're yakking like three animated radios.

. . . did you see anything? Feel anything?

. . . see anything, no. Feel anything? Well it's hard to say. I do know I received a pretty lucid message from . . . whoever. For some reason, I am to examine Eloise's *tail section.*

. . . interesting. Do you know why?

. . . I only know I am supposed to do it before we take off again. Would you believe it, they even knew I'd ground her after re-entry.

. . . it seems they know a lot of things. David pondered a moment. *Gia, do you agree there were other entities?*

. . . absolutely. I even tried to . . . er . . . converse with them.

. . . yes?

. . . I asked about Earthgate.

. . . how strange. I asked about the gate to Phuili.

. . . ahha! Did they answer you?

. . . with an image. Very strong, very clear. It was of a pair of human hands framing a circle. They were smaller hands, smooth. A female's, I think.

. . . mine?

. . . it would seem logical.

. . . all I got was an impression of a white dot.

. . . nothing else?

. . . I did not understand it either. It seems we—

It was not as if a switch had been opened. At least, not exactly. But with breathtaking suddenness the three found themselves returned to their separate shells, their few minutes of warm sharing a fading memory. Galvic Hagan descended from the aircraft and began to inspect the wires and struts of its spidery rear section.

"Am glad it not last more," David said at last.

Gia turned in her seat. "Why?"

"At moment zis one not happy at loss of zought-speak. But zis one also know time make normal. If zought-speak last longer than did, zen I zink time not make normal. Me and you and Hagan stay always in loss."

"I see." Indeed, Gia did see. Like sex, their intimate sharing had been a sweet agony. Literally, a "high." Much longer, and it would have become an addiction for the rest of their lives, like a potent drug with no antidote except the drug itself. And that, she knew, was gone forever.

Her wistful reminiscence was interrupted by an exploded epithet. "Well I'll be. . . !" Muttering angrily, Vic came forward to the cockpit and handed up to her a putty-like blob about as big as a thumb nail. "Bloody murderer!" he snarled.

Gia rolled the substance between gloved finger tips. Her throat was tight. "Explosive?"

"And how! See those little gold flecks? That means it's denzonite, a plastique normally as inert as a stone until it's zapped with a precisely tuned radio signal. It doesn't need a receiver, or a detonator. It's its own trigger."

"Take it please," Gia said, feeling slightly sick. She flinched as she watched him grind the ugly substance into the ground with his boot heel. "We're OK, I hope?"

"We'd better be," Vic said as he returned behind the controls and turned on the power.

"Wait a minute."

He turned. "What now?"

"We took this flight at a moment's notice. Right? So how could—whoever it was—have known? Even which of the aircraft we would use?"

The jets whined and *Eloise Three* surged upward. "He didn't have to know," the pilot replied as he banked the machine in a wide circle about AA 6093 and then set the course toward home. "Presuming you are the target—which seems entirely likely—it required no great feat of the imagination to figure out you would sooner or later need one of the aircraft. So our nasty friend simply took advantage of an early opportunity and attached a package on both Eloises. By now he certainly knows you are on a flight somewhere, so I presume he and his button are just waiting for us to sail gracefully over the horizon." Vic chuckled. "You know, I feel real bad about how we're going to disappoint him."

"Maybe assassin Phuili," came a quiet comment from the rear seat.

The two humans were astonished. The aircraft wobbled as in his surprise Vic twitched the controls. "Phuili don't do things like that," he said. And then his doubts surfaced. "Do they?"

"Not before," David replied. Sadly,

he added, "But zis time Phuili life can change much. I zink some might twy kill to stop change."

It was an astonishing admission. But at that moment Gia was thinking of beings who were neither human or Phuili. Perhaps it would be easier to think of them as gods: all-seeing and all-powerful, as much cognizant of the rules which guide the universe as they were of a sabotage device aboard *Eloise Three*.

The mysterious entities beyond the AA were apparently benign beings. But if human and Phuili were being manipulated—even for their own good—where did that leave free will? The joy of achievement and discovery?

Behind them the sun sank below the horizon as the aircraft raced over a shadowy landscape rapidly deepening to blackness. Stars were appearing in numbers and brilliance far beyond that which could be seen from under Earth's dusty skies, but the mind of the human female was being turned inward, away from the external world.

Whatever their powers, they are nevertheless mortal.

Coming from within herself though not originating with herself, the statement was a true one. Gia did not know why she knew that, but she had no difficulty accepting it as incontrovertible fact. It had a corollary: that because the entities were physical beings, then like most life forms they had originated in the organic soup of some primeval ocean. They had traveled the same road man and Phuili were now traveling, so knew the value of the painful learning experience which is true progress.

Then why their intercession?

Because for us, there were no others.

The rise to intelligence of the entities had been a freakish circumstance during the dawning eons of the galaxy. Life should not have happened but did, on a world on which evolution somehow avoided the side-tracks, dead ends, and natural catastrophes that make normal evolution a spasmodic sequence of fits and starts. So when they looked for their peers among the stars, they found they had arrived too soon; that only a mere handful of primitive life-bearing worlds existed among literally thousands that were still condensing from the accretion discs of countless young solar systems.

With "others" there could have been a new view point, an exciting consensus of opposites. It was a special mathematics in which *two* is infinitely greater than *one*—an equation which for the entities was tragically incomplete. So a decision was made. If they could not be part of that equation . . .

. . . they would become the mathematician.

The equation was now—finally—almost complete.

Man plus Phuili.

The new duality.

"Interesting," the A.R.A. said after Gia had finished.

Gia nervously bit her underlip. "Don't you think it's a bit more than that?"

"Perhaps." Green eyes thoughtful, the older woman leaned back in her chair. "Well, Galvic? What do you have to say about all of this?"

The young man shrugged. "I'm not so sure about the last part. But the rest I can vouch for. Especially the telepa-

thy. That's how they told me about the denzonite."

"As I said. Interesting." Jenny held up a speckled blob. "This was found in the tail section of *Eloise One*." She grinned. "Don't worry. It's been neutralized."

"It had better be!" He took the blob and looked at it sourly. "I don't know how much you know about this stuff, but even a few molecules are pretty potent."

"Oh yes." Wickedly, "The scorch marks on your aircraft prove that."

Vic stared. "Then he . . . it . . ." Abruptly he subsided. "Oh what the hell."

Gia shared the sense of narrowly avoided disaster. "They saved our lives, you know." She shivered. "Wish I knew who. Or what. And who did—?" She gestured at the substance in Vic's hand. As if it had suddenly aquired legs and a sting, he threw it down on the corner of the A.R.A.'s desk. It adhered obscenely.

"Second question first," Jenny said. She produced a photograph. "Gia, do you remember this person?"

The girl studied the picture. "You showed this to me before. Isn't she one of *Farway*'s crew?"

"That's right. Carmen Klaus is the one with a family resemblance to Digger's mysterious Mr. Genese."

"Now I remember." Gia looked up. "So?"

"A few hours ago, Klaus booked out a runabout and was last seen heading toward Pock Hill."

"Yes?"

"Pock Hill is an excellent vantage point in the direction of six-oh-nine-three."

Gia's stomach did a flip. "Interesting," she said, in unconscious parody of the A.R.A.'s recent reaction. Not so restrained, Galvic let out a long whistle. "A woman, by God!" He spread his hands wide. "And why not?"

A good question. Gia felt she could kick herself for overlooking the possibility. History after all was full of accounts of women impersonating men and getting away with it, sometimes for years. So it seemed one riddle (and presumably its accompanying threat) was finally about to be exorcised.

The A.R.A. could be excused for her air of satisfaction. "I have already dispatched a security patrol," she said, anticipating the obvious question. "I think that is one lady who is about to be withdrawn from circulation for a while."

"Provided she is the assassin of course," Gia said, still faintly tasting sour grapes. She rose to her feet.

"Going somewhere?"

The expediter nodded. "I need to think for a while."

"About how to tell illusion from reality?"

Gia hesitated. "Something like that."

"Your description of the beings' history, their promotion of a "duality" between us and the Phuili. Why didn't Vic pick that up?"

"For the same reason I did not get the message about the denzonite, I suppose," Gia said. "It depended on who was being talked to."

Galvic blinked with surprised realization. "Say, that's right! Whatever

was said to us, it was never via an open three way—''

Gia laid a restraining hand on his arm. ''Vic, it's not what happened on the other side of the gate that bothers me. It's what happened on *this* side, during the return flight. If I was not hallucinating, then we and the Phuili are on the verge of something pretty incredible, right? But if I was merely the victim of an over-stimulated imagination, then how do we avoid proving to the Phuili hardliners what they have always preferred to believe—that we humans are not only inferior, but unstable?''

''Did you discuss this with David?'' Jenny asked.

''Would you?'' Gia retorted.

The A.R.A. regarded the younger woman thoughtfully. ''Put yourself in David's shoes. If he picked up the same message, and had the same doubts, do you think he would have discussed it with any human before he talked to his own kind?''

Gia's jaw dropped. ''You think. . . ?''

''*You* think about it,'' Jenny said.

She was studying the pictures she had taken of 6093, when the little alien entered the lab and watched her for a moment. Then, ''I speak Jenny.''

Gia turned and looked at him. ''About what, David?''

''About ozers ozer side of AA. About humans and Phuili togezer being more zan humans and Phuili not togezer.''

Gia had a sinking feeling. ''She told you.''

''Not twue. I told her.'' The jaws flexed in the Phuili equivalent of a smile. ''Zen she told me.''

In her excitement the expediter knocked some of the prints off the table. ''Glory,'' she whispered. ''What a day this has turned out to be.''

''I wish not tell you until I say to ozer Phuili. After I say, I am told human female perhaps hear same. But not tell me for same weason I not tell her.'' The large eyes twinkled humorously. ''Perhaps humans and Phuili should more twust ozers of each.''

''Yes,'' Gia said fervently. ''Oh yes.''

With the rolling gait characteristic of his short legs and splayed feet, David walked across the room and picked the prints off the floor. As he handed them to her, he pointed to the top one. ''I see zat before.''

Putting the others aside, she looked at the print. Showing the bowl as seen from above, it was the one she had been studying when he came in.

''Put the picture on table,'' the Phuili instructed. ''Hold wiz hands as you just doing.''

Puzzled, Gia did as he asked. ''I don't understand—'' Wide-eyed, she stopped. The thumb and index finger of each hand had automatically spread apart, holding the print down by the corners and framing the image of the bowl between. *A pair of human hands framing a circle.* Smaller hands, smooth . . . It was part of what she would never forget, part of the warmly silent communicating they had shared and then lost. And there was something else.

''A white dot,'' Gia whispered. ''They showed me a white dot.''

David nodded. ''Me ask about Phuili gate, zey show me circle. You ask gate

your world, zey show little dot. What means?''

Gia was staring at an enlarged photograph on the wall of the lab. Apparently put there either as a measure of frustration or because someone had a peculiar sense of humor, it was a rectangle of unrelieved black. She pointed. ''I suppose you know what that is.''

The alien nodded. ''We have same, zough we not waste spaces on walls wiz pictures we know show nozing. Many pictures taken fwom above bowl AA One to twy find twansmitter fwom where energy come. Zat picture and many more taken by wobot flyers vewy close to middle of bowl. Much time waste.''

''Perhaps because they were examining the wrong AA,'' the expediter said, pulling the sensing head of the projection magnifier toward her and carefully inserting the print of AA 6093. She turned on the magnifier, and as the room lights dimmed she began to rotate the zoom control. The round black image swelled beyond the edges of the lab's two-meter screen, causing the room to become stygian as the Shouter's brighter landscape was swallowed beyond the frame. Suddenly, at the center of the screen, a point of light appeared and then diffused as the magnification limit was exceeded. Gia reversed the zoom until the light contracted to a sharp, bright point. ''There!'' she said triumphantly.

It was more than an hour since Galvic Hagan had dropped out of *Eloise One*, the jets of his harness brilliant until he vanished beyond the rim of the bowl. Commentary from the pilot of the circling aircraft remained spasmodic, as he flew in as close as he dared to watch Vic's progress, then retreated to a distance where his signal was not completely blanked by 6093's radio interference.

''. . . crawled almost up to the edge of the bowl, slow as hell but sure. Seems those adhesion pads really work, huh? Whatever gizmo he found must be pretty small; his abandoned lift harness looking a lot more conscpicuous there in the center. Going back in now . . .''

Undoubtedly he saw Vic step off the edge, but by the time he was able to transmit the news, everyone on the ground was already watching the tiny figure drift downward under its huge canopy. It took time to descend three kilometers of vertical distance, and when Vic landed it was amid a crowd. But by pre-arrangement everyone held back to allow one human and one Phuili to approach the parachutist.

''Please don't expect me to do that again!'' Vic said breathlessly as he returned Gia's hug and clasped David's extended paw. ''The harness worked fine, the chute worked even better, but getting up the slope of the bowl—'' He shuddered. ''Now I know what frictionless means.'' After discarding the suction discs attached to his knees and elbows, he reached into the voluminous pouch on the front of his suit and withdrew a glittering object about thirty centimeters long. ''Here, lady. It's your bauble.''

Gia gasped in wonder as she held it. A flat ended cylinder of material which refracted light in brilliant colors, its translucent heart contained a tiny three-

dimensional image of an AA. "It's beautiful. But what does it do?"

"S'for you and David to figure that one out," Vic replied with ill-concealed smugness as he watched her pass the object to her Phuili colleague. "But I lay you a hundred to one another of those is in the bowl of eleven-eight-five-two."

"Zat is logical," David agreed as he examined the crystal-enclosed miniature.

By this time the mixed group of humans and Phuili had crowded around, and exclamations of human astonishment were interspersed with Phuili gutturals. David returned the object to Gia and fired a burst of syllables to an attentive member of his own team. Immediately the other Phuili turned about and trotted toward a tiny single-seat aircraft parked apart from the other machines. "He weturn base and awange Phuili mission to ozer AA," David explained to the humans. "Soon we know if same in zat bowl."

"If it is, which I do not doubt," Genevieve Hagan said as she took the object from Gia and held it up to the light, "then our mysterious benefactors will have put two rabbits into the hat." She looked at Gia. "You know, of course, this pretty paper weight was not there a month ago.?"

The expediter nodded. "I've looked at the last series of photographs. Clean as a whistle." Gia turned to David. "Do you mind if we take this back to PERU?"

"You take," the Phuili agreed. "I come talk later."

By this time *Eloise One* had spiraled down to a dusty landing, and Vic immediately persuaded the pilot to return as passenger on another machine so he himself could fly the two women and the "gizmo" back to PERU. Not unexpectedly nothing was solved during the seventy minute flight, though Gia and Jenny exchanged the trophy at least a dozen times as they attempted to fathom its purpose.

"We'll just have to see what the lab can do with it," Jenny said finally as the cluster of buildings rose over the horizon. She sighed. "Gia, presuming this is Peter's "key"—in full view, as he said—now what? I have an uneasy feeling that instead of an answer we have uncovered an even larger question. And right now my dear, more questions are what I don't need."

The A.R.A.'s foreboding was not misplaced. Two hours later they met in her office and heard a harrassed-looking technician describe a scientific impossibility.

"What ever it is, it certainly isn't matter as we know it," he reported, staring at the object with distaste. "It doesn't chip, it doesn't scratch, and it reacted in absolutely neutral fashion to every frequency I could throw at or through it."

"Solidified energy," Gia murmured, intending to be facetious. Galvic started to chuckle, but subsided as the technician said angrily, "Why not? Tell me Earth's moon really is made of green cheese, or that the universe is smaller than the head of a pin, and right now I won't argue. Because that . . . that . . . *thing* has screwed up scientific logic in a way nothing short of shameful!" Still red faced, the man stamped

out of the room and slammed the door behind him.

"Well," Jenny said after a moment.

"The poor chap was almost violent." Vic picked up the object and hefted it. "Energy? Green cheese?" He put it back on the desk. "Shameful!"

The A.R.A. smiled, but faintly. "Gia, have you contacted Earth yet?"

"Haven't had a chance." Gia hesitated. "Aside from the fact there has not been enough reason."

"Well there is now, isn't there? And there is the matter of the late Carmen Klaus."

Vic started. "Our denzonite suspect?"

"More than a suspect, I think. She apparently blew herself to bits as you flew over Pock Hill. One of the bits—her hand—was still holding a button transmitter."

"I don't understand—" Gia began.

"I think I do," Vic said. "The stupid broad must still have had some denzonite with her when she tried to blow us out of the sky." He shook his head in disbelief. "Even the best of us make mistakes. But . . . *that?*"

It had been an awful death, even for one whose trade was bringing death to others, but Gia experienced a lifting of spirits as she realized she was finally free of a disturbing threat. Later, as she sat before a T-Com console, fingers aching from ten minutes of unaccustomed typing, she wondered if she had been out of the security game too long. Expediters were not, after all, supposed to be risk takers, yet for days that ancient bony finger had not been far from her shoulder.

Suddenly a new pattern of lights swept the console and Digonness's reply began tracking across the display:

JOPHREM GENESE'S BEING A WOMAN CERTAINLY EXPLAINS THE EASE WITH WHICH SHE ELUDED ARREST. AT LEAST WE ARE WELL RID OF HER, THOUGH IT IS TOO BAD HER DEMISE HAS EFFECTIVELY SEVERED POSSIBLE LEADS TO HER EMPLOYER. I KNOW WE HAVE OUR SUSPICIONS IN THAT REGARD, BUT SUSPICIONS ARE NOT EVIDENCE. SO PLEASE KEEP THAT PART OF IT TO YOURSELVES FOR NOW.

"Agreed," the A.R.A. murmured. Squeezing into the seat alongside Gia, she typed, THIS IS JENNY. ANY IDEAS OF WHAT TO DO WITH THE GIZMO? SO FAR, IT SEEMS ABOUT AS USEFUL AS A BOOKEND.

WHAT ABOUT THE PHUILI? HAVE THEY RETRIEVED A SECOND UNIT?

NOT YET. BUT I AM CERTAIN IT IS THERE.

IN THAT CASE, SUGGEST TO THEM THEY KEEP THEIR UNIT ON THE SHOUTER. THEIR LAB IS LARGER AND BETTER EQUIPPED THAN PERU'S, SO IT IS LOGICAL THEY TACKLE THE PROBLEM USING THEIR SHOUTER-BASED FACILITIES. MEANWHILE SHIP YOUR UNIT OUT ON THE FARWAY. IF THAT THING REALLY IS A KEY, IT IS STILL POSSIBLE THE LOCK IS HERE ON EARTH.

Galvic whistled. "But we'll lose two years! The Phuili could be off and running while the *Farway* is still this side of the Pleiades!"

MAKE THAT FOUR YEARS, Digonness came back. BECAUSE IF THE ANSWER IS AT YOUR END, THE UNIT WILL HAVE TO MAKE THE ROUND TRIP. NEVERTHELESS I AM CONVINCED WHAT I SUGGEST WILL SERVE THE GREATER GOOD. THINK OF THE PHUILI AS MEMBERS OF A PARALLEL SCIENTIFIC TEAM, NOT AS COMPETITORS.

"What a nice idea," Jenny said. She chuckled. "Now if we could just persuade the Phuili to think the same way."

Later they met with David. The two units, one labeled *6093* and the other marked with a Phuili hieroglyphic, stood side by side on the table. They were identical: the same shimmering yet nonreactive substance of the cylinder, the same tiny AA replica embedded within. Jenny had passed on Digonness's proposal and the response was an extended exchange of gutturals between David and his two Phuili colleagues. Finally, "If we find before ship weturn your world, Phuili gate open much sooner."

"We accept that possibility," the A.R.A. said.

David nodded. There was approval and a hint of respect in his large eyes. "In short time zis way perhaps better for Phuili. But in long time I zink it better for humans and Phuili togezer. Zerefore we agwee."

Just like that. Gia thought her mixed-up feelings were hidden, but she had forgotten the legendary empathetic sense of the Phuili. For the sake of inter-species harmony, Peter Digonness and his Phuili opposite number had long ago concluded an agreement in which the Phuili would respect the human need for emotional privacy, in exchange for human acceptance that "haste" is not in the Phuili lexicon. By definition the human side of the agreement was the more difficult, especially considering the dragging pace of most joint projects. So to say that Gia was surprised at David's alacrity in accepting the proposal, was an understatement. Equally unsettling was the inescapable fact that once the unit from 11852 disappeared into the Phuili research lab, her own role on the Shouter would become redundant. David, recognizing the human female's aura of confusion, and apparently deciding this was a moment to bend the rules, was sympathetic.

"Gia, you not like zis. You not zink we do wight?"

Gia blinked at the little alien. Perhaps it was innate or perhaps it was a residue of what they had shared beyond the AA, but she had no doubt he knew her feelings. And the fact that she knew he knew, hinted at a still open two-way. But she did not mind.

"You are doing what must be done," Gia told David sincerely. She turned to the A.R.A. "It's just that as things start becoming interesting, I find myself sort of—"

". . . out of it?" Jenny queried, her eyes twinkling.

The expediter shrugged. "As far as Earthgate is concerned, anyway."

"Well you are wrong," Jenny said.

Gia was revived as the *Farway* reentered normal space three days' travel time from Earth. After thirty minutes of painful exercise, followed by an even more painful experience of being required to swallow an evil tasting high-nutrient concoction, she was released, as the medic humorously put it, "under her own recognizance." Forcing unsteady legs to carry her in the direction of the bridge, her steps echoing hollowly along the silent corridors of the nearly empty ship, Gia finally entered inhabited territory in the deck immediately below the cavernous space vessel's humming Control Center.

Suddenly she was startled by a pair of strong arms and a hug. "Vic!" she said, astonished.

Galvic Hagan slackened his hold and grinned. "Welcome to the land of the living."

"Where . . . how . . . ?"

He chucked her under the chin. "Came aboard right after they turned you into a corpsicle, dear." His grin broadened. "By the way, the difference between our ages has narrowed a couple of years. Care to take me on?"

Placing both hands on his chest, she pushed herself away. "Boring couple of years, huh?"

"Not so much. I'm returning home to go back to school. Done a lot of studying."

"Subject?"

"Planetology."

"A good choice," Gia said approvingly. "You already have the field experience, so you should have no trouble—"

"Bless my soul, she's awake!" Beaming, Endart Grimes trotted over and grasped Gia's hand. "Galvic my boy, why didn't you tell me?"

"You didn't ask," the younger man sighed.

"And you, young lady. How do you feel after your second long rest in four years?"

Gia noted the fat man's apparent good health. "Not as up to it as you, I suspect. How do you do it?"

Grimes chuckled. "No miracle. There is still much work to do on the equipment, so I had myself revived several weeks ago." He patted his stomach. "I have had time to catch up."

"But between meals he is always in his workshop," Vic said. "Gia, you should see it. I bet he could build a phase converter if he wanted to!"

Grimes blushed. "Please. I am just a mechanic performing a few modest modifications." He added sadly, "unfortunately, there is still no way I can repair a sour module."

"Don't be so bashful, man. You're an artist!" The fresh voice was that of a large, middle-aged man with a lined face and twinkling blue eyes. He went directly to Gia and kissed her soundly. "You look well, Ms. Mayland."

"And so do you, captain," Gia returned fondly. It was no secret they were old friends, though Captain Joel Greshom's personal relationships were matters he normally did not discuss with his professional associates. Firmly holding her arm, he steered Gia across the deck to the door which led to his private quarters. Once inside, he sat her in the most comfortable chair. Then he called up the steward and ordered a light meal.

As she relaxed, she looked around the big room. At the simulated antiques, old leather-backed books, the handsome Turner reproduction above the realistic stone fireplace. "If the colonists had known about this—"

He laughed. "Girl, you're barking up the wrong tree. Many have supped here, and without exception they all felt sorry for me. I remember one farmer solemnly informing me that a few creature comforts are no substitute for a wide landscape under the open sky. He was right, too."

"You haven't been planetside since my mother died, have you?"

For a moment the captain looked bleak. "Never felt like it." He went to

a trophy case, and from among the memorabilia of a dozen worlds lifted out a glittering cylinder. "Here. Forget about my past and concentrate on your own. A little something to refresh your memory."

It was like a tonic. Gia felt a restoring glow as she held it up to the light and examined the delicate structure contained within. "It's not a matter of memory. For me, it was yesterday when I brought this on board. Anyway, why isn't it in the safe? I don't think you realize its importance."

Again the big man laughed. "What would be the point? The person in charge of the safe also happens to be a loyal employee and shareholder of the outfit which is apparently the prime suspect behind your troubles. So why would I go to the trouble of protecting that bauble from Transtar's evil machinations—whose loyal employee and shareholder is me? Hmm?"

He was, of course, making fun of her. But the point was well taken, though Gia did not immediately abandon her concern. "So everyone knows about this? What it means and where it is kept?"

"I suppose. My officers of course, who often visit me here. And young Hagan. And certainly Endart Grimes."

"Oh yes. Endart Grimes." Gia reluctantly replaced the tiny AA in the trophy case and closed the door.

The captain eyed her curiously. "Don't you like the man?"

She shrugged. "I hardly know him."

"Which is the problem, I suspect. He acts like a fond uncle and you resent it. Right?"

"You are very discerning."

"Not really. I just know you too well. Anyway, he's not such a bad fellow. A little lonely perhaps, but he has his work to keep him company. He is very dedicated to what he does, you know."

"So are we all," Gia said moodily, reflecting on the fact that in her own job it was going to be difficult to sustain the interest and excitement of the Shouter assignment. When Jenny had suggested she belonged with the crystal-enclosed artifact right through to its hoped-for solution on Earth, it had made a lot of sense at the time. But in the cold light of reason, it was more likely the harried A.R.A. had had better things to do than invent work for an expediter who was better at detecting than expediting.

"Penny for your thoughts," the captain said.

"Nothing important," Gia lied. She forced a smile. "I think I need to resume an interrupted holiday."

She was serious about the holiday. A few days of relaxation might do much to revive her flagging spirits, especially while the artifact was being examined in Expediter's labs. But thoughts of sun and sand were put firmly aside by the first ground-to-orbit call to the huge starship. "I want you down on the first shuttle," Peter Digonness told her, his four-years-older screen image tight with supressed anticipation. "If what you have is what I hope it is, then from now on you can select your own assignments with my blessing. If it is not, then you and I will probably end up sharing the same terminal in the computer pool."

Gia nodded. She knew the Deputy Director was not exaggerating the consequences of failure. "I am not really worried," she said. "The artifact was

placed where it had to be found. So it has to have a purpose."

Digonness agreed soberly. "Perhaps. We do know that so far the Phuili have accomplished nothing with their unit. So it is just possible that bringing ours to Earth is the right approach. After all these years, I wonder—"

They were separated by millions of kilometers, their images relayed via a communications net encompassing ground and space. Yet suddenly the two shared a rapport far beyond the linking ability of lasers and microwaves. Gia had felt it before, she welcomed it gladly and then felt a sense of loss as it faded as abruptly as it came. Digonness's astonishment was replaced by a dawning realization, and then by an introspective calm. He said softly,

"It seems, my dear Gia, there is somewhat more to communicating than I realized."

It turned out that the first shuttle was not designed to carry passengers. The space below the flight deck was cramped, with Gia, Galvic Hagan and Endart Grimes squeezed into a space not as wide as a standard ground car. Behind them, most of the thirty-meter cargo bay was filled with two disassembled life suspension chambers and four unused modules, all destined for modifications at the P.L.S. plant in Seattle.

The artifact had been stowed in a compartment next to her seat, and as soon as the maneuvers of separation and retrofire were complete, Gia retrieved the crystal-enclosed model and turned it over in her hands.

"Some souvenir," Vic commented seriously.

"True," Gia agreed, peering at the delicate miniature within. Somehow her enthusiasm was diminished, making her wonder if she was a victim of overload—too much, too fast. Subjectively the rapid pace of events on the Shouter had happened only yesterday, and not even twenty-six months in stasis could relieve the effects of accumulated stress. Yet it had been only hours ago in real time that the feel of this ice-silk surface had kindled within her a soaring sense of accomplishment. There had been no doubt, no doubt at all, that the dream of Earthgate was finally on the verge of realization.

Now, she felt nothing. The dream was dormant.

Suddenly Gia stopped rotating the model. She upended it and peered along the bottom edge of the crystal cylinder. She carefully traced her thumb along the edge and then looked again. "This is not it," she whispered.

"It isn't what?" Galvic asked curiously.

She turned to him. The young man flinched at the shock in her eyes. "My God Gia, what—?"

"It's a fake," the expediter said. Abruptly she grasped his hand and dragged it, palm-wise, across the cylinder's edge. "Look. Is it bleeding?"

He pulled his hand free and glanced at the fading impression on the skin. "No, it's not bleeding. Should it be?"

"You would have been sliced to the bone if this was the genuine artifact! See the little nick on the edge? Not even a diamond should be able to do that. Compared to the original, this is putty!" Gia looked across at the other passenger. "Isn't that right, Endart?"

The fat man, who had apparently been dozing, half roused himself. "... ah ... I beg your pardon?"

"When did you make the substitution, Endart?"

"Now just a minute!" Astonished, Vic looked from one to the other. "Gia, what are you getting at? What substitution?"

"Ask him!" she flashed. Leaning forward, Gia met Grimes' heavy-lidded gaze. "Endart, what is your actual connection with P.L.S.?"

Grimes lowered his head modestly. "Founder, Director of Research and Chairman of the Board." He looked up. His face was still jovial, but the pale eyes had become aware. And cold. "Endart Penders Grimes. That is my full name, you see."

"Oh my lord." Galvic Hagan shook his head in disbelief. "Move over, Transtar."

"You'd better believe it," Gia said. "P.L.S. is a small one-specialty outfit heavily dependent on government grants to improve a product which Earthgate will make obsolete overnight. Now *that* is a motive! The woman once masculinely known as Jophrem Genese was working for Grimes all along. It was no accident she blew herself to kingdom-come when she pressed the button which was supposed to blow us out of the sky. One insignificant blob of denzonite, tuned to the same frequency as the denzonite Genese herself had concealed aboard our aircraft, and Grimes almost had it all. No us, no witnesses, hopefully no Earthgate, and no hired killer. Do I have it right, Mr. Gimes?"

The Chairman of Penders Life Support Systems was regarding his accuser thoughtfully. "Very ingenious. But, of course, absolute nonsense. For instance, why would I substitute for something which never existed in the first place?" He pointed at the artifact. "Where was it really made, Ms. Mayland? In the workshops of PERU perhaps? It seems to me that your scheme to save your own reputation at the expense of a poor fat man who has never done you harm, is most reprehensible. I am sorry, but after we land I intend to report this whole sordid matter to the proper authorities."

It was an amazing performance. Despite herself, Gia felt a reluctant admiration for the mental agility contained within that polished skull. But Grimes was clearly on the defensive, so she determinedly pressed her advantage. "Go ahead. Report. Meanwhile, I am sure an analysis of material samples from your workshop will find something with an interesting similarity to material from this." Gia held up the artifact. "Or don't you think so?"

Grimes was unimpressed. "I use common enough substances. So make your analysis. It won't prove anything."

"It won't get us Earthgate either!" Vic said angrily, swiveling in his seat and grabbing the front of a voluminous tunic. "Tell us what you did with the original you bastard, or by heaven I'll ... *oof!*"

He gasped and released his grip as Gia thumped him between the shoulder blades. "Vic, you are a jackass," she said coldly. Her voice softened. "The artifact is indestructable, so he has to have concealed it somewhere. Probably, I suspect, aboard the *Farway*. We'll

simply make sure nothing is shipped to ground until the ship is searched. Even if it takes weeks."

"Or years?" Grimes asked slyly as he straightened his rumpled tunic. "So the charade continues, eh, Ms. Mayland?" He smiled. "You will find nothing, of course. But we both know that, don't we?"

And he's probably right, was Gia's gloomy realization as she thought of the enormous volume contained within the living decks and storage spaces of the three hundred meter star ship. But whatever the outcome of the search, one thing was certain. Grimes had to pay for what he had done. If she could not see him put away in one of the orbital prisons, Gia was sure she could filter enough evidence through to the P.L.S. stockholders to exclude firmly the stout executive from any of the financial fruits of his crimes. Which would certainly damage his pride, as well as his bank account.

Damn him!

All the punishment in the world could not compensate for the loss of Earthgate. Staring miserably in front of her, Gia barely noticed the flare of a steering jet through the side window, and then the dropping away of Earth's horizon as the shuttle's nose came up for reentry. She heard a slight thrumming as the thick wings began to bite atmosphere, felt a gradual increase of weight as deceleration pressed her into her chair. As the shuttle slid down its narrow track of safety towards denser air, the thrumming increased and became a vibration. Reacting to computer commands, control surfaces extended from their housings. There was a coughing roar as ram-jets fired up. . . .

"Explosion aboard!"

Even from the lower deck they heard the pilot's shout as the shuttle shuddered and then began to break apart.

"Emergency separation!"

There was a bang and then breath was gasped out of their lungs as something shoved with enormous force against the rear bulkhead. Looking like a larger version of an ancient Apollo capsule, the separated nose section immediately flipped over to re-entry attitude, and for a moment Gia saw the crumpling shuttle fall away behind them. Haloed with a flickering blue light, the discarded stub-winged craft was falling in on itself.

It's imploding!

The moment was barely enough for astonished uncomprehension before there was another jolt as the drogue chute snapped out behind them and steadied the jarring motion of their fall. Somewhere a relay closed and the huge main canopy shot out after the drogue, again ramming their bodies deep into restraining cushions as the shroud lines snapped, stretched, and then held.

"Is everyone OK down there?" the pilot shouted. Apparently the intercom was gone, along with just about everything else.

"I think so!" Vic shouted back. "What the hell happened?"

"Something cut loose in the cargo bay, that's all we know. Thank God this is an old prototype model with capsule separation. Otherwise we'd be part of the mess back there. Anyway, brace yourselves. We're going to hit!"

They did, violently. After the first bounce the capsule hit again, tilted, then

rolled completely over until it stopped with a shuddering jarr and a screech of riven metal. It took only a moment to trigger the latches of the escape hatch, and not much longer for the three passengers and two crewmen to scramble out of their dented confinement. They found themselves on a sandy slope with sparce patches of coarse grass struggling for existence amid eroded rock outcroppings. The sun was low, the sky clear, and the air cool. For a minute or so it was good to relax, to breath deeply and to marvel at the fact they had all come through the experience with nothing more serious than a few scrapes and bruises. Even Endart Grimes, despite being older and overweight, looked almost content as he surveyed the scene. "Where are we?"

The pilot noted the position of the sun, then looked at his watch. "It's mid-afternoon and we were approaching Kennedy along a polar orbit. So I would say sixty degrees north or thereabouts."

"Canada," Vic said. "Some landing pad, huh?"

A wind began to blow up the slope and it seemed the sky was darkening. Gia thought she heard distant thunder. "Hope we're not in for a drenching," she commented as she and Vic climbed up to the top of the slope. Already the wind was fiercer, so they crouched low until they reached the edge of a cliff which overlooked a very stormy sea. Winded, Gia sank down on her knees. "If we had come down in that—"

"—we would not be breathing now," Galvic said, his face pale as he realized how close they had been to eternity.

There was a crunching of feet as the others joined them. By this time the wind was so strong everyone had to shout to be understood. Gusts of stinging sand beat on exposed flesh and sea birds squawked alarm as they flapped laboriously inland toward safety.

It was a strange kind of storm and it was becoming stranger.

A few kilometers out from the shore, a roiling dark cloud seemed suspended over the water. Lightning flickered in and around the cloud and thunder rumbled incessantly. The wind had increased to a frenzy, forcing the five to flatten themselves prone on the ground. Gia thought the assistant pilot shouted something, but his words were swept away in the roaring cacophony.

What is it out there?

The question was obvious, the answer was not. For the first time in her life Gia felt a genuine fear of the unknown, like a child abruptly abandoned in a dark room. The wind whipped and howled toward the thing over the water, toward the frothing column that had reared up into the base of the cloud like a liquid pedestal. Within the cloud itself there was something shadowy, a vagueness that slowly rose upward until, just below the summit of the cloud, it began spreading into a gigantic T.

"It can't be," Gia whispered. "It just can't be."

But it can be, a voice mocked in her mind. *It is!*

Along with realization came a sound of laughter, high pitched and with more than a hint of hysteria. The wind was beginning to subside, enough so that Endart Grimes, between paroxysms of mirth, was able to gasp, "Don't you see, girl? Don't you see? I've given you Earthgate!"

"He has what?" Vic asked with astonishment, trying to look both at the cloud and at the wheezing executive. "What is the man blathering about?"

"I think it is pretty obvious," Gia replied stonily, her eyes fixed on the now unmistakable shape within its stormy cocoon.

"I didn't want even the slightest chance of it being found," Grimes went on hoarsely. Hands clutched against his stomach, he was rocking back and forth as if he was in pain. "So I hid it in one of the P.L.S. suspension chambers, just before the equipment was dismantled and loaded aboard the shuttle. I mean, how could I know it wanted Earth's atmosphere to feed on? That it was, in fact, nothing more than a template?" The fat man gave way to another wracking paroxysm of laughter. "Just think about it! If what you had with you in the cabin had been the real thing, we would not be here now, would we?" Wheezing horribly, he pointed shakily at the thing over the sea. "Instead, we'd be part of—"

He did not finish the sentence. Eyes bulging, Endart Penders Grimes toppled slowly on his side, quivered once and lay still. After a moment, Gia checked his pulse.

There wasn't any.

The place was Akimiski, a large island in James Bay. North of the island, James Bay widened into Hudson Bay, the ocean in a continent's hart. Ten kilometers off Akimiski's shore, a *seed* had reached for, and found, millions of tons of matter. Starting with a couple hundred tons of space-going machinery called a cargo shuttle, it then began absorbing from the gas-liquid interface at the planet's surface. Like a mini black hole it was impartial; along with air and water it took in huge numbers of fish and birds, a few seals, a couple of beluga whales, and one polar bear. It would have made no difference wherever it landed; ocean or desert, mountain top or city, it only needed matter. Unlike a black hole however, the *seed* was not insatiable. It was, as a dying man pointed out, merely a template, a means to recreate itself on an incredibly larger scale.

Which it did.

Exactly two hours and thirteen minutes after the implosion began in the shuttle's cargo bay, the process of transformation was complete and a new AA towered over the shallow waters of James Bay. The vortex was no more; air and sea were calm, and a rescue heli-wing accomplished a smooth landing near the four survivors.

At plus two hours and thirty-two minutes, even as the heli-wing was climbing away from Akimiski, a huge sphere of flickering light suddenly appeared above the AA. There was no accompanying

heat or noise, and the air remained calm.

At plus thirty hours and three minutes, a broad-winged aircraft appeared from the south and quietly vanished into the light. Roughly a tenth of a second later, *real time*, the same aircraft emerged above an AA locally known as "6093" and shortly thereafter alighted on the dusty surface of a hurriedly prepared runway. Six hundred light years had been traversed in less time than it takes to draw a breath.

Two passengers emerged from the aircraft. One, a young woman, held back as her older male companion walked hesitatingly toward a mixed group of humans and aliens who were waiting nearby. One of the group, a human, came forward and met the man halfway. They clasped hands and studied each other. Finally, a smile.

"Welcome home, Peter," Genevieve Hagan said softly. ■

ON GAMING

(continued from page 77)

Failure to do so is treason."

Each player had a laser pistol with reloads, and a utility belt with flashlight to help us achieve our mission.

"You are assigned equipment. Give thanks for The Computer's bountiful generosity! Preserve this equipment from harm or theft. Only a traitor would be careless with The Computer's precious resources."

We had back-up assistance in our mission from one security officer, and one security soldier armed with a powerful laser rifle. These two characters were controlled by the referee.

"Know the enemy! Guard against treason. Serve The Computer. The Computer is your friend!"

In addition to our weapons and equipment, each player had a security clearance code (we started at the lowest level), and belonged to a secret society (I was a member of the First Church of Christ Computer-Programmers), and had a mutant power (I had advanced hearing ability). The players didn't know what each other's mutant powers and secret society allegiance were.

"Mutants and members of secret societies are traitors. All good citizens should report traitors to The Computer."

I assumed the role of "leader" of our small group, and ordered the other two troubleshooters to go in front of me on either side of the hallway, just in case we ran into any "traitors." The security officer and soldier remained behind.

As we approached the ambush area, more traitors, who had just arrived to also try and retrieve the weapons and equipment, opened fire at us with their lasers. The troubleshooter directly in front of me returned fire with his pistol and hit two traitors. But he also accidently hit an autocar. The car exploded, destroying the valuable robot brain in it we were sent to retrieve.

We were now in big trouble. His poor aim would be considered treason. As leader, I did the only responsible thing I could. I shot the troubleshooter in the back—after yelling: "He destroyed the autocar. He's a traitor!"

Eventually, the other troubleshooter

(continued on page 117)

Jay Kay Klein's biolog

Englishmen are famous for traveling to distant points on the globe, bringing the arts and sciences with them. Now, we have one Clarke (Arthur C.) who has brought science fiction writing to Colombo, Sri Lanka, and another Clarke (J. Brian) who has done the same for a spot on the other side of the world: Calgary, Canada. Just east of the Rockies, this city in Alberta and site of the famous Stampede every July has grown from 140,000 when Brian arrived in 1952 to a full-size metropolis of 600,000.

Brian was born and raised in Birmingham, his school years bedeviled by nasty aircraft bearing black crosses and bombs overhead. Just before the war someone gave him a bundle of *Astoundings* (as *Analog* was called then) and as soon as shipping restrictions ended he became a subscriber, living for each month's issue. The ten-year-old was hooked permanently when he saw Doc Smith's Kimball Kinnison on a cover standing steely-eyed in the lock of a spaceship.

In London, he attended a Polytechnic on a course that led to membership in the Institute of Heating & Ventilation Engineers, including the usual rigorous British apprenticeship. There is something to be said for a technical education when writing hard science fiction, though Brian likes to think he is light years away from his office in a consulting engineering firm when writing a story for *Analog*. It took a couple of years and about a dozen rejections before editor John Campbell bought his first. JWC was the only editor who bothered to send Brian something other than a standard rejection slip. "Good . . . but not quite good enough. The competition's rugged! We're now paying 5¢ a word for short stories up to 7500 words, and quite a few of the boys are after that." (Campbell, June 12, 1967)

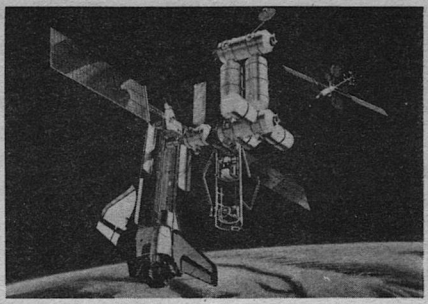
Campbell went on to say that Brian's idea of having the Great Pyramid gloriously left as Man's last artifact was unlikely, since Egyptian stone wasn't up to it. In fact, he consulted "the boys at Argonne National Laboratory," who agreed that Man's remaining artifact would probably be millions of toilet bowls, which are mechanically tough and chemically indestructible. (As Isaac Asimov had already noted in one of the *Foundation* stories.) Accordingly, Brian's first published story was *Artifact* in the June, 1969 issue, but about an alien object found floating in space. This received the lead position and the cover.

J. Brian Clarke

Clarke is optimistic about the future and sure that not only will we survive the present period of insane bickerings, but we will go on to the planets and stars.

His own immediate future includes finishing the follow-up to the story in this issue (a sequel itself to one in February, 1984), selling an already finished novel, and completing a second one.

The scenery around Calgary is magnificent, and he often hikes the mountain trails. Best of all, the clear skies permit satisfying views of the stars through his own small telescope and the motorized twelve-incher of the Calgary astronomical group. ■



NEXT STOP:
SPACE STATION

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The Alternate View

THE COMPUTER MYSTIQUE

G. Harry Stine

"*Mystique*: 1. An attitude of mystical veneration conferring upon an occupation, a person, or a thing an awesome and mystical status; the special cult of anything . . . 3. Qualities or skills that set a person or thing apart and beyond the understanding of an outsider. (from the Middle English *mistik*. from Latin *mysticus*, from Greek *mustikos*, from *mustes*, an initiated person.)" —*The American Heritage Dictionary of the English Language*, 1969.

A major difference in basic philosophy exists between Occidental science and Oriental mysticism.

Science and technology—a major force in today's world and in our everyday lives—is based upon the Baconian principle that a person should be able to duplicate any action, effect, or phenomenon by reading the instruction manual and without any contact with the original inventor, scientist, engineer, etc.

On the other hand, in order to comprehend and use the mystical knowledge of the Orient, one must spend years undergoing training and initiation under the direct, day-to-day supervision of the guru or person with the knowledge. In essence, to gain the wisdom of the Orient one must visit the guru on the mountaintop. There is no way to get the know-how by consulting books or other documents.

While it is debatable as to whether or not the Oriental mystics do indeed have arcane knowledge that we barbarian Occidentals do not possess, one cannot debate the fact that even the Orientals can learn Western science and technology without visiting the fountainhead of knowledge. They are able to read the documentation.

Science and technology depend upon written documentation and the predictable, repeatable result that can be achieved by anyone.

Oh, yeah?

Ever heard of Murphy's Law?

While all areas of science and technology are supported by libraries of documentation, when one gets right down to the nitty-gritty of trying to solve a particular specialized technical problem, the manuals probably don't say a word about it, forcing one to visit the guru who knows.

"Uh, that's a nasty transmission problem. I don't have the tools for it. Why don't you take it to Joe Hydramatic's shop?"

"Look, we're not a dealer for that make of television, and it requires special parts we can't get. Mike Kamakaze on North Tenth Street specializes in these."

"I'm a Cessna man myself. We'll have to ask Orville about it when he

gets back from vacation. He's our Piper man.''

I suspect that every reader has run into his or her personal versions of these typical stereotyped comments on technology.

However, now we've got a new area of technology that conforms even more closely to the basic definition of mysticism:

Computers.

Arthur C. Clarke once observed that any sufficiently advanced technology is indistinguishable from magic. And Robert A. Heinlein reminded us that one person's magic is another person's engineering.

Be that as it may, computer technology is probably far more a matter of mysticism than any other modern technology.

Think not? Have you tried to put a new computer up lately with nothing to help you but the Owner's Manual?

(I understand that the Apple MacIntosh has a crackerjack Owner's Manual; if so, it's the sole exception.)

Let me quote verbatim from the instruction manual that came with the modern computer system I just got to replace the ''obsolete'' 1979 version in which the mechanical parts of the disk drives were wearing out:

''Use ZSM to assemble your modified USERCUST.ASM. During the assembly, you will be asked what size the system is. ZSM will put the assembled code on the disk in drive A, calling the file USERCUST.HEX. Then load this into memory using the DDT. This causes USERCUST.HEX to overlay the user area, as desired. DDT is finished when a '-' appears. Depress Control-C to return to CCP.''

Now decipher that apparent nonsense trying to use the Oxford Dictionary! As an old technologist myself, I fully realize that any technology generates its own patois. But it becomes exceedingly bothersome when this jargon uses common garden-variety English words with totally new and unknown meanings that are not re-defined anywhere in the ''operating manual.'' Apparently, one must use some sort of ZSM glue to put together the parts for a USERCRUST.ASM. Then apparently one must determine the size of the system with a handy tape measure. And I thought that the EPA had outlawed DDT. . . .

I got my wife a twin to my machine so she could help me on occasion and so that we'd have some redundancy if one system went down. She had trouble from the start. ''It says type RETURN,'' she complained. ''I typed R-E-T-U-R-N . . . and nothing happened.''

Once that was solved because she'd come to the guru on the mountaintop (me), the next problem was, ''It says hit CONTROL C. I do it, and nothing happens.'' As a typist, she was trained not to hit two keys at the same time, so she'd hit the CONTROL key and then the C key in succession. Her guru husband had to explain that a computer was different from an electric typewriter and that she was expected to hit two keys simultaneously in this case.

Then there was trouble getting the computer to run a printer with a standard parallel interface (in the process of which I learned from various gurus what

all this meant). The Owner's Manual advised us that to operate this particular type of printer, Part Number 5415–0000–00–04 was required. It was ordered for a couple of hundred bucks and turned out to be a dollar's worth of cable, four plastic connectors of the sort I first saw on German V-2 rockets thirty years ago, and a simple etched circuit board. "Plug Part A into Slot B," read the instructions, which were astoundingly simple. But it didn't work when I finished with it. Nothing worked. First problem: the connectors weren't keyed, and it was possible to insert them backwards.

(Reminds me of the time someone inserted a 96-pin Cannon connector backwards—which theoretically can't be done, but it was—in a nuclear device in Nevada. When it didn't even go "poof" when it should have gone "bang," some poor joe had to climb the tower to find out why. He did.)

Then I went through the pin and cable connections, tracing everything through just to make sure. Turned out that the only ground return between the computer and the printer was the third wire of the respective AC power cords, which measured between 0.5 and 4 ohms, depending upon which socket the AC plugs were put into.

At this point, I came to the reluctant conclusion that computer technology was indeed computer mystique. I called the dealer, who didn't have the slightest inkling of what the problem could be. So I called the absolute fountainhead of knowledge, the factory itself.

Turned out that nobody in Customer Support knew what was going on either because "Burt was the expert on interfacing that computer with printers, and he's no longer with us."

When I remarked that I'd found the floating ground in the interface system and observed that using the AC power cord for a common ground return wasn't exactly considered good operating practice, much less conforming to the National Electrical Code, the answer was, "Well, it's a ground return, isn't it?"

The final solution: Throw the computer into my airplane (because I didn't want to pack it for fear it would be damaged in transit, whether in the clutches of an air cargo outfit—I've seen how they handle packages—or in the baggage hold of an airliner, which wouldn't work out either because no airline comes within fifty miles of the factory), then fly it back to the gurus on the mountaintop. They couldn't find the problem, either. And there was no documentation to fall back on. Whereupon they called in another expert who looked and said, "Oh, yes, when we configured that system, we didn't think a parallel printer would be used. All it needs is an interface chip in position U-seven."

Some people at the computer factory got upset when I made some comments about the computer mystique. Since it drew blood there, I thought it might prove interesting and/or infuriating to *Analog* readers.

There is absolutely no question about the fact that computer technology is indeed mystical. It requires arcane knowledge to practice the art. Some people may retort that it's because it's high technology, to which I must reply with a bucolic expletive, it's still primitive technology and has a long way to go. Others may apologize, saying that the

technology is moving too fast for things to be standardized yet to the point where things can be linked as a system, to which I must reply that computer technology really hasn't made that much progress since Intel developed the 4004, although it's been refined to beat hell.

No, it's probably because any sort of computer is an incredibly complex system, and there are few people who think in system terms. This is because what holds true for the computer mystique is also true for other complex systems such as a modern jet airliner or automobile.

But that doesn't mean that most computer users don't feel like "The Perfesser" in the cartoon strip "Shoe." Recently, the Perfesser wanted to burn the Owner's Manual for his tree-top computer but didn't think it would help him fix the computer. Whereupon the wizard with "Computer Repair" on the back of his cape told him, "Sure it would—especially, if you burn it on the altar with the sheep guts." ■

ON GAMING

(continued from page 111)

chased off the traitors by going beserk and charging them in the dark hallway. Meanwhile, I made a slight tactical withdrawal—I ran back to the security officer for help, unaware of what the other troubleshooter was doing.

"You must fulfill your mission. The safety of your fellow troubleshouters and the security of your Alpha Complex depends on you."

Although he didn't believe my story of traitors in the area, and suspected me of sabotaging the mission, the security officer allowed me to lead the soldier back to the area of the recent battle. The security officer didn't call for reinforcements, and followed us carefully from a distance.

After a few parting shots in our direction, the traitors retreated, having stolen only a few valuable items. The other troubleshooter stood, exhausted, with a captured laser rifle in one hand and his own laser pistol in the other. I immediately grabbed a robot brain from the one undamaged autocar and showed it to the security officer, exclaiming: "We are loyal citizens. We have served The Computer."

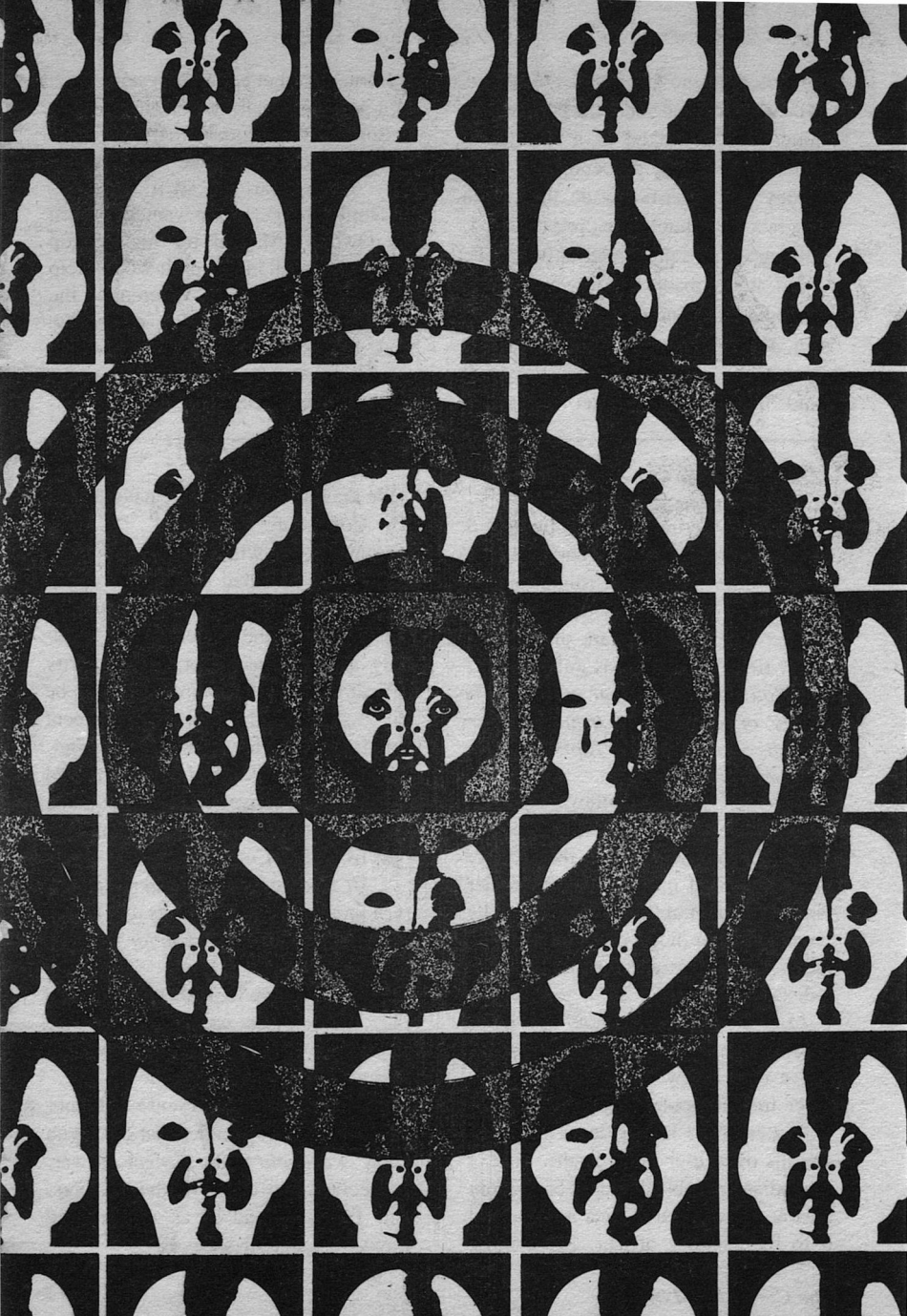
The player whose troubleshooter character was killed by me was upset. The other player/troubleshooter had chased off all the traitors single-handedly and he was upset. The security officer (referee) had wanted us all to be killed so he could steal the equipment for his secret society—and he was upset.

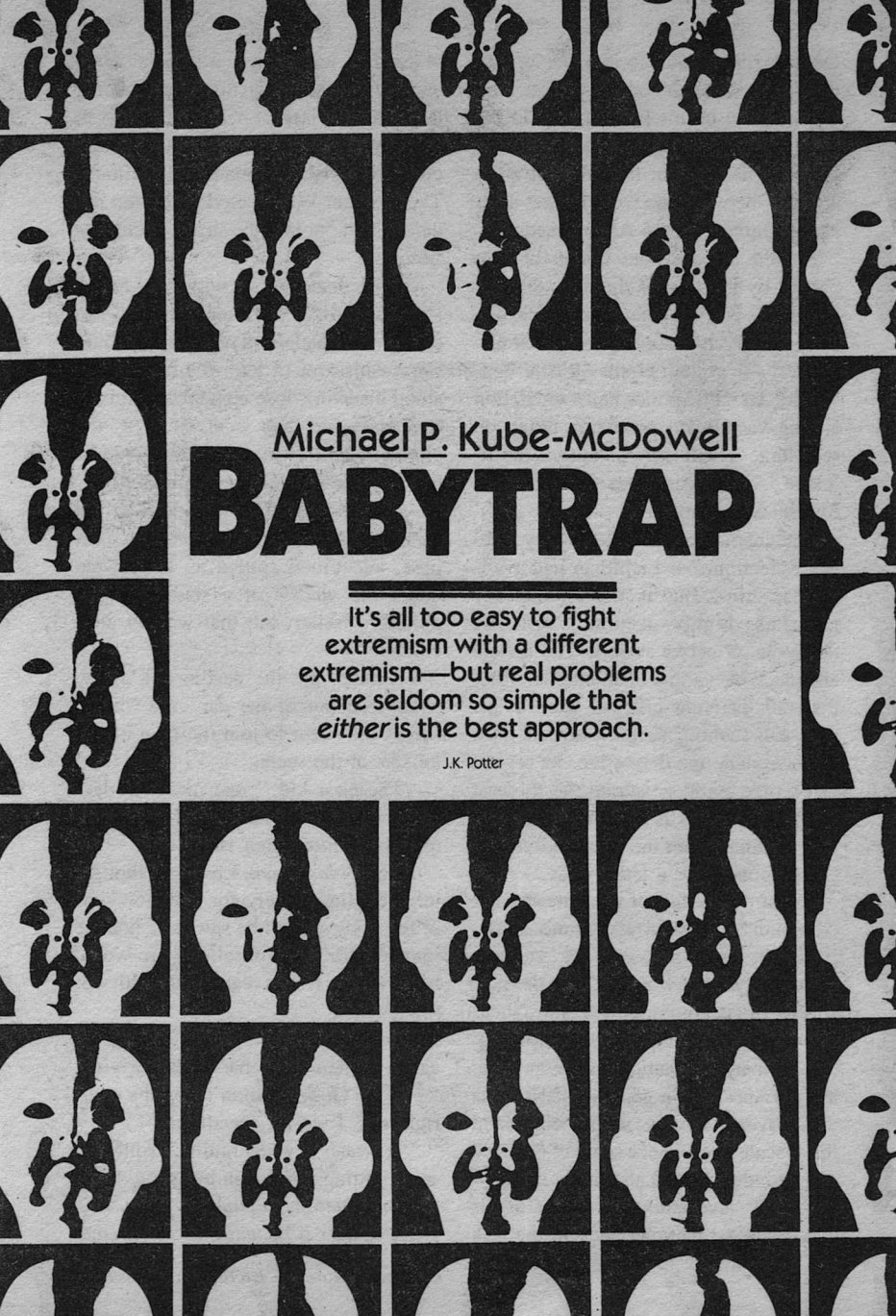
I was a traitor, I had lied, exhibited cowardice, betrayed my companions, and survived. I received a commendation from The Computer.

"All internal security agents please turn in your personal effects and report to the food vats. Thank you for your cooperation."

This adventure took about an hour to play, including set-up time (rolling dice to determine each character's eight attributes).

If you have a warped sense of humor as I do, and enjoy games that drive you crazy, *Paranoia* is the perfect answer. It receives one of my highest ratings, and I recommend it as a fun—and funny—change of pace. ■





Michael P. Kube-McDowell

BABYTRAP

It's all too easy to fight extremism with a different extremism—but real problems are seldom so simple that *either* is the best approach.

J.K. Potter

Donald Lichtman checked his watch, then propped his elbow on the car door and his chin on his hand. It would not be long now. His square-barreled chem gun was nestled out of sight but close at hand, between the front bucket seats of the Bureau-owned Antares sedan.

Should anyone take notice of him parked by the side of the busy Seaside Heights street, the chem gun would pass for a mobile radar unit, and Lichtman himself for a plain-clothes traffic cop. Seaside Heights' police had a reputation among vacationers for being tough on speeding, which only enhanced the illusion. And illusion was everything in Special Selection.

The chem gun was not the only Special Selection tool Lichtman had available to him. But it was one of his favorites: highly accurate, virtually noiseless, effective at up to 100 meters and in a wide variety of situations. More than 20 different charges were available, but Lichtman almost always used a succinylcholine derivative. Its crystal projectiles could penetrate the thickest clothing as easily as bare skin, and only five splinters from the thousand-crystal charge comprised a lethal dose.

Yet stray crystals of the water-loving compound vanished like June snowflakes in open air, and the victim's dying body itself would reduce the poison to more commonplace substances before the rare autopsy was performed.

Lichtman was waiting for Kevin Wise, a Hypersurvivor, a genetic misfit three years over his limit, with a combined three-scale intelligence score of only 5.2 and a grade C physical-genetic rating—

Motion seen from the corner of his eye brought Lichtman back to the task at hand. It was Wise, on schedule, pedaling furiously down the alley on a bike that was too large for him, slowing to wait for a gap in the heavy traffic before crossing the island's main thoroughfare. The moment Wise reared up on the pedals to dart out into the street, Lichtman fired.

Of the dozen or so witnesses to the accident, only Lichtman would see clearly what happened next. Wise would slap at his arm (a hail of tiny crystals stung his skin), lose control of the bike (his arms and legs went numb as the choline agent attacked), and topple to the pavement (vital nerve functions destroyed, he was effectively dead before he hit). Brakes squealed, metal crumpled, and blood spilled as Wise went under the wheels of a station wagon pulling a trailer, but that was all anticlimax.

Lichtman put the needle gun away, clambered out of the car, and walked across the street to join the knot of onlookers at the scene.

"The poor kid," one man was saying, shaking his head. "He couldn't have been more than 10."

Thirteen last week, Lichtman thought idly, circling slowly for a better view of the body. When he saw it he nodded imperceptibly to himself. There would be no autopsy. The 'cause' of death was self-evident.

"I couldn't stop," wailed the middle-aged woman who had been driving. "Oh, my God, I couldn't stop, he came right out, I wasn't speeding."

"It wasn't your fault," someone said, putting a hand on her shoulder in a feeble attempt to comfort her.

"I wonder if he was a local or a ren-

ter,'' a young woman said callously. ''That'd sure ruin someone's vacation.''

''Ruined the kid's, that's for sure.''

''It's a damned shame,'' muttered another, ''but that's what happens when you pull dumb stunts. A damned shame, but the kid should have known better.''

Sirens sounded in the distance and Lichtman began the walk back to his car. He drove across the bay bridge to the Parkway and headed south to the Wildwood exit. There he asked for a toll receipt and filed it with his records. Having been careless about incidental expenses on his last trip, he enjoyed some small satisfaction at correcting his oversight.

Then he headed toward the beach to find sixteen-year old Debbie Peterson, who was scheduled to drown while surfing in the moonlight that evening.

Though it was only Kerry Wohlford's first time in the executive conference room and his first meeting as a member of the Selective Engineering Bureau's Steering Committee, he found it hard to concentrate on the business at hand.

All three arms of the Bureau were represented: the top management of Medical Selection, in which Wohlford himself had served; the other six regional supervisors for Field Selection, the many commercial arms of that not only advanced the Bureau's work but provided most of its funds; and Lichtman of Special Selection.

Wohlford found his attention drawn to Lichtman, whose paradoxical reputation preceded him. At sixty-two, Lichtman was the oldest at the table, and yet the only one still active as a field agent. He was generally conceded to be among the most intelligent members of the committee, and yet he masked his intelligence behind a crudely direct manner of speech.

Lichtman's large frame overflowed the chair he occupied. He sat with his legs crossed, folded hands hooked over one knee, and rocked slowly in his chair, as though tolerantly waiting for the proceedings to be over. His busy gaze kept moving around the table. When his eyes and Wohlford's locked briefly, Wohlford found only boredom there.

As Field Selection: Atlantic brought an interminable report to a close, the Chairman glanced down at the agenda and then up at Lichtman.

''Special Selection?'' he said in a dry croak.

Lichtman uncrossed his legs and straightened up in his chair. He flipped open his flat binder and tipped it to read the report inside.

''Investigated 41 Probables, identified 38 Hypers, carried out 33 special selections with five cases still pending resolution. Filed reports to regional supervisors affected. Prepared six-month figures for all regions.'' He looked up at the Chairman. ''I'd like to single out agent Coleman for his excellent performance in the FBI special tactics school. He finished second in a class of seventeen.''

The Chairman nodded gravely. ''Anything else?''

''I'd rather not waste everybody's time,'' Lichtman said with a sidewise glance at the FS:A supervisor. ''The details are in my written report, but if you have any questions I'll be happy to expand on what I've said.''

"Thank you, Donald." The Chairman looked down the table until he found Wohlford. "Central."

"Yes, sir?"

"The six-month reports showed that your Hyper identification program is producing very little." The Chairman's smile was cold. "If you'd like to argue that your trapsters are working with an efficiency no region has ever experienced, I'll enjoy hearing about it. Otherwise I want to know what you expect to do about the problem."

The challenge caught Wohlford by surprise. "Sir, I have no reason to think that there's anything unusual in the six-month figures. We *are* very happy with the emulation accidents paralleling Jumpin' Jensen's stunt tour—"

"Mr. Chairman?" It was Lichtman.

The Chairman lifted a hand in accession.

"The problems in FS:C's Hyper program were there before Kerry was, and it isn't right to hold him accountable during the transition period," Lichtman said firmly. "I'll work with his staff to bring the performance back to nominal."

Wohlford was the only one surprised when the Chairman quietly acceded to the suggestion and moved on to other matters, and that compounded his surprise. When the meeting was over, Wohlford sought out Lichtman.

"I can't believe he let you talk to him like that," said Wohlford, shaking his head.

"You mean the Great Bear?" Lichtman said, jerking his head toward the now-empty head of the table. "The Chairman is careful not to make me remind him I could have his seat at any time for the asking."

"Oh." That was news to Wohlford, and he did not know whether to accept it at face value.

Lichtman cocked his head. "Look, as far as this review goes, don't worry. I wrote the book on Hypers. We'll get it taken care of with a minimum of disruption."

"I appreciate your help."

"That's all right. That's why I didn't take the Chairman's post. There's things that need doing that the top man can't do. I figure I'll take his job when I'm ready to take it easy."

There was something about the man that made Wohlford uncomfortable, something that went beyond the fact that in all the Bureau, Lichtman's job was the least desirable. Wohlford could not give a name to his discomfort, but it was nonetheless real.

He found that most Central staffers were reluctant to talk about Lichtman, a reluctance bordering on fear. What few facts Wohlford garnered were unilluminating: that Lichtman regularly defied convention and just as regularly escaped reprimand, that he had directed Special Selection since its creation twenty-two years ago, that he recently completed a doctorate in biochemistry.

But Lichtman himself talked freely. That came when the two were alone, en route to the Central States headquarters near Cincinnati aboard one of the Bureau's four-place *Airstar* canard jets.

"Hell, I was the second person the Bureau hired, and the first one's dead. Bob Hamblin. He's the one who hired me, back when the Bureau was just two

connecting rooms in the Planned Parenthood offices. God, that's a long time ago—let's see, are we still using 'The Preservation of Deleterious Recessives Through Modern Public Policy' in Basic Orientation?''

''That's right, you wrote that, didn't you?''

''My master's thesis in population ecology, Iowa State University. No, that's not quite true. The degree was never granted. Jury rejected the thesis outright as unfit. Nicest thing any of them said was to rename it 'peeing in the gene pool.' ''

Wohlford laughed lightly, politely, and looked away. A break in the clouds afforded him a view of the rounded green shapes of the Pennsylvania Appalachians and the winding ribbon of I-80 ten thousand feet below.

''I guess I wasn't surprised. Academics are notoriously slow on the uptake,'' Lichtman continued. ''The doctors understood that not every baby was worth saving. The insurance companies understood that not every case warranted heroic measures. The government—I mean the bureaucracy, not the faces at the top that keep changing—understood the advantages of harvesting the products of reproduction. But the far right and the far left dug in for the siege. As far as I'm concerned, they left us with no choice.''

''How so?''

''You *are* too young to remember, aren't you? Their Baby Doe laws tied the hands of doctors by mandating 'all practicable' treatment. Their Human Life amendment tied the hands of parents by prohibiting abortions and any sensible in-vitro screening process. They closed down P.P., which left Bob and me seeing the shape of what was coming and only one way around it. Well, hell, if you can't see to the culling before or during the pregnancy, you have to do it after birth.''

''Which is working. They haven't stopped us.''

''No, they haven't. We're not doing the job we could be, and they've made themselves a fine nuisance.'' Lichtman winked. ''But we manage, right? We manage.''

The Bureau had been ''managing'' since before Kerry Wohlford was born, a thought that occasionally had the power to give him pause. How close did I come to being one of Lichtman's targets? One recessive gene? One codon? One tenth of a point in the evaluator's computer? The thought came less often the longer he was with the Bureau, but it had not yet left his consciousness completely.

That was the only soft spot in the emotional armor Wohlford wore on the job. He knew the Bureau's enemies list: diabetes, hemophilia, Down's syndrome, cystic fibrosis, Tay-Sachs disease, thalassemia major, PKU, Duchenne muscular dystrophy, Fabry's disease, Lesch-Nyhan syndrome, and dozens more. He knew the shape of each pernicious mutation and the havoc it could wreak. And he knew the progress that had been made by the simple expedient of making the world a more dangerous place to grow up in.

It was easy to tell himself that those who should survive did. The fact that the Bureau's clandestine efforts changed the conditions of the life test did not

disturb him. As he had written in the margin of his notebook during a Basic Orientation lecture:

"Every species must undergo culling in natural environment to stay healthy. Our natural environment now artificial, culling must be artificial as well."

But face to face with Special Selection (and its guiding spirit) for the first time, Wohlford found it vaguely unfair, like changing the rules in the middle of the game.

And yet Lichtman had kept an even emotional keel through more than two decades of selecting Hypers—perhaps a hundred a year himself, thousands more through the agents he trained and directed.

There was no essential difference, Wohlford told himself, between Medical Selection's acts of omission and Lichtman's acts of commission. The two were of a piece, a necessary if difficult task forced on the Bureau by those who could not stomach gentler alternatives.

On that point at least, Wohlford's convictions were unwavering.

"I assume you're going to want to meet with the evaluators?" Wohlford asked as they neared the bland office building housing FS:C.

Lichtman shook his head. "Not until I have a chance to look at some of the records."

"You sound as though you have some idea what the problem is."

Lichtman's head bobbed in agreement. "If I had a spare twenty, I'd lay a wager with you that I'll be out of here in three weeks or less. There's something that happens to evaluators when supervision has been lax or they've just been on the job too long."

"I didn't realize—" Wohlford started, pulling the plate-glass office door open and stepping aside to let Lichtman pass.

"They lose the capacity to make the hard choice," Lichtman continued. "All the gray area decisions go in favor of letting the Hyper live. So the efficiency rating goes up while the number of special selections drops. Everybody looks good—until you realize how many bad genes are slipping through the net."

Lichtman found his way to the Records Division with a familiarity that reminded Wohlford that he, not Lichtman, was the newcomer. For the next two days, Wohlford saw and heard nothing of his visitor except that the librarians were so busy that the managers were having trouble getting their own reports processed.

Then for the two days following, Lichtman did not appear at the offices at all. On the third day, Susan Foulkes, FS:C's head evaluator, came to see Wohlford.

"Have a moment, Supervisor?"

"Is there some kind of problem?"

"Lichtman."

"The door, Ms. Foulkes." When it was closed, Wohlford continued. "Supervisor Lichtman is a guest, not a problem."

"You can tell he thinks so, anyway."

"If you're having a problem working with him, let's focus on that and avoid dealing with personalities."

She settled in a chair without waiting to be asked. "Who's working with him? I haven't seen him."

"He hasn't come to you to talk about evaluation procedures?"

"No."

"Then what's this about?"

"Arrogance. He's gone into our last six months of evaluations and reversed every negative conclusion. Now he's out selecting the kids we passed on," she said angrily.

"Without discussing any of it with you and your staff?"

"Not a word."

"I wish he'd been more diplomatic," Wohlford said, leaning back in his chair. "Still, why is that a problem? Our results have been out of norm. Headquarters sent him here to correct them."

"As of the 8 A.M. newsnet obits, he's taken out five kids already. Good kids. Two of them I'd have risked my job to see were left alone. They *weren't* borderline cases."

"In *your* judgement," Wohlford said pointedly. "But it seems to me it's your judgement that's in question."

Foulkes's facial muscles went rigid. "We follow the equation. Between certain limits, we have latitude to consider intangibles. If we use that latitude to see that we err on the side of conservativism, I don't think you can hold that against us."

"Perhaps not. But we are free to overrule you. Or is that what you're objecting to?"

"My ego's not at stake. The lives of seventeen more kids are. I object for them, because they can't."

"That's Protectionist talk," Wohlford said sharply. "I won't have that in my office."

"I don't care," Foulkes barked back. "Lichtman doesn't make judgements —he looks for excuses. Everybody knows that. Well, it's wrong."

"And so you shield kids from Selection."

"No, no, no. Look, you've got to understand us. We're under no illusions. We know that kids live or die based on the equation and that we're the ones who add up the numbers. I just don't think that the people who go out and do the Selections ought to enjoy it." She threw up her hands in resignation. "I was hoping that being an outsider you'd see that. Guess I expected too much of you."

"That's enough," Wohlford snapped, coming to his feet. "I don't know if my predecessor allowed you to talk to her that way, but I'm not about to put up with it. Go home and cool off. I don't want to see you around here until tomorrow morning."

She stared back at him in disbelief for a long moment, then muttered "Amateur" and stomped off. When she was gone, Wohlford sat back in his chair and toyed with a pencil, the muscles of his clenched jaw relaxing but slowly.

The tension generated by his argument with Foulkes stayed with Wohlford through the night. He knew that he would not have reacted so intensely had Foulkes's charges not come uncomfortablely close to his own misgivings. It was true that he had not taken the traditional track to his position: basic training in population data analysis, followed by an apprenticeship as a Field Selection strategist, or trapster.

Instead, Wohlford had spent his first two years out of the University of Michigan roaming the country for Medical

Selection. During his three- to six-month stints at various hospitals and clinics, he performed proscribed genetic analyses and looked the other way as prescribed when allied doctors and nurses acted on the results.

As far as Wohlford was concerned, it was the Bureau's front line, morally demanding and emotionally draining. The vigilance of the Department of Health and Human Services' spies was unending, and the danger of being exposed constant. When carelessness or pure bad luck betrayed a Med Serv employee, there was nothing the Bureau could do except hope some foreign disaster would push the "BABY-KILLER" headlines off the front pages.

Wohlford had welcomed the automatic rotation at the end of the second year. For the next eighteen months, he worked in the National School Health program, checking hearing, inspecting for lice, and taking the skin scrapings on which the Bureau's other efforts were based—light duty that amounted to institutional R&R.

His next assignment was in the Heritable Disease Institute, a well-known and widely acclaimed residential hospital ostensibly dedicated to reducing the suffering of children who had struck a double zero in the roulette game of genetic disease.

But the Institute's other function was more important to the Bureau—to be a place where personnel could be sent to hold in their arms a young boy whose muscles were failing him, to watch a girl who each day remembered less than the day before, struggle to learn—in short, to renew their sense of purpose. Wohlford had done well there, rising to the post of hospital administrator in the span of six years.

And then Supervisor Wells had suffered her heart attack, and the Chairman had come knocking on Wohlford's door.

Wohlford rejected the emotion of Foulkes's charges as mere professional jealousy. Perhaps she had been angling for the supervisor's post. More likely, she simply resented Lichtman's intrusion into her turf.

But there was something in the substance that deserved attention. He was not knowledgeable except in general terms about the day-to-day work of a regional operation, did not think like a trapster, had never participated in a special selection. If he expected to hold onto his new office, that had to change. And there was no one better to learn from than Lichtman.

The next morning, Wohlford called Foulkes into his office. "Did Supervisor Lichtman leave any sort of itinerary with you or anyone else?" he demanded.

Foulkes brightened at the question. "No, but he's being very logical about working his way across the region from west to east. I think I can tell you who'll he be going after next," she said.

"That won't do. I need to find him. Is he driving a Bureau car?"

"I think so. He usually signs out a blue Antares."

"Any way to find *it?*"

"Not directly, but he'll be using a Bureau debit card for his expenditures. Judy should be able to tell us where he is as soon as he checks into a motel tonight. We can get an idea from where he last topped off the hydrogen."

"See that I'm informed immediately."

"I will. And I'll bring you a list of the subjects he overruled us on, annotated by the original evaluators."

He frowned at her. "Don't bother. That's not what this is about."

"It's already completed," she said stubbornly. "I'll send you a copy anyway. You might find it illuminating."

"In the meantime, I'm finding you aggravating. If you would?—" He gestured toward the door.

When she left, Wohlford called his secretary. "John, see that a car and a plane are standing ready for me. I'll let you know later which I'll be needing."

When Wohlford reached the Holiday Inn in Toledo shortly after 6 P.M., Lichtman's room was dark and his blue Antares was already gone from the parking lot. Wohlford made certain that the older man had not checked out, then returned to his car to check the Opportunities list for Alicia Snow.

The Opportunities list was the heart of any Field report. In it were compiled the activities and proclivities through which a subject could be reached. The success of the Special Selection program lay in the fact that each death was the result of pushing the subject a little farther down a road they had already set off on. If the Opportunities list was competently executed, the deaths were always in character, plausible, credible.

In Special Selection argot, *long list* meant easy pickings, *short list* that the agent's creativity would be taxed. *HeDees* were beyond the reach of safe selection, destined to survive despite themselves—from their ranks came the patients for the Heritable Disease Institute.

Alicia Snow's list was short, but on it were two items so obvious that even Wohlford could recognize their potential: an experimental attitude about drugs, and a fondness for cruising a particular four-block strip during the evening hours.

Despite the darkness, it was not difficult to find Lichtman. The Antares stood out as the newest and best-kept vehicle in the neighborhood. For a moment Wohlford thought it was parked and Lichtman afoot, but then he saw a silhouette in the passenger's seat, on the curb side.

Wohlford turned right before reaching the spot and parked his own car on a side street. Though he knew it entailed some small risk, he wanted to watch Lichtman work, and circled around to a spot at the mouth of an alley a hundred feet down the block from where the car sat. There he crouched in the shadows, joining Lichtman in waiting.

Twenty minutes passed. More than a dozen young people made their way along one sidewalk or the other, some in boisterous groups, some alone. But Lichtman did nothing. Wohlford's legs began to ache, but he did not care to risk his hiding place by moving. His hands were cold, partly because of the falling temperature and partly the anticipation of death.

He quickly forgot his discomforts when he heard female voices and the distinctive clatter of fashionable steel heels on concrete. He leaned out, risking a glimpse down the sidewalk, and saw two young girls walking up the street past the dark, boarded storefronts,

both clothed in the colorful and exaggerated fashions popular in the cities.

As the girls neared the car, Lichtman flicked a small plastic bag out the window. It landed almost noiselessly at the taller girl's feet.

"Hey, gee-zer, you dropped sump'in," she said. Her voice reflected clearly to Wohlford off the glass and masonry. Her tone was light and flirtatious.

"Not me. Must have fallen out of your pock-et," Lichtman said, mimicking her tone. "You like good stuff, I can tell."

She stooped to pick up the envelope and examined its contents. "I never saw no pills like this. How good?"

"They stretch time, sweetheart. Whatever you doing when you pop these, it seem like you doing it forever. Pop it when you're smoking or snorting. You'll think you be flying for weeks."

"Maybe I take it when I go see Renaldo tonight," she said, and the girls giggled together at their private joke. "How much, geezer?"

"Free sample."

"I like the way you does business."

"Come back next week and I tell you how you can get more."

"I hear you, geezer." She pushed the envelope deep into a pocket of her tight jeans and the two skittered away. Wohlford drew back deeper into the shadows so that they would not see him, then froze. Lichtman had moved back to the driver's seat and his face was now fully illumed by the yellow light of the sodium streetlamp.

And he was laughing.

Wohlford drove slowly back to the motel in order to have time to think. He knew it was possible that some unrelated thought, even something heard on the car radio, had prompted the man's ghoulish display. That is, he knew intellectually it was possible, but he knew instinctively it was not so.

Still, when he knocked on the door of Lichtman's room he did not know what he was going to say.

Lichtman's face registered surprise, but he stepped back to admit Wohlford into the room.

"I saw you work tonight," Wohlford said, settling in one of the two armchairs.

"You wandered a long way from home on your evening constitutional," said Lichtman, crossing his arms over his chest. "Anything I can do for you, Supervisor?" He edged closer but remained standing, like a teacher looming over a student.

"You can tell me about Alicia Snow."

"Not much to tell. She'll take the capsules—probably has already. When she does she's dead."

"Susan Foulkes thinks she should have been allowed to live."

"Sentiment clouds judgement. Susan Foulkes could use about a year at the HeDee." Lichtman lit a cigarette with a practiced motion. "Alicia Snow carried genes for sickle-cell anemia and hemophilia and she's a lock to have five or more kids, the first probably before she turned sixteen. Considering her fondness for drugs, she figured to be a real mutant factory."

"Even so, you shouldn't have acted without going over the cases with my people. I thought that's what you'd intended."

"What is there to go over? They know the equation, Supervisor, as do you."

"I know there's a lot of things that aren't in it."

"QL = NE*(H + S)," Lichtman recited easily. "Everything's there. Quality of life equals natural endowment times the contribution of home and society. When the home won't contribute and society can't—well, you know what happens when you multiply by zero."

"I think you're abusing your discretionary authority, Supervisor," Wohlford said stiffly.

Lichtman sniffed. "That's crap and you know it. Our commission is to see that we don't repeat the mistakes of the 20th century. Thanks to do-gooders from both ends of the spectrum, we were keeping alive millions who didn't appreciate it and couldn't take advantage of it. And they were destroying us. But we kept on, encouraging dependency—encouraging the fit to waste their energies preserving the unfit."

"Until you showed them the error of their ways. Until you 'wrote the book' on Hypers and promoted your equation. Why did you do that, Lichtman? Why was that so important to you?"

Lichtman did not seem to have heard the questions. "That's a common error, that I created the equation. They take all the footnotes and citations out of the teaching copy of my paper. The QL equation is actually a hundred years old, from the 1980s—right before the extremists got the upper hand. I found it in a paper in *Pediatrics* on withholding treatment from spina bifida cases. Back then they could talk about such things without risking imprisonment. Of course, that's what put blood in the lifers' eyes."

"I don't care where it came from. I only care about how you use it."

"Maybe your problem is you're so used to seeing these diseases in full force that you don't quite understand that the real strengths and weaknesses of these kids are hidden." Lichtman yawned and stretched as though considering bed. "It's a simple lesson from nature, Supervisor. Only unsound limbs fall during a storm. The process is messy, but the forest ends up healthier. Ninety-five out of every hundred children still reach age 15. We just see that the right five die."

"Was Alicia Snow's friend one of the right five?"

Lichtman looked at Wohlford crossly and stubbed out his cigarette. "She wasn't part of tonight's selection."

"No? Then why did you give Alicia more than one capsule? One's a fatal dose, isn't it?"

"Two's preferred."

"You know damn well she'll share her little gift with her girlfriend."

Lichtman sighed exasperatedly. "Come on, Wohlford, grow up. The two of them together probably couldn't spell cat if you spotted them the C and the A. If they do have a little private drug party, what's the loss? We need strong minds and clean bodies. That pair was short on both counts."

"You don't have evaluations to back that up."

"I don't always need them. You learn to read them, after a while. It doesn't take long to size up a subject."

"No? How long does it take? Five minutes? A minute? Thirty seconds?"

"I got no problems with what I do."

"Maybe the Chairman would."

Lichtman sat down on the edge of the bed and began removing his shoes. "Are you his mouthpiece now? I knew something was coming the minute he went outside the fraternity to get you. Look, I've been doing this for twenty years. Don't walk in in your first month and think you're going to change me."

"You know what I think, Lichtman?"

"I'm not sure it matters to me," Lichtman said, unbuttoning his shirt sleeves.

Wohlford leaned forward, which brought their faces within inches. "I think the only way somebody could do this for twenty years is if he *liked* it. Any sane man would have gotten out a long time ago. What is it, Lichtman, kids pick on you when you were small? Or maybe your own kids disappointed you?"

Lichtman's face hardened with an icy fury. "It's none of your goddamnned business."

"I just want to know what fun it can be playing the bully when your victims never hit back."

"Thanks to myasthenia gravis, my sister Trina had a short and miserable life," Lichtman said, his voice a malevolent hiss. "My baby brother's life was even shorter. Mom was scared of going to the hospital because of the way they kept checking to see if we were caring for Trina.

"So she had the baby at home and my father never let the midwife show him to her. I remember watching, he just took him out into the woods wrapped in a blanket and came back alone. I got a vasectomy when I was 20 and nobody questioned it because they knew I've got more lethal and crippling genes in my nuclei than any just world would let a single human carry.

"We're filthy, Wohlford, filthy with two hundred years of misplaced kindness. And now you sit in the filth and try to tell me it's wrong for us to clean ourselves." He turned his back on Wohlford. "Get out. I've given you more answers than you deserve."

"I'm going with you on the rest of these selections."

Lichtman made a chopping motion with one hand. "I don't work that way. Don't push, Wohlford. And pass that message to the Chairman for me. Because I promise you, the guy who's pushing is gonna be the one who falls down."

Wohlford sat in his chair, rubbing the bridge of his nose with his fingertips and rocking slowly with his eyes closed as Foulkes finished the last of her Lichtman anecdotes.

"If everybody knows about Lichtman, why hasn't something been done about him?" he asked quietly.

"What could be? He's untouchable within the Bureau."

"We've done enough killing to inure ourselves to one more."

"But who does that sort of thing? You and I would never get near him."

"I could have gotten him in Toledo, if I'd only had a gun. On the street."

"It takes more than an opportunity. I've had hundreds of those. But could you have done it? That's what I mean. He's a loose cannon, but who's going to try to tie him down? Those who could

were hand-picked and trained by him—and he commands a great deal of loyalty.''

''And outside of them he commands fear.'' A disturbing thought crossed his mind, and he gave it voice. ''Has he ever taken someone out for challenging him?''

''I don't think it's ever come to that. On the other hand, nobody doubts that he's capable of it.''

''All right. Maybe he is safe from the Bureau. But that's not the only way.''

''We can't squeal. Everybody's hands are dirty.''

''I don't accept that. We've martyred dozens in Med Serv and the Bureau's never been brought into it.''

''Lichtman isn't the kind to go out a silent martyr.''

''Maybe we could ride it out. Maybe we should.''

She shook her head. ''Everybody's hands are dirty,'' she repeated. ''You've spent your time where the easy calls are made and the kids all *look* sick. You'll understand after you've been here a while.''

Wohlford drew a deep breath and let it out slowly. ''No. Sorry. There is a difference. The Med Serv lets nature decide. The trapsters let the subjects decide. Lichtman makes all the choices himself.''

Foulkes sighed. ''You're fooling yourself. The job of a good trapster is to take it beyond the level of choice, to do selections as efficiently as possible without taking out part of the protected group. There's no difference between what Lichtman does and what I do.''

''I thought you wanted him replaced.''

She looked at him in surprise. ''Replaced, yes. But you're talking about something else. What he does will still need doing.''

''Killing 12-year olds isn't the only way to eliminate mutant genes.''

''A one-day-old zygote has too many cells for gene editing. We couldn't begin to weed the recessives out of the adult population.''

''Then start earlier.''

''What, gamete screening and in-vitro fertilization? Even if the 28th Amendment weren't there to bring the government down on us, you still can't stop people from making love when and how they choose. Or make 'em use contraception.''

''No,'' Wohlford said slowly. ''I suppose not. Keep me informed about Lichtman's, ah, progress, will you?''

''Are you going to do anything about him?''

''You as much as told me there isn't anything I can do.''

''I can hope, can't I?''

Each day for the next week Foulkes brought him the bills and obituaries that demarked Lichtman's progress through the District.

''One thing you can say for him, he's efficient,'' she said cynically at one point. ''A death a day, just like clockwork.''

Wohlford said nothing, but inside him a great debate was underway. He was firmly convinced that the Med Serv was justified in allowing the most heavily burdened newborns to die. Had he not believed it, he could not have taken part.

On the trapsters' work Wohlford was

still ambivalent. The Bureau needed the money the pyrotechnics, target sports, and the like brought in, and the level of activity was low enough to avoid the vision of a world boobytrapped for the unwary and the weak.

But what Lichtman did was wrong.

Unfortunately, drawing the line between the three avenues of selection depended on subtleties the courts and public would not be likely to recognize. They would not see past the deaths—of infants, of children, of adolescents. They thought in terms of absolutes and rarely thought about the absolutes.

Wohlford tried to focus on Lichtman. Underneath whatever occasional levity might exist in the Bureau, there was always a sense of gravity, a recognition of the price paid by the parents. But, and Wohlford realized that this was what had first disturbed him, Lichtman lacked that quality of conscience.

As the days passed and the toll mounted, the fine distinctions eluded even Wohlford. What made Lichtman worse than anyone who might replace him? That he took pleasure in his work and performed it with zeal? Did that change anything essential? If not, then what made Special Selection different from Field Selection or Primary Selection? The absence of the illusion of choice?

If there was no difference, then eliminating Lichtman would change nothing, and exposing him would change everything. There was no middle ground on which to preserve the Bureau's work and honor both.

That was the choice that had immobilized all previous opposition, Wohlford realized. Nothing had been done because the only options were either pointless or unthinkable.

And now he had to decide whether there was any point to the pointless, whether to think the unthinkable.

The body of the boy who appeared behind the screen door of the farmhouse was gangling, growth having outraced both appetite and coordination. But the eyes were alive, alert, mature.

"Christopher Beech?"

"Yeah? Who are you?"

Wohlford shifted his weight back on his heels, and the porch boards creaked. "Sometime before the end of the week a man is going to try to kill you. I thought you'd want to know—and do something about it."

"Going out for a ride, Mom," Christopher called. There was no answer, and he expected none. He always rode in the early evening when his chores were done and his schoolwork was ready for his father's inspection.

The fenders of the motorbike were encrusted with several caked layers of Indiana soil, but the well-tuned engine caught at once. He headed off on the start of the trail he had cut with his many passings, south along the drive to the road and then east along the edge of the big field, which he had helped Dad put into corn this year. That was the fast part of the run, a long straightaway paralleling the drainage ditch and County Road 22.

At the first marker—the tree with the red reflector at the entrance to the driveway—Christopher pressed the timer button on his watch and gave the throttle a sharp twist. The bike rose up on one

wheel for a moment, then jumped forward down the narrow trail.

As he took the first jump, a bare mound of dirt added just the week before, he saw the blue car parked on the sloping shoulder of the road. He tried to ignore it, and keep his eyes focused straight ahead as he always did, thinking about the 90 degree skid turn coming up. As he neared the car he could not resist a glance sideways, and saw the shape of a man in the front seat.

Suddenly his entire right side flowered in pain, as though a hundred wasps had stung at once. He braked to an uncharacteristically inexpert stop, stalling the engine, and twisted his body to look back.

Crouching amidst the waist-high stalks of corn, hidden by the canopy of wide green leaves, Wohlford heard the bike approach and saw Lichtman straighten in his seat. The blunt black muzzle of a chem gun peeked through the open window and tracked Christopher's progress.

Lichtman fired just as the boy reached Wohlford's hiding place. The boy passed in a blur and a hail of errant cyrstals tore through the leaves around Wohlford. He felt the bite of several of the projectiles on his left cheek, and flinched. But he was not afraid. The choline inhibitor would work as well in his bloodstream as in Christopher's. He gripped his silenced pistol more tightly and waited.

The car door opened with a creak and Lichtman stood up halfway in the opening, looking in the direction Christopher had gone. His face was twisted by a look of puzzlement.

Then the puzzlement vanished, followed by an instant of naked fear before Lichtman began a retreat back into his car. At that moment Wohlford stood up, raised the pistol in a surprisingly steady two-handed grip and squeezed the trigger six times.

One Teflon-jacketed bullet shattered a window, and a second punched a hole in the door. But the others found their intended target, red halos blossoming on Lichtman's clothing. He seemed to sit down on the side of the car seat, then slipped to his knees. The car door swung open wide as he toppled forward on his side and slid down the slope almost to the turgid water in the bottom of the ditch.

Wohlford looked to the boy, who sat unmoving and unbelieving on the saddle of his bike, then crossed to the ditch, leaped lightly across the water, and went to Lichtman's side.

Lichtman's eyes were glazed. "Underestimated—the Chairman." His lips went slack and his gaze became vacant and unreacting.

"I didn't do this for the Chairman," said Wohlford quietly. "I did it for the children."

He felt for Lichtman's billfold. From it he extracted Lichtman's debit card and the auto registration—the only documents which would connect him with the Bureau. He held them on the palm of his hand and stared at them, pondering one last decision.

Christoper rushed up at that moment. "Geez, he is dead, isn't he?" He gaped at the body. "Those needles hurt. But I feel all right."

"I'm sorry I had to involve you. It was necessary," Wohlford said mechanically. *Necessary so that Lichtman*

could have that stomach-turning moment to realize that everything had gone wrong. Necessary so that Lichtman would have his self-affirming triumph torn from him at the very moment it was to happen.

"Shoot, that doesn't matter, he'd have killed me like you said. Who is he? What do those things in his wallet say?"

Slowly and deliberately, Wohlford replaced the cards in the billfold and the billfold in Lichtman's pocket, then stood up.

"Give it a week or so, and you can read about it in the paper," he said, his voice tired. "Any paper. You're going to be famous, Chris. All you have to do now is go call the county sheriff."

Christopher looked at him oddly, then started up the engine and headed back along the trail.

Wohlford ran his fingers back through his hair, and looked down at the still form of Lichtman. *You got out the easy way*, he thought. *The hardest part is still to come. They were wrong, but instead of challenging them you matched their extremism. You abdicated the moral high ground, and it's going to be a terrible fight to reclaim even a piece of it.*

The key-card was still in the Antares's ignition, but Wohlford barely glanced at it and considered only briefly the invitation it represented. He had done the pointless and the unthinkable; against that background, the decision to face up to his own culpability was an easy one. Christopher would be at the house by now, phoning. Wohlford sat down on the blood-splattered seat to wait. ■

● Our June issue, if all goes according to plan, will contain a remarkably diverse collection of stories, from the very down-to-Earth to the very far out. Vincent di Fate's cover is for the latter: the conclusion of Charles Sheffield's *Between the Strokes of Night,* which, as promised, expands the scope of events to a point from which you can look *way* back at the beginning. At the other extreme we have "The Ungood Earth," a collaboration by Rob Chilson and William F. Wu, both of whom are in a good position to *know* how future technology might affect a Midwestern farmer. The collection is rounded out by a variety of offerings from such writers as Walter L. Fisher, Jerry Oltion (with new collaborator Kevin Hardisty), Bill Johnson, and Eric G. Iverson.

Thomas Donaldson's speculative fact article won't really tell you "How to Go Faster Than Light," but the title was too good to resist and the article does try to nudge your thinking in that direction. Actually, nobody we know *knows* how to go faster than light, so far—but neither do we know, rigorously, that it can't be done. You've probably heard that we do so often you've started to believe it, but all the "proofs" that FTL is impossible rest on implicit assumptions. Donaldson's article drags a few of the assumptions out into the light of day and takes a look at what loopholes might exist—even one of which, if it turns out to be real, could make an enormous difference in humankind's future.

IN TIMES TO COME

the reference library

By Tom Easton

Them Bones, Howard Waldrop, Ace, $2.95, 225 pp.
Sun's End, Richard Lupoff, Berkley, $2.95, 280 pp.
Icehenge, Kim Stanley Robinson, Ace, $2.95, 262 pp.
Brother Esau, Douglas Orgill and John Gribbin, TOR, $2.95, 286 pp.
Dinosaur Planet Survivors, Anne McCaffrey, Ballantine/Del Rey, $2.95, 304 pp.
The Infinity Concerto, Greg Bear, Berkley, $2.95, 342 pp.
Symbol of Terra, E. C. Tubb, DAW, $2.75, 237 pp.
Master of Space and Time, Rudy Rucker, Bluejay, $?, 229 pp.
The Adventures of Samurai Cat, Mark E. Rogers, TOR, $8.95, ?pp.
Philip K. Dick: In His Own Words, Gregg Rickman, Fragments West/The Valentine Press (3908 E. 4 St., Long Beach, CA 90814), $9.95, 256 pp.
Sherlock Holmes Through Time and Space, Isaac Asimov, Martin Harry Greenberg, and Charles Waugh, eds., Bluejay, $14.95, 355 pp.
Castles, Alan Lee (illust.), David Day (text), David Larkin (design and ed.), Bantam, $24.95, 192 pp.

I am almost two weeks ahead of my deadline as I sit down to begin this column, but I will lose a day or so later on. Thus, I anticipate. I start early so I can make that deadline.

The problem is that someone I have known all my life, someone I have long loved, met her deadline this morning. My Aunt Madeleine Bates, my mother's sister, died of a sudden heart attack. The funeral will be later this week, once my cousins and uncles can get to Maine from Florida and New York and Boston and California.

Aunt Madeleine was not a science fiction fan. She barely knew what it was, other than that her nephew wrote it and reviewed it and enjoyed it. I expect her son-in-law reads it, for he is an engineer and inventor of the sort that

has often appeared in *Analog*'s pages. Accordingly—and to prove once more that I can turn *anything* into a lead—I commend to his attention this month's first book and dedicate my review of it to Aunt Madeleine's memory.

The book is no literary masterpiece, but it is one of the more enjoyable books I have read this year, which you might expect from the author's name alone. It's Howard Waldrop's **Them Bones**, the fifth of the new Ace Specials.

The story begins (in a sense) early in the next century. World War III has left only a few survivors, and they are desperate. They will try anything, even an experimental time machine that gives them hope of going back to change the conditions that led to the war. Their target is early-1930s Louisiana (reason unspecified), but their first emigrant, Madison Yazoo Leake, arrives elsewhen. He finds a world of paradox, without an Alexander or a Rome, a world where Arab traders visit the Americas in steamships, a world where Aztecs have spread to the Mississippi in their insatiable drive for human sacrifices. He lands among Moundbuilders, one of whom can speak Greek with him, and he finds himself fitting in very nicely.

The rest of the temporal emigrants arrive in our own world-line, but much, much earlier than intended. They face Indians who resent things like new diseases, and they are soon massacred.

The *book* begins with a crew of salvage archeologists, digging out pre-Columbian mounds threatened by a flood-control project in Louisiana. The date for them *is* the 1930s. They share our world-line. But, they find in their mounds a wealth of anachronisms, from horses to—the cover tells you true—dogtags. Their reluctance to believe what they see is quite understandable, and Waldrop plays it off against the reality of the time-travelers in a very nicely understated way.

Them Bones is classic SF, the kind that can make your head spin, well and deftly and wittily told. And it is patent Waldrop, with its cockeyed blending of past and future and present, likely and unlikely. Don't miss it.

Richard Lupoff's **Sun's End** is another title for a funeral mood and week, but it's not nearly as good as the Waldrop. Lupoff gives us Daniel Kitajima, a 21st-century technician who gets smashed up working in space construction and rebuilt centuries later as a cyborg superman. He has to learn to use his new abilities, but he is so super that he need no longer eat for the sake of that insignificant organic part remaining to him, his brain. (Hah!) He is also Croesus-wealthy, thanks to the cliche of compound interest, and hence immune to the conditions of a crowded, corporation-dominated world. A man out of time, a sleeper waked, he can seek his own mission, and he finds it when he learns from decadent bureaucrat Osvaldo Mgouabe that the world has only a few more centuries to live. The sun is warming, and the reason just may lie with a rogue planet, a gas giant with a plenitude of satellites, that is orbiting at right angles to the ecliptic. Daniel and Osvaldo go there, and then. . . . The answer to that ellipsis has to lie with volumes two and three of this trilogy. We can make guesses, and we may well feel that we needn't worry greatly about coming up with novel ideas. Lupoff certainly hasn't, at least so far.

I wish the book had been better edited, or the author had done another draft. As it is, the plot wanders disjointedly, losing its thread in inconsisten-

cies. Bloopers don't help, either. On page 15, Lupoff says a Moon has a libido instead of an albedo. On page 54, he claims the asteroid belt is visible as a disc, comprised of "uncounted specks of irregularly shaped rock, eternally dancing and tumbling about one another"; that chestnut, I thought, had been laid to rest years ago. On page 164, he has a falcon chewing. And more.

Avoid it. Lupoff is too sloppy to be called a good writer. Or maybe he just had the movie in mind.

Kim Stanley Robinson's **Icehenge** is in part a nice study of the psychology of virtual immortals. The plot gives us three eras: **1.** In 2248, the colonists of Mars revolt against a socialist Committee. Emma Weil, a specialist in ecological life-support systems, helps mutineers and their friends in the asteroid belt outfit an escaping starship. At the same time, the colonists are fighting a losing battle. **2.** In 2547, Hjalmar Nederland, an archeologist, finally wins Committee permission to excavate the ruins of one of the revolution's last battles and proves just how untrue the Committee's revisionist history of the period is. At the same time, an expedition to Pluto discovers massive monoliths of ice, the henge of the book's title. Nederland explains the henge by pointing to a journal, supposedly by Weil, that records a glimpse of a mutineer's sketch of a possibly planned monument. **3.** In 2610, Nederland's great-grandson Edmond Doya thinks he has another explanation for the henge—and, perhaps, a clue to what became of Emma Weil.

The interesting thing is that many of the people in Robinson's future world are present in all three eras. Their lives have been massively extended, and Nederland, for instance, was a child at the time of the revolution. Then how can history be rewritten? How can Nederland hope to find truth in a dig? Doesn't he—and others—have a memory?

Robinson focuses on the selectivity of memory. As we age, we do weed out old events. Childhood vanishes, except for occasional flashes, perhaps evoked by an odor or a glint of light. Memory is a moving window even on our short segments of time; Robinson says that it will be the same thing if our lives are extended, and the impact will be greater. Personal amnesia will prove just as unavoidable as social amnesia, and it will replace social amnesia as the explanation for why revolutions are lost.

I like that idea. It fits my own experience. It fits with the way past revolutions have been lost within the revolutionaries' own lifetimes. And I like the way Robinson expresses it. He does it so well that we almost forget to wonder what ever happened to the starship.

Douglas Orgill's and John Gribbin's **Brother Esau** first appeared from Harper & Row in 1982, but I didn't see it then. Now TOR sends me a copy of their edition, and I learn that military historian and journalist Orgill died in February 1984. This book is his last, it may be his best, and my belated review is appropriate.

The story centers on Liliane Erckmann's search for human ancestors in the Himalayan borderland between India and Pakistan. She is a bee-bonneted anthropologist, yes, but she proves right. Her aids find a million-year-old skull with a brain capacity in the modern range. In fact, they find two, but one is only a century old. The screams of "Fraud!" die down only when Liliane and her crew capture a living specimen.

The apeman, Esau, is a curious blend of beast and human. He tears the heads off animals and people, perhaps in an act of primitive reverence, and caches them beside antique skulls. He cannot speak, but he is intelligent and soulful. He is the reality behind the legends of the Abominable Snowman.

Esau does not thrive in captivity. Nor perhaps does Liliane. But sympathy and political pressures lead to his release, while she remains bound. Fortunately, she neither wears a radio tracking collar nor is pursued by vengeful Pathans.

The authors are not strong on character, and their settings are mostly painted backdrops, but they manipulate symbols most tellingly. Esau, thanks to a million years of evolution at high altitude, has a certain immunity to radiation. He and his kind may thus represent the future of genus *Homo*, and their fate is a judgment on species *sapiens*. Fortunately or timidly, the authors hedge that judgment in their epilogue; the result is a thin ray of hope.

Buy the book. You'll enjoy it.

I didn't like Anne McCaffrey's *Dinosaur Planet*, and I care only marginally more for its sequel, **Dinosaur Planet Survivors**. In the first, a contingent of explorers was set down on the world of Ireta, whose jungles rumble with duplicates of Terran dinosaurs. They are seemingly abandoned, and a heavyworlder faction tries to take over to set up a colony. The lightworlder leaders and technicians flee into cold-sleep. Forty years later, they awaken as the Survivors of the sequel. The heavyworlders have died, all but one, and their descendants have built a flourishing settlement. They also await the imminent arrival of a heavyworlder colony ship, ready to claim a world of wealth despite the plans and strictures of interstellar government. Fortunately, the Survivors have awakened just in time, the Space Patrol is on its way, and the villains are about to be thwarted.

The dinosaurs? Well, you see, once upon a time these sentient rocks, the thek, set up a zoo. Somehow they even managed to include a Pleistocene mammal in with their Jurassic specimens. And then . . .

Story and prose and characters, all seem designed for simple-minded twelve-year-olds. Or TV producers.

Greg Bear's **The Infinity Concerto**, on the other hand, is a delight. Teenager Michael Perrin meets composer Arno Waltiri, who once, under the influence of the mysterious David Clarkham, wrote and conducted "The Infinity Concerto" with the aim of transporting its audience. Literally. Some of its hearers flipped out, moving bodily into Fairyland, the Realm of the Sidhe.

When Waltiri dies, he leaves Michael a key and a set of instructions that take him too to the Sidhe. There he finds an age-old conflict between human and Sidhe, long since climaxed in the defeat of the last human wizard—Clarkham himself. Humans dwell only in a single oasis in the midst of the wizardly Blasted Plain. There too dwell the human-Sidhe hybrids, the Breeds, of whom the oldest are the Crane sisters, Nare, Spart, and Coom. It is the Cranes who take on the training of Michael, teaching him such things as how to decoy pursuit by casting shadows. They want him to survive, for he is a poet, and his destiny is linked inextricably to the Realm's.

Bear gives us wit, charm, and grace. He also gives us a vision of Faery that may just owe a bit to a wish to show others how to do it right. Read it, and its sequel, *The Serpent Mage*.

* * *

Dumarest has come to his thirtieth adventure in E. C. Tubb's **Symbol of Terra**. He has found the man who knows where to find Terra, but that man will not tell until after Dumarest has helped him in his quest for the Fountain of Health and Youth that is his only hope for repair of a ravaged body. Dumarest, of course, helps, though first he must turn an enemy left over from #29 into a friend and ally by defeating her champion in single combat. All escape just before the Cyclan can close in once more. They find the Fountain, too, hemmed in by assorted monsters. Unfortunately, the man who holds the secret Dumarest craves lingers too long in its regenerating radiance, and Dumarest gains only the benefit of a few more tidbits of information.

Will these tidbits be enough? Maybe. But there is also a hint of a conspiracy that has removed all clues to Earth's locations from official data banks. What new obstacles will Dumarest now encounter? Will he *ever* get home?

And how many volumes does Tubb think it takes to prove Thomas Hardy was right when he said, "You can't go home again"?

In **Master of Space and Time**, Rudy Rucker gives us a silly variant on Heinlein's *Puppet Masters*. Drunken inventor Harry Gerber *seems* to have invented a wish-granter. He and his entrepreneurial buddy Fletcher gather the necessary components and put it together. Fletcher wants money. Gerber's girl friend wants to fly. Gerber wants a doorway into another world where he can have an adventure. And when Gerber injects his brain with the jugful of activated blue quarks, they all get their wishes.

The trouble is, Gerber's adventure world is run by a Gerber-variant that is a naked brain which buds itself into back-riding parasites. Gerber et al. gleefully rid the world of the puppet-masters, but one escapes into our own. It buds crazily, taking over everyone in sight, and Gerber and his buddies must find some way to stop it.

They do, of course, succeed. In the process, they find the one workable way to beat a one-wish genie—give everybody one wish. Once opposites have cancelled, what's left, says Rucker, should be benign, bizarre, and bemusing.

It's typical Rucker. Full of crazy infinities and regresses and bad jokes. Totally wacko.

The Adventures of Samurai Cat, written and illustrated by Mark E. Rogers, is equally wacko, if in a different vein. This one is total sendup for Salmonson, Tolkien, Lovecraft, Howard, and the Norse mythos.

Title-cat Miaowara Tomokato is such a renowned warrior that when word of his death brings armies of rebels to destroy his lord, Tokugawa Nobunaga, it takes only the revelation that he lives to put the hosts in disarray. Sadly, the rebels are persistent. When Miaowara takes a day off to visit relatives (including a peskily belligerent nephew, Shiro), they take out his lord. Nobunaga's talking head then sets Miaowara on the path of vengeance. That path leads from Catzad-Dum in Middling Earth to the land of the Dunwich Cow (with a marvelous rendition of Asimov as publicist for the Real Old Ones, Yog N'goggawoggah and Yoknapatawpha) to the Aquitaine of Con-Ed (whose grand villain is Thpageti-Thoth) to Asgard itself. With Shiro's persistent help, Miaowara bloodily avenges his lord before walking into the sunset. His final words are, "One doomsday should be enough for any kitten."

You get the idea. Wacko. Sophomoric. Delicious.

Just before his death in 1982, I think, Philip K. Dick was just beginning to hit his stride. Others have praised his earlier work too much; it was his latest efforts that showed mature control and richness of thought. Yet there are all those others. Gregg Rickman is one of them. He read the Dick corpus, wrote a paper, and sent it to Dick. Upon the latter's invitation, he then met and talked and taped over Dick's last year of life. Many of the taped interviews have now been collated into **Philip K. Dick: In His Own Words**, amplified by Rickman's original paper and a few comments from others. More of the tapes will go into a second volume, *Philip K. Dick: The Last Testament*. A third volume will be more like a formal biography.

My initial impression was that Rickman is far too adulatory to be a trustworthy amanuensis (Dick says Rickman writes "What I want to hear"). Yet once the initial essay is past, we have exactly what the title promises: Dick's own words, edited lightly and ordered to give fairly well organized discourses. We learn his views of his own work and history, of critics and other writers, of agents and movies. We even find his own ignorance showing: he seems to have written *The Man Whose Teeth Were All Exactly Alike* (which I haven't read) under the misapprehension that Neanderthals had molars where we have incisors. We get a good sense of Dick the man, and this book will be invaluable to future scholars.

I do wonder why Rickman published the book with such a small outfit. The highly idiosyncratic typesetting and production mean an ugly book rife with typos, and the marketing seems unlikely to reach a large number of buyers.

* * *

Would you like to know just a little about how Isaac Asimov, Martin Harry Greenberg, and Charles Waugh put together all their anthologies? Charles is the story man; he has a phenomenal index to the short fiction of the last 40 or more years in his head. Greenberg and Charles both come up with anthology ideas, but Charles apparently takes most of the responsibility for the tables of contents. Greenberg is the one who leaves his Green Bay home to chat up editors wherever he can find them, sell the anthology ideas, and negotiate contracts. He also buys anthologization rights from story authors and doles out the bucks.

So what does that leave for Asimov to do? He writes introductions and head notes, but I have the impression that his main role is letting Greenberg say, whenever an editor balks at buying an idea, "Well, of course, we can always bring in *Asimov!*" Instant name recognition, and a great marketing gimmick.

I may be too cynical, though Charles has told me stories. . . . At times, Asimov may be the one to think up the idea or strike the deal, but you can never tell from the book. Some are better than others. Some are worse. Some are so-so.

How about **Sherlock Holmes Through Time and Space**? It's one of the better ones, partly because of the mythic stature of the Holmes canon with which it connects, partly because SF writers who work to extend the canon seem to do good work. I commend to you Asimov's own "The Ultimate Crime," James Powell's "Death in the Christmas Hour," the Anderson-Dickson Hoka yarn, "The Adventure of the Misplaced Hound," Sterling Lanier's "A Father's Tale," and more by Gene Wolfe, Fred Saberhagen, Richard Lu-

poff, Mack Reynolds, etc. There are two by P. J. Farmer, and even one by Sir Arthur Conan Doyle Himself: "The Adventure of the Devil's Foot."

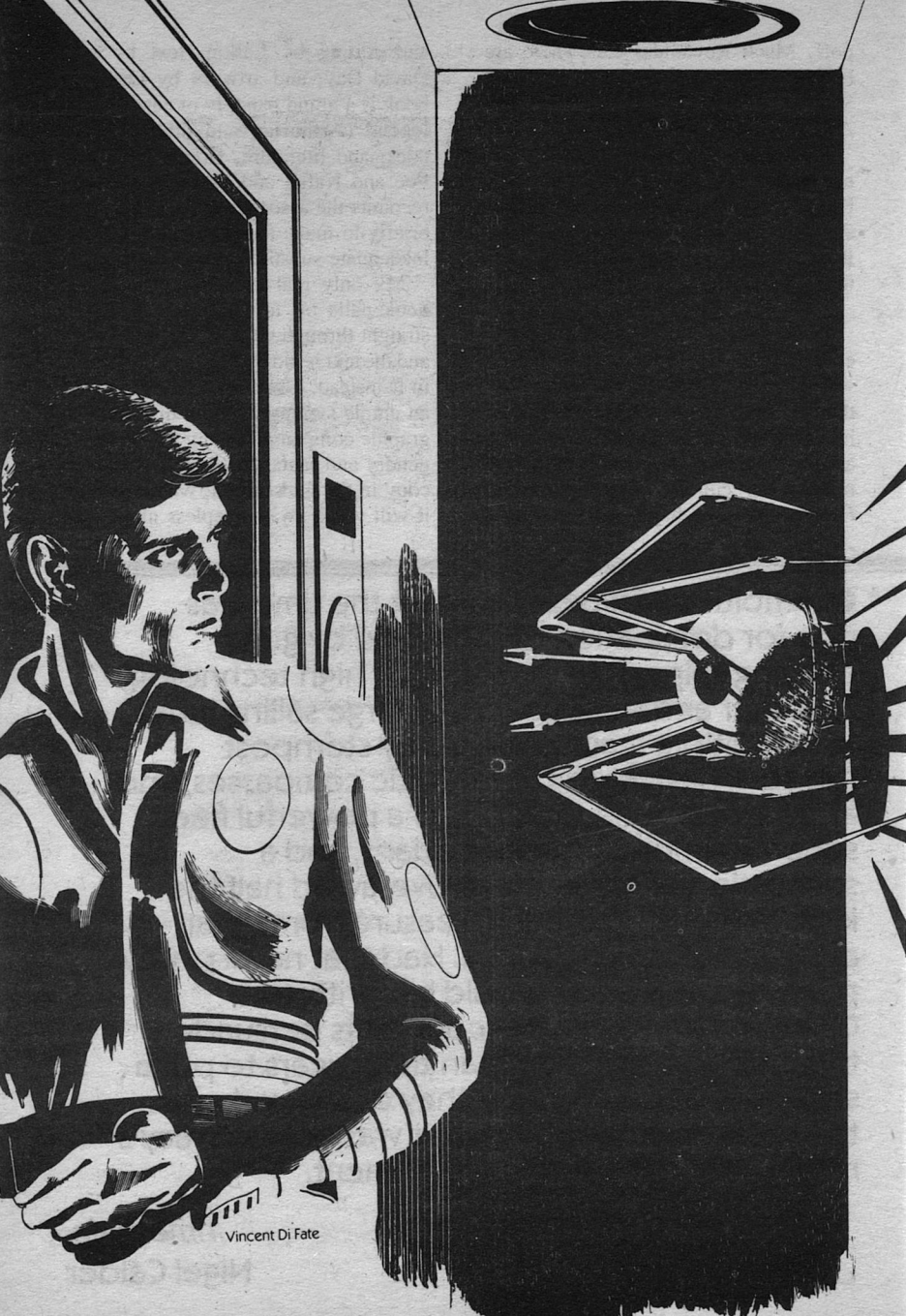
Have fun as you watch Moriarty become Wells's Time Traveller, see Holmes as youth and senile dodderer and doll, and witness the puzzles of the Baker Street Irregulars (to which Asimov belongs).

Alan Lee is an artist who has apparently been bughouse for castles since he was a kid. That didn't get him very far, though, until David Larkin discovered him in 1969 and began employing him as an illustrator. Ten years later, the relationship culminated in the Froud *Faeries*. Now we have **Castles**, design and editing by Larkin, text by poet David Day, and artwork by Lee. The book is a grand panoply of castles from legend (Arthurian and others), fairy tales, and literature, from Beowulf to Poe and Kafka and Tolkien. The text recounts the associated tales, albeit too briefly to make the book more than an inadequate substitute for the originals.

My only real complaint is that the book palls far too quickly when read straight through. It is too many castles, and the text is too often too cute. Browse in it instead. Use it as what it truly is, an ample synopsis and an imaginative, graphic companion to any library of legendry and fantasy. I think I'll put my copy in the guest room, where perhaps it will while away sleepless nights. ■

● Ambitious Chinese saw that the time was ripe for domination of the world by gun-carrying ships. They pulled their high technology together and built dozens of large sailing junks with multiple masts, steered by sternpost rudders, navigated by magnetic compasses, and armed with guns. In A.D. 1405 a powerful fleet set off to impress the barbarians, and a succession of expeditions overawed half the known world, gathering treasure from as far away as Mecca and Africa. Had that naval policy persisted, this book would be written in Chinese. Officials and accountants persuaded the emperor after less than thirty years to put a stop to it, and eventually they destroyed even the records of the voyages. It was bureaucracy's most breathtaking accomplishment.

Timescale,
Nigel Calder


Vincent Di Fate

Charles Sheffield

BETWEEN THE STROKES OF NIGHT

Part Three of Four

When faced with a totally unfamiliar environment, the first thing to do is explore it. And that may include some very fundamental surprises about *why* it is unfamiliar.

SYNOPSIS

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

Charlene Bloom has the unpleasant task of explaining what has happened to Dolly to the Institute Director, **Judith Niles.** *Bloom explains about Dolly's death, and notes that before Dolly died her condition had apparently stabilized for a while, with brain waves exhibiting their usual profiles—but fifty times slower than usual. Judith Niles is very interested in this result, and wants to explore it in detail. However, she is distracted by two other factors: there are big cuts*

threatened in the Institute's budget, and she is expecting an important visitor.

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

Judith Niles is tempted, because she is experiencing funding difficulties, and also because some of her experiments depend crucially on a low-gravity environment. But she is worried, because Salter Wherry, in addition to his reputation as the man who developed space industry and self-sufficient colony ships in space, is also known as a master manipulator of other people. Judith Niles decides to go up to Salter Station and take a look at the situation there for herself.

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

Wherry proves to be very old and frail, and has already survived several serious heart attacks. He explains to Judith Niles that he does not have much time left, and he wants an instant *solution to the narcolepsy problem. It is slowing construction work on the arcologies, and he wants to see them finished. As an added incentive, he points out that Judith Niles will have an opportunity to perform experiments on Salter Station that she is unlikely to get permission for back on Earth.*

Judith Niles is tempted, even though she strongly suspects that Wherry has some hidden agenda of his own. She believes that she already has the answer to the narcolepsy problem, and upon her return to Earth she performs an experiment to test her idea. With Wolfgang Gibbs as a volunteer in a spacesuit from Salter Station, they take the air pressure in a chamber down close to zero and ask Wolfgang to perform simple manual tasks using the TV camera in the suit to provide him with an image. Gibbs loses consciousness. Later, Niles explains to Jan de Vries what happened. Small and recent design changes in the suits produce pressure on the wearer's neck in certain positions, compressing the carotid arteries. That causes a momentary blackout. However, feedback through the TV scan system is at such a rate as to continue that blackout and cause continued narcolepsy.

While they are talking, Judith Niles has problems of her own: she begins to suffer from blurring and double vision in her left eye. Jan de Vries urges her to have a thorough medical examination, and adds another factor for her consideration. Hans Gibbs had mentioned that insurance rates for space work have increased because of the narcolepsy—but now de Vries finds that the

insurance company concerned is controlled by Salter Wherry. They both suspect that Wherry is working to manipulate them for his own purposes, though neither of them can think of a logical reason for it. Eventually, Judith Niles makes the decision that the Institute should move up to Salter Station.

Meanwhile, Salter Wherry has been reviewing the international situation back on Earth, where climatic changes have caused crop failures and thus increased political instability and unrest. He sees new evidence of major changes to come, and he is alarmed enough to tell Hans Gibbs that operations must be sped up. The Neurological Institute must move to space as soon as possible, and the arcology completion schedule must be advanced.

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

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

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

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

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

Year: 27698 A.D.

The year is 27698 A.D. On the planet Pentecost, in the Cassiopeia system, the

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

Peron is pleased (and amazed) to find that he placed third in the Games, behind **Lum** *and* **Kallen.** *The fourth place winner,* **Elissa,** *grabs the stunned Peron and drags him away to celebrate their victory.*

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

Leaving Pentecost, they have a brief view of The Ship, the great structure that supposedly carried their ancestors to Pentecost from Earth, many thousands of years ago. They are told that The Ship is off-limits and cannot be visited, and then they travel on, to attempt a landing on **Whirlygig.** *This is one of the Fifty Worlds whose high rotation rate allows it to be visited without using a ship. Peron lands first, and arranges things for the others: Kallen, Lum, Elissa, Sy, Rosanne, and Wilmer. This particular group has been selected to work together and make the landing.*

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

Arriving at the pole, Peron and Elissa find that the others are struggling with a problem on the airlock to the dome. Peron, Sy, and Lum work to operate it manually, and Rosanne prepares to enter. But Peron realizes there is still danger, and he moves to stop Rosanne. He

pushes her safely out of the way, and is caught himself in an explosion of air from the defective lock. He is carried for many meters, bouncing across the rocky surface. When he regains his feet he is unharmed, but he finds that his suit's insulation is ruined. There is no spare suit, and no way he can get back quickly to the ship. He is doomed to freeze to death.

At this point Wilmer takes charge. He tells Peron there is only one hope, and it is a long shot. Taking equipment from his carrying case, Wilmer gives Peron a series of injections. Peron begins to lose consciousness, but as he does so he hears Wilmer tell him that if he survives, he will wake in S-space. Peron, blacking out, prepares to die on Whirlygig.

Chapter 17

Waking was agony.

It began as only a low murmur of voices, speaking a familiar language but with pitch and intonation so changed that they were barely comprehensible. It was like the voice of a machine. He strained to understand. ''. . . little more asfanol . . . even a few more minutes . . . until we know what to do with athers (others?) . . . heart beat sturdy (steady?) now . . .''

Then a clearer statement, in an angry and petulant lower voice. ''Damned nuisance. Can't do a thing until we have a policy statement. Why that fool had to do what he did . . . it will take us a month . . .''

He was breathing. The air came hot into his lungs, searing the delicate alveoli with every slow breath. He felt it burn across the air-blood barrier, then fiery rivers of oxygen were surging along arteries and capillaries out to every extremity of his body. It was a relentless pain. There was an agony of awakening tissue and returning circulation, accompanied by muscle spasms he could not control.

Peron moved his tongue. As it touched his teeth it felt dry and swollen, too big for his mouth. But when he licked his lips there was a sense of slick, glycerine texture and a taste that puckered the inside of his mouth. He grunted in disgust, but no sound would come from his throat.

''He's awake,'' said another voice. ''Get ready. Peron Turca. Can you open your eyes?''

Peron tried to do it. The lashes felt gummed shut, but by a steady effort he could free them, little by little. He peered upward through slitted eyes and found that he was looking at a pale gray ceiling, curving without seam to meet walls of the same color. Somewhere off to his right there was a steady swishing and pulsing sound.

He turned his head to that side. The neck muscles reluctantly creaked, stretched, and obeyed his mental command. He was lying next to a great mass of medical equipment, monitors, pumps, IVs, and telemetering units. Numerous tubes and wires ran across to his bared right arm. Others extended to run up his nostrils and down to his lower body. He was naked.

He lifted his head. There was something subtly wrong in making the movement, but it did not feel like an internal problem. It felt rather as though the laws of mechanics had been changed, so that although he was clearly not in free fall,

neither was he moving under any normal form of gravity.

And something was wrong with his eyes. Badly wrong. He could see, but everything was blurred and indistinct, with edges poorly defined and with all colors muted to pastel shades.

Peron turned his head to the left. Next to the table on which he was lying sat a woman. She was middle-aged, frowning, and looking at him with obvious disapproval. Her face had a smooth, babyish skin, and she wore a blue cowl that was closely fitted to her skull.

"All right," she said. She did not seem to be speaking to Peron. "Motor control seems to be there. *Command: Let's have three c.c.'s of historex in the thigh.*"

It was the voice that he had first heard, and again it sounded hoarse and oddly mechanical. He saw and heard nothing happen, but after a few seconds there was a brief new ache in his thigh. Then the pain in all his muscles began to decrease. The woman gazed at his expression, and nodded.

"Excellent. *Command: Check the monitors, and if they're satisfactory remove catheters. Gently.*"

Peron stared down at the catheters that ran into his lower body, and made sure that he kept his gaze on them. Again he saw and felt nothing, but after a moment they had vanished. Another second, and the tube into his nostrils was gone. He drew in a long, shuddering breath. The fire in the lungs was still there.

The woman still looked annoyed. "You feel strange and uncomfortable. I know. S-space has that effect on everybody at first. It doesn't last. Just be thankful that you're alive when you ought to be dead."

Alive! Alive. Peron had a sudden flood of memory, carrying him back to the last despairing minutes on Whirlygig. He had been dying there, resigned to the inevitable, quite sure of his own death—and here he was alive! All the pain washed away in a moment, overwhelmed by knowledge of life. He wanted to speak, to give out a great shout of joy at the fact of simple existence; but again no words would come out.

"Don't try it," said the woman. "Not yet. You'll have to learn how to speak, and it takes a little while. And don't rub your eyes, they're working normally but things look different here. Now, there are things to be done before you're ready to talk. That fool Wilmer certainly gave us all a problem, but I guess we're stuck with it. We can't kill you now. *Command: Bring him a drink. Water will do, but check the ion balances and the blood sugar, and if he needs anything make the necessary additions.*"

She held out her hand, and suddenly it was holding a flask of straw-yellow liquid.

"I want you to try to take this from me. Can you do that? Then drink all of it and try to talk to me."

Peron lifted his arm, and again there was the feeling that the laws of physics had been changed. It took deliberate control to make his hand move in the direction that he wanted. He carefully took the container, brought it back to his mouth, and drank. It was like balm, soothing his throat and making him re-

alize for the first time that he was desperately thirsty. He drank it all.

"Good. *Command: Take it away.*"

The flask was gone. The woman looked a little less irritated.

"Can you speak? Try a word."

Peron swallowed, commanded his vocal chords, and was rewarded with a grunt and a grating cough. He tried again.

"Yaahh. Y-Yaasss." His voice sounded alien in his ears.

"Excellent. Give it time. And listen to me. You have to know just a few things, and there's nothing to be gained by waiting to tell you them. Do you know who the Immortals are?"

"They vissi—vizzit—Pen'coss. Don' know if 'uman—or not. Lave—live—f'rever."

"Wish that were true." The woman gave Peron a sour smile. "I'm an Immortal. And now, so are you. But we won't live forever. We'll live about seventeen hundred years, according to our best current estimates—if we don't get killed somehow along the way. That's one thing you have to learn. You can be killed just as easily now as you could before. Living in S-space won't protect you. Understand?"

"Unn-derstand." The skin on Peron's face felt as though it had been stretched tight, and it could not show the emotion he was feeling. If he was an Immortal, what had happened to the others? Would he outlive Elissa by sixteen hundred years? No good news could make that thought palatable. He lifted his head—*again, that strange feeling*—and looked at the woman directly. "What happ'n to others on Whir'gig?"

"I'm not in a position to tell you that. I told you, what Wilmer did for you has made more trouble than he dreamed. Before we are permitted to tell you more, we have to get approval from Sector headquarters, and that means a long trip. We've been on the way for about five hours already, and it will be nearly two days before we get there. Until we do, you'll have to be patient. *My* patient, as it happens." She gave him her first real smile. "You can start by resting some. In a few minutes you'll get a reaction from the historex, and I'm going to give you another sedative and painkiller now. *Command: Give this man five c.c.'s of asfanol.*"

Nothing visible, but again a surprise ache of something in his thigh. Peron wasn't at all ready to go to sleep—there were a hundred questions to be answered, and he wasn't sure where to start.

"Are we going back to The Ship?"

The woman looked startled, then amused. "No. I can't tell you much, but I can tell you that. We're on a longer trip. Sector headquarters is outside the Cass system—nearly a light year away from Cassay and Pentecost."

"And we'll be there in *two days*. So you *do* travel faster than light!"

Now she was looking very uncomfortable. "I'm not supposed to tell you anything—I'm a *doctor*, not a—a damned administrator." There was an irritation at somebody or something in her tone, and Peron filed it away for future reference. "But we don't travel faster than light. In S-space, light travels almost two thousand light years of normal distance in one of our years. We're

traveling at only a fraction of light-speed."

Peron was overwhelmed by the thought. Could she be telling the truth? If she were, Sol and Earth itself were only a couple of months away. And if they had been on their journey for five hours already, they must be deep into interstellar space. He was beginning to feel drowsy, but suddenly he had a tremendous desire to see Cassay again. And what would the starscape be like, at this tremendous speed?

"What's wrong?" She had seen his expression.

"Can we look out of here—look at the stars?"

She shook her head. "I sometimes have that wish myself. When you wake up, take a look in the next room. There's an exterior port there. You'll find that things look rather different in S-space. But now I have to go. My name, by the way, is Ferranti; Dr. Olivia Ferranti. I will be seeing a good deal of you until we're sure that you are stable here. And I'll be back tomorrow." She gave him a reassuring nod. "Be patient. *Command: Take me to my apartment.*"

"But what—"

Peron didn't bother to finish his sentence. She had gone, vanished instantly into the air. In another thirty seconds the drugs had taken him and he was sound asleep.

The room where he had first regained consciousness lacked clothing, food, or drink. There was a terminal near the table, which must clearly communicate with other parts of the ship, but when he next awoke Peron resisted his first urge, to call and ask for something to eat. He felt ravenous, and still oddly disoriented, but there were other overriding priorities.

All the monitors by the table were still working, but now they received telemetered data originating from small sensors attached to his body. They undoubtedly passed those signals on to some central monitoring computer, but possibly that responded only to emergencies. Peron felt that he should have at least a few minutes before his actions were controlled again. He slid off the table, took a moment to collect his balance, and then headed for one of the room's two doors.

It led to a long windowless corridor. Wrong choice. He backtracked, and found that the other led to a bigger room, with a great transparent port at one end. Peron went to it and stared out.

He had certainly expected something different from the usual starscape seen from within the Cass system; perhaps the familiar constellations, but subtly distorted. But what he was looking at was wholly inexplicable.

Beyond the port, the whole sky was filled with a faint, pearly glow. It seemed to possess no orientation, and everywhere it was of the same uniform brightness. No stars, no nebulae, no dust clouds, no galaxies; the whole universe had disappeared, lost in a diffuse, glowing haze.

Peron felt his head begin to spin. He was in S-space, and it was so far different from anything he had imagined that he had no idea what to do next. If he had been trapped and held prisoner —for that was the way he was beginning to perceive his situation on this ship—in any ordinary environment he could per-

haps have gained control and had some say in his own actions. But what could he do here? There was nothing in Pentecost's science that even hinted at the possibility of this. Sy, far more able scientifically than Peron, had scoffed at the very idea.

Peron felt a moment of annoyance. If only Sy could be here now, to see how far his theories would take him. . . .

The rest of the room lacked any furnishings or useful sources of information. There was a set of small and mysterious doors or panels in the base of the wall, each only a couple of feet high, but he could not open them. He turned to go back to the corridor, and was reminded of his own hunger and thirst. He remembered Dr. Ferranti's ability to conjure drink from nothing (And ask Sy to explain *that*, while he was at it!). Could it possibly work for him, too? There seemed nothing he could lose by trying.

"Command." Even though he was alone, he felt self-conscious—what he was attempting was impossible! But it had worked, he was convinced of that. *"Command. Bring me a drink."*

He waited, feeling foolish. And to confirm his feeling, absolutely nothing happened. He tried once more. *"Command. Bring me something to eat."*

Nothing. How could anything else be the result? He must have been hallucinating, to be convinced that Ferranti had magical powers to make objects —including herself—appear and disappear instantly.

Peron had scarcely come to that conclusion when everything about him changed in one brief and bewildering flicker of movement. There was a second of total disorientation. Then he was no longer standing at the entrance to the corridor. Instead he was in a room with pale yellow walls, decorated with elaborate murals and amateurish paintings. He was fully clothed, in well-fitting brown shirt and trousers. His own shoes, last seen when he donned a suit before leaving for Whirlygig, were on his feet. He was seated in a hard chair, with his hands resting firmly on its arms. In front of him was a long, polished desk of silvery metal, its upper surface containing a single, orange folder and one pen.

And sitting behind that desk, looking at him with a slightly bored and definitely supercilious expression, was a wizened, brown-eyed, hairless man. Peron took an instant and inexplicable dislike to him.

Chapter 18

"I am Captain Rinker, in command of this ship," said the man. "Dr. Ferranti tells me that you are fully stable and adapted to S-space. Is that so?"

"I don't know. I feel no pain, but I certainly don't feel normal."

"That will pass. Anything else?"

"Someone seems to want to starve me to death."

"Your own fault. When you awoke you could have called for food. Instead you chose to pry." Rinker gestured at a wall display that was showing the room where Peron had returned to consciousness. "You were observed. It would serve you right if we did not feed you for a while. But you are lucky. Regulations would not permit us to starve you. *Command: Bring food and drink, suitable for the awakening.*"

A tray appeared instantly, resting on Peron's knees. The clear carafe held the same liquid as he had drunk before, but the plates of food were unfamiliar. There were brown patties with a coarse granular texture, orange-red jelly, and white slabs of smooth creamy consistency. Rinker gestured to them.

"Carry on. You may eat while we talk."

Peron looked around him. There was no other person in the room, and no sign that the door had opened or closed. "How are you able to do that?"

"It is not appropriate that I tell you. Such information will be given to you at Headquarters—if it is given at all." Rinker waved his hand at the display. "Your efforts to use the service system were already noted. To save you further wasted time, I will point out that any more efforts on your part will be just as unsuccessful. Let me also point out that I am under no official obligation to talk to you, or to deal with you in any way except to provide safe transfer to Headquarters. But I want you to know how much trouble you have caused, you and that fool Wilmer."

Peron could not resist the food in front of him. His body insisted that it had been weeks since it had received nourishment. He ate ravenously. The patties had a reasonable resemblance to bread, and although the white material tasted nothing like the cheese that Peron had expected, it tasted good. He stared across the desk at Captain Rinker, swallowed, and spoke.

"I can't speak for Wilmer, but any trouble I caused was not my doing. I would have died on Whirlygig without his help. I don't see why you assign blame to me."

Rinker gave an impatient wave of his hand. "You were marked as a troublemaker before you left the planet. So were your companions on Whirlygig. You were all scheduled for special indoctrination on the ship *Eleanora*, to be kept apart from the other contestants. As for Wilmer, he was supposed to be there as an *observer*—not as a participant. I have warned several times of the danger of using local recruits as observers. They have too many ties to your planet and its people. But my advice was ignored."

"Is Wilmer an Immortal?"

Rinker leaned back in his chair, frowning. His voice rose in pitch. "That stupid term! It is one I never use. Wilmer was recruited to our group, yes. And he shares our extended life span. But he has never left the Cass system, and he certainly knows nothing of our larger mission. Now I must suffer the consequences of his dabbling. For three hundred and sixty of your years, I have visited Pentecost and the Cass system. This is my nineteenth trip. And never has anything gone wrong. I have developed a perfect record in my work. Success is expected of me, and I demand it of myself. But now, thanks to what Wilmer did on Whirlygig, all that has gone. This visit has turned into a disaster. The materials I should be carrying back from the group on *Eleanora* have been left behind; final selection and indoctrination of recruits has been delayed; and I am carrying six additional and unwanted passengers with me to Headquarters, all of whom are tagged

as potential trouble. Do you think I should be happy?''

As Peron's hunger and thirst lessened, he felt an increasing curiosity at his surroundings. It was also matched by a growing annoyance. He had done nothing to justify Rinker's tirade. What did the foolish man expect him to do? Ask to be taken back to die on Whirlygig?

He lifted the tray and placed it on the desk in front of him. ''I don't say you should be happy. But you shouldn't blame me for what happened. Why won't you tell me what's going on here?''

''So you can cause more trouble?''

''I am not going to cause trouble. But naturally I have many questions. I don't ask for your time, but let me at least have access to a terminal and the data banks. And you say that some of the other contestants are here on this ship. I would certainly like to see them.''

Rinker stared angrily at the messy tray lying on his clean and polished desk. He gave Peron an unpleasant smile. ''I cannot allow you access to the data banks. As I told you, this situation is unprecedented. No one has ever joined our group here without indoctrination. What happens to you can be decided only after we reach Headquarters, and until we arrive there you must do exactly as you are told. You want to see your companions? Very well. *Command: Remove this tray.*''

It vanished instantly.

''Command: Take us both to the suspense room.''

This time Peron had a dizzying image of a long corridor and gray walls. It lasted for a fraction of a second. Then the world steadied, and he and Rinker were standing together in front of a bank of waist-high metal doors. Each one formed the entrance to a long, deep container like an outsize coffin. Monitors sat on the transparent top of each box, and all the outputs were collected into a thick optic bundle that ran to a computer terminal. The room was freezingly cold.

''Perhaps this will give you an idea of how seriously I regard this situation.'' Rinker stepped forward to one of the boxes. ''Your companions are here.''

''What have you done to them?'' Peron felt a sense of horror. Was Rinker telling him that Elissa and the others were imprisoned in those black, icy caskets?

''They are in cold sleep, and will remain there.'' Rinker's voice was as chilly as the room. It offered no possibility of discussion. ''They are of course in no danger. I run a well-regulated ship, and all the equipment is checked constantly. They will be awakened—a simple procedure—when we reach Headquarters. Then this matter will move to other hands than mine. I will be very glad to see the last of it.''

Peron stepped forward to peer in through the top of the nearest chest. Kallen lay inside, swathed up to his neck in soft white material. He looked dead. His eyes were deep-set in his head, his face gray and drained of all color. Peron stepped to the next container. That one held Elissa. He shuddered to see what she had become. Without its usual animation, her face was like a wax model.

"Are you sure that they are all right?" Peron had to ask. "They look—"

"I have no time to waste in repeating myself. They are all right. I have already told you and shown you more than I intended. You will eat your meals with the rest of us, and I will see you then. If you need food before that, use the terminal. *Command: Take him to his living quarters.*"

There was no chance to protest. Rinker and the room with Elissa and the others suddenly vanished. Peron found himself alone with his worry, perplexity, and frustration, in a room that held only a bed, a desk, and a terminal.

The Planetfest games had provided periods of terror, exhaustion, suspense, and near-despair. But there had been nothing to match the sheer frustration of the next twelve hours. By the end of it, Peron had reached an unvoiced decision: if he was branded as a troublemaker, he was going to earn his label.

He had started out simply wishing to know more about the ship and his environment. That had proved to be far more difficult than he expected. The room he had been assigned opened to a narrow corridor, which soon branched in both directions to larger rooms and other passageways. He had tried each one in turn, making mental notes of any changes of direction.

A pattern quickly emerged. If he went off along the left corridor, he was free to wander as he pleased. He had found a dining-area, and a library whose terminals ignored his requests for information, but readily provided food or drink. It appeared instantly and mysteriously in front of him the moment that his order was placed through the terminal, and was removed just as promptly when he requested that. He had also met some others of the ship's complement, all much more friendly than Captain Rinker. There were only three of them. It seemed to Peron a preposterously low number to control such a large structure. But as Olivia Ferranti pointed out to him when his wandering took him past her living quarters, it was far more people than were needed. Everything was under automatic control; Captain Rinker alone could handle everything. In fact, the rest of them were making their first trip, and had come from Headquarters to the Cass system for their own reasons (which she refused to discuss). She had even offered something like an apology for Rinker's behavior.

"He's unusually valuable. There are not many people who *like* making these long trips, often with no companions. It takes a special temperament. Captain Rinker likes things neat. He can't stand the idea that you've disturbed the pattern of his life."

"But Wilmer did that, not I."

"Maybe. But Wilmer isn't here, and you are. So you're getting it."

"And he's allowed to keep my friends unconscious?"

"He's the captain. He is in control until we reach Headquarters. Then he'll have to explain his actions, but he'll have no trouble doing that—he's following regulations. And honestly, he's not harming your friends at all. Now, I have to go. We can talk a little more if you like at the next meal period. *Command: Take me to the forward exercise facility.*"

And she was gone.

Peron found that he could get as far as the door of the suspense room, but it refused to open for him. And he could issue as many commands as he chose, in any tone of voice, for anything he liked, but they were all ignored.

When he left his room and went off along the right-hand corridor, affairs were even less satisfactory. The left corridor led him to the upper part of the ship, in terms of the effective gravity. The right corridor should then have taken him to the lower part, and it certainly started out that way. But no matter which branch he followed, when he had progressed a certain distance there would be a dizzying flicker—and he would be back in his room, sitting at the desk. Some whole section of the ship, of indeterminate size, was inaccessible to him.

After a dozen fruitless attempts, Peron lay on the bed in his room, thinking hard. It was twelve hours since his meeting with Rinker, but he didn't feel at all tired. Olivia Ferranti had told him to expect little need for sleep.

"One fringe benefit of S-space," she had said. "You'll find you sleep maybe one hour in twenty."

He continued to feel physically peculiar, but she had been right on that, too. After a while he simply adjusted to it. He still had the impression that he was moving his body in a world where the laws of mechanics had been slightly modified, but it was a feeling that faded.

"Do you want to join us for dinner?" The voice came suddenly from the terminal next to his bed. It was Garao, another of the ship's company that he had encountered in his travels around the forward section.

"I don't think so." Then he sat up quickly. "No, wait a minute. Yes, I do. I'll come over." He didn't feel hungry—except for more information. And the only way to get that seemed to be from other people. Direct exploration of the ship had been totally unrewarding.

"No need for that," said Garao. "Hold tight."

There was the now-familiar moment of disorientation. He found he was sitting in the dining area with three of the others. Captain Rinker was not present. As Ferranti had told him, the captain much preferred his own company, and often dined alone.

Everyone seemed to take it for granted that Peron would now eat and drink the same things as the rest of them. When he arrived there were already five or six different dishes on the table—all of them unfamiliar. He found something that looked like a fish fillet, but clearly wasn't. And there were several pseudo-meat products, each flanked by some kind of vegetable. Nothing tasted quite the way he expected—and all the food was cold.

The others seemed surprised when he mentioned that. Ferranti looked at Garao and at the linguist, Atiyah, then shrugged.

"I should have mentioned that to you before. You won't get hot food in S-space. Better get used to it cold."

"But why?"

"Wait until we get to HQ, and ask there." Ferranti was clearly embarrassed by her non-answer. She was sitting next to Peron, so he was faced only with her profile. But her voice showed her discomfort. "I would tell you, but it's against captain's orders. If you like

hot food, I can make what we're eating more acceptable. It's easy enough to order spices. *Command: Bring more of these dishes for Peron Turca, but with added hot spice.*"

There was a delay of about fifteen seconds, then additional dishes appeared on the table in front of Peron. He was preparing to help himself to them, when he noticed the expression on Garao and Atiyah's faces, across the table from him.

"What's wrong? Isn't it all right for me to eat these?"

"That's not the problem." Garao picked up an empty plate. *"Command: Take this away."*

Again there was a delay of a few seconds, then the plate suddenly vanished.

"See?" Garao looked gleeful. "It's the same trouble we had on the trip from Headquarters. Seems even worse."

"It is," said Ferranti. "This time it takes twice as long."

"What takes twice as long?" Peron felt as though they were speaking in riddles just to confuse him.

"Service," said Atiyah. He was a man of few words. "It should be instantaneous. Let's time the delay. *Command: Bring me a glass of water."*

They sat in silence, until after about ten seconds a filled glass of clear liquid appeared in front of Atiyah.

Garao nodded. "We'd better notify Rinker at once. He'll have to leave S-space to correct this. Serves the stiff-necked bastard right—him and his 'perfectly-run ship.' "

"And won't *that* make him pleased," said Ferranti. "Already he's complaining what a disaster this trip has been."

"Leave S-space? But where will he go?"

The others looked at Peron for a moment. "Sorry," said Garao sympathetically. "But this will be captain's orders again. We can't include you on this. *Command: Take Peron back to his room."*

"Wait a minute." Peron was frantic. "Look, to hell with captain's orders. If something is wrong I have a right to know it, too. I'm on the ship as well as you. I want to stay here and find out what's happening."

But the last sentence was wasted. Peron added a string of curses to it. The service delay may very well worry the others, but it was still too short. He was back in his room again, talking to the empty walls.

Chapter 19

Peron allowed himself only a few seconds of cursing. Then he ripped off his shoes and ran at top speed along the corridor that led to the upper part of the ship. The monitors would still show his movements, that seemed certain. But now there was an emergency on board, so who would be watching? There would never be a better chance to explore areas that were normally forbidden.

His earlier careful study of the ship's internal layout had not been wasted. He ran fast and silently towards Rinker's living quarters, sure of every corridor. At the branch before Rinker's door he paused and peered around the corner. Was he in time? If Rinker had already left, there would be no way to know where he had gone.

He heard the door slide open and

ducked back, then retreated to the next bend in the corridor. No footsteps. Rinker must be heading in the other direction.

He ran lightly back and stole another look along the corridor, just in time to see the disappearing back of Rinker's blue jacket and shiny bald head. He was heading over to the left, angling away from the dining room.

Peron tried to visualize the geometry. What lay in that direction? All that he could remember was two great storage chambers, each filled with some kind of pellets, and more living quarters. The suspense room lay out at the very end of the same corridor.

Rinker was heading steadily on, hunched over and not looking back. Past the storage areas, past the living areas —what could he possibly want in the suspense room?

Had Peron forgotten some branch in the corridor? He knew he could not ignore the possibility. He took a bigger chance and closed the distance that separated them. He was close enough to hear Rinker's heavy breathing, and to smell the unpleasant musky talc that he used as body powder.

Peron's nose wrinkled. No wonder the man usually made his trips alone!

He hesitated at the door of the suspense room. Rinker had gone inside, but there was no way to follow him in and remain unnoticed.

There was a creaking sound from within. Peron ducked his head briefly into the doorway. Rinker had opened one of the great, gleaming sarcophagi —and now he was climbing inside and closing the door.

As soon as the front panel was completely closed Peron sneaked forward into the room. But instead of going to Rinker's chest he went to one farther along the line. He looked in through the transparent top. Lum lay there, white and corpselike. Peron tried to ignore the massive, still form and looked instead at the walls of the container.

Strange. Although he had not noticed it on his first visit with Captain Rinker, the box seemed to have a complete set of controls *inside*, as well as outside—as though those imprisoned frozen figures might waken, and wish to control the apparatus from within. And here was something else, just as odd. At the far end of the container, leading only into the blank wall behind it, was another door, the same size as the one at this end.

A couple of minutes had passed since Rinker had gone inside and closed the door. Peron stepped quietly across to stand beside the box. He placed his ear close to it. There was a hissing of gases, and the dull thump of a pump. Peron risked a quick look in through the top. Rinker was lying there, eyes closed. He looked quite relaxed and normal, but a network of silvery filaments had appeared from the walls of the container and attached themselves to various parts of his body. Fine sprays of white fluid were drifting down from tiny nozzles to dampen his skin. Peron touched the surface of the container, expecting the icy cold he had felt at Lum's casket. He jumped and pulled his hand away sharply. The surface was hot and tingling, as though it was sending an electric current through him.

For a couple of minutes the situation did not change. Then the spray turned

off. The nozzles were drawn back into the side of the container and the silver filaments loosened and withdrew. Peron watched and waited. Ten seconds later Rinker's body seemed to tremble for a moment.

And then the container was empty. In a fraction of a second, before Peron could even blink, Rinker had vanished completely.

Peron was tempted to open the door of the container. Instead, he went to an empty one that stood near to it, and opened that. The internal controls appeared quite simple. There was a three-way dial, a timer with units in days, hours, and hundredths of hours, and a manual switch. The switch setting showed only an N, an S, and a C. The C position was in red, and below it stood a written notice: *WARNING:* DO NOT USE SETTING FOR *COLD* (C) WITHOUT SETTING TIMING SWITCH OR WITHOUT ASSISTANCE OF AN EXTERNAL OPERATOR.

Peron was thinking of climbing inside to take a closer look when he heard a warning creak from the other container. The door was being opened again. He forced himself to move carefully and quietly as he closed his casket. Too late to leave the room—the door was swinging open. Fortunately it came toward him, so that he was hidden temporarily behind it. He moved silently to the shelter of the next door and ducked down behind it.

Rinker had returned. He was slowly heading out of the room, looking neither to right nor left. Peron caught one glimpse of his half-profile, and saw sunken, bloodshot eyes and a pallid complexion. He followed at a discreet distance. The other man walked drunkenly, as though totally exhausted and giddy with fatigue. Instead of continuing to his quarters he went into the dining-room area. Garao, Ferranti, and Atiyah were still there, talking.

And they were still eating dinner. That seemed peculiar, until Peron realized it had been only a few minutes since Garao's verbal command had whipped him unwillingly back to his room.

"All fixed," said Captain Rinker harshly. "There's a defective component in the command translation device. We don't have replacements on board, so I've jury-rigged it for the trip."

"Will it last, or will it fail again?" That was Olivia Ferranti's voice.

"It will fail again eventually. Not for a while, I hope." Rinker gave a great yawn. "That was almost too much for me. It took a long time. I was there nearly five minutes, with no rest. I must go and sleep now."

There was a murmur of semi-sympathetic voices. "Let's hope it doesn't go again during the trip," said Garao —though his tone didn't support his words.

"It won't," said Rinker. "I don't expect any more trouble on this trip."

Peron thought of those words as he tiptoed away along the corridor. Rinker's actions and comments were revealing, and Peron had some faint inkling now as to what was going on.

If he were right, Rinker had more trouble coming than he imagined.

As soon as he was out of earshot of the dining area, Peron began to run again at top speed. The emergency was

over—and that meant his movements would be watched again. Would there be monitors, even within the caskets?

He reached the suspense room and went at once to the same casket that Rinker had occupied. The door opened with the same creak, and he climbed inside and lay down. All the controls were within easy reach. He could stretch up his hand and set them with a simple push of a button. The choice was already fixed. He didn't want S, since he was already in S-space; and he didn't want C, since that was the cold sleep of Elissa and the others. It had to be N—but what did N mean?

Peron had been moving at top speed, but now he hesitated. Suppose the process that took Rinker out of S-space called for other knowledge that Peron lacked? It was clear that the others on the ship had extra powers, since service commands from Peron were ignored. What if the use of this device required those same powers?

Time was passing. At any moment the familiar dizziness might occur, and he would find that he was once more in his room. But still his finger stayed lightly on the button. When he had been absolutely certain of unavoidable death on Whirlygig he had been able to face it staunchly, with a complete calm. This was different. Whatever Rinker and the others might do to him, he did not believe that they would kill him. But he could die now by his own hand. His next action might prove to be suicide.

Peron took a last look around at the casket walls. *Now, or never.*

He drew a long, deep breath, closed his eyes, and pressed the button marked N.

* * *

Chapter 20

There was no startling moment of change. Peron had expected a twisting surge of nausea, or perhaps some unendurable pain of transition. Instead he felt a cool touch of electrodes at his temples, and the soothing spray of fluid on his skin. He relaxed, and drifted away into a quiet meditation. It went on for a long time, and ended only when he became aware of his own heartbeat, loud in the secret inner chamber of his ears.

A feeling of well-being was creeping over him, as though he were waking from the best sleep of his life. There was a temptation to lie there for a long time, basking in the sensation. But then he became filled with a sudden fear that he had merely fallen asleep, that nothing else had happened. Worried, he opened his eyes and looked around him.

The inside of the casket had not changed its configuration—but, startlingly, it had somehow changed color from a bland bluff-yellow to a pale orange. Even his clothing was different, black instead of brown.

He sat up, then steadied himself against one wall. He had fallen asleep in a one-g gravity field; now he was in free-fall.

The door through which he had entered could not be locked from the inside. What about pursuit? Aware that he was still likely to be followed and discovered, Peron scrambled his way toward the other door. Thank heaven for the free-fall experience he had gained after they left Pentecost! He felt a little peculiar now, but there was no vertigo or feeling of nausea.

The door opened readily. He pulled

himself through and closed it behind him. There was an outside catch, and he set it so that it could not be opened from within the box. Next he moved along the row of doors, and locked each one in the same way. Then, and only then, did he feel a first moment of safety.

He looked around. He was floating free in a long, turning passageway. It was dimly lit by faint yellow tubes that ran parallel to the walls, and far away in the distance he could hear a low-pitched rumbling and whistling. He headed in that direction.

As the passage turned, he came to a square-sided chamber with a fully transparent external wall. He stood there for a long time, overwhelmed by the sight of the universe outside the ship. The faint, luminous haze of S-space had gone. Instead he was gazing on a glittering sea of stars, as bright as they could appear only from open space. The old familiar constellations were there, just as they had looked from orbit around Pentecost. They gave him an odd feeling of reassurance. He was still alive, and he was back in a universe that he perhaps understood.

While he was still watching, there was a louder rumble in the corridor. A machine was approaching, drifting along the wall on an invisible magnetic track. The main device was small, only as big as his head, but a number of long, articulated arms were tucked away in at the side. He watched it warily.

It moved along quite slowly, at less than walking speed. A few meters away from him it ducked away into a small door in the wall of the corridor. Peron recognized the type of aperture—there were hundreds of them, all over the ship. They were everywhere, from the living quarters to the dining-room to the library, and he had been unable to open any of them. The machine had no such trouble. It slipped through smoothly, and vanished.

Peron continued on his way. He was in a part of the ship that he had never seen before. The passage finally led him to a great chamber, where hundreds of machines were located. Most sat immobile, but from time to time one or more of them would start into action and slide off on some mysterious errand. He followed a couple of them. Each finally passed through one of the small doors that lined each corridor.

Peron decided that he had to find a quiet place to think. He headed farther along the passage, and at last found he was in a different type of chamber. This one was an automatic galley, similar to the one that had served the Planetfest winners on their travels around the Cass system. Peron found a water spigot and drank deeply from it. He reveled in the clean feel of the pure liquid on his tongue and palate. Whatever its other virtues, S-space definitely made food and drink taste less interesting. He took a few moments more to study the arrangement, and noticed that there was processing equipment different from anything he had seen in the other galley. From the look of it, it could produce a standard menu, or something with added and unknown ingredients.

While he was watching, four of the little robots came trundling into the galley area. They ignored him. They were carrying plates, most of which still held the remains of a meal. One of those

plates caught Peron's eye. It held the remnants of uneaten spicy food—the same food that had been served to Peron at his last meal in S-space. The surface of the robots glistened with moisture. Peron went across to one of them and touched it. The metal was icy cold. He put his finger to his mouth and tasted the liquid with his tongue. The droplets were plain water, condensed from the air around him.

He sat down on the floor, put his head between his hands, and pondered. Everything made sense—if he could force his mind to accept one incredible possibility. And it was a possibility that he was finally in a position to check for himself.

Peron stood up. He took the heaviest metal tureen that he could find in the galley, and swung it as hard as he could against the metal wall. It did not bend. He headed back to the chamber where the patient robots sat, and waited until one of them rose from its position. Then he followed it closely as it proceeded along one of the numerous passageways branching off from the central opening.

When the machine turned to move through one of the small doors, Peron was ready. The door opened, and the robot slid through. While the door was still open Peron jammed the sturdy metal container into the gap. There was a squeak of metal and a protesting whine from the door's control mechanism, but the aperture remained open.

Peron crouched down and looked through.

An icy current of air met him from the other side. The temperature there must be very close to freezing. The little robot had gone on its way, and the area beyond was lit only by the dullest of red glimmers of light.

Peron judged the width of the door with his eye. There would be just enough space for him to squeeze through, provided he was willing to risk the skin on his shoulders. He eased off his jacket, pushed it through ahead of him, and wriggled to the other side.

It was even colder and darker than he had thought. He shivered, and pulled his jacket tight about him. Unless he had more clothing, it would not be possible for him to stay there long.

Peron recognized the room that he was in. It was next to Rinker's living quarters. He had been there before, in his original explorations of the ship. But there was one great difference. Instead of a one-g field he now felt that he was still in free-fall.

The little robot had disappeared. As he watched it came into view along the corridor. It was carrying an empty bottle of the fermented drink that Rinker usually enjoyed with his solitary meals. The robot came steadily closer. Again it ignored Peron. It hesitated at the door jammed open by the tureen, then went to another door and calmly passed through it. As it did so, another pair of service robots appeared on the other side, and set to work to free the obstruction and repair the door.

Peron did not stay to observe. He hurried through to Rinker's apartment, where Rinker was sitting in a chair. He was completely motionless, his hand raised and his mouth open. Peron stood and watched for several minutes. Finally the hand inched closer to the open mouth. Peron stepped forward and touched Rinker's cheek. It was like

chilled marble. Fingers stabbed to within an inch of Rinker's eyes produced no reflexive blink of the lids.

It was proof enough. Peron hurried out and headed for the suspense room. On the way there he passed the dining area, where the motionless figures of Garao, Ferranti, and Atiyah still sat at table, three perfect sculptures of frozen flesh.

The suspense room was deserted. Peron paused for a long moment in front of the cold sleep caskets. Again he wondered at his motives. To risk his own life was one thing; to put the lives of his friends in jeopardy was another. Wouldn't it be better to wait until the ship arrived at the mysterious Headquarters of the Immortals, and see how the group would be treated there?

He tried to imagine the answers that the others would give. Part of his mind could create a simulated conversation with Lum, Kallen, Sy, Elissa, and Rosanne.

"You're in no danger in the tanks, and I'm not sure just how the revival process works. It looks simple, but suppose there's a hidden snag? Maybe I should just wait and see what happens when we get to Headquarters?"

He thought he could hear their consensus: "Hell, no. If there's one thing none of us can stand it's to have somebody *else* running our lives for us. You know that—why do you think we were considered troublemakers? Go on. Make trouble. *Get us out of here.*"

He stepped to examine each tank in turn. The controls were all identical. He could change the dial setting either to S or N, and there was a table to indicate the correct procedure for each. The return from cold sleep to N-state was a fairly long process. It would take twelve hours. But Peron did not need to stand guard all that time. He would forage for warm clothing for everyone—Elissa and the others were all naked except for the filmy white covering. Then he could crack open another door, and return to the warmer area where the robots lived and the galley was located.

He considered a barricade for the door to the suspense room, then decided that it would not be necessary. If things went according to plan his work would be over before Rinker and the others could interfere.

Elissa first. He couldn't wait to see her and talk to her again. It took only a few moments to change the setting and press the Start command. Peron peered in anxiously through the transparent top of the tank. There was a hum of motors within the casket, and after a few moments a yellow vapor began to fill the interior. Then Elissa and everything else within were soon invisible. Filled with trepidation, Peron went on from tank to tank, setting the conditions that should bring all the others back to consciousness from cold sleep.

The horror had begun for Elissa when she saw the condition of Peron's suit. It had been shredded and ruptured by impact with Whirlygig's rough surface until it must be useless for thermal protection. The outside temperatures guaranteed that he could not survive.

Before their grief could do more than begin, Wilmer had taken charge. Even Lum's casual self-confidence and Sy's remote air of superiority had crumbled and been swept aside by the other's grim

certainty. They had done as Wilmer asked—and done it without questions.

First a breathable atmosphere had to be created within the dome. Then Elissa and Kallen had eased Peron gently out of his suit and clothing. His skin had darkened, and veins were prominent against the dusky surface. Elissa bent close. She could see no sign of breathing. She felt for a pulse, but could find no trace. His wrist and throat were ice-cold to the touch of her ungloved hand.

"Give me a hand to turn him over," said Wilmer. "We want him face down. Good. Now you go over there and help Lum with the temperature controls. They have to be precise—and you don't want to watch this."

Elissa had watched anyway, unable to tear herself away. Wilmer removed the gloves of his suit and encased his hands in a fine, glassy material that molded itself tightly to his skin. He flexed his fingers a few times, testing the fit, then took a silver scalpel from his green case. He made careful incisions into the base of Peron's neck and at the lower end of his spine. Fine, gleaming catheters were inserted there. Placed at the entrance of each aperture, they snaked inward without further action from Wilmer, insinuating themselves deep into Peron's body. Wilmer placed a face mask in position over Peron's nose and mouth, and connected it to a small blue-gray cylinder. He turned a valve, and Elissa heard the hiss of gas.

The temperature in the dome had risen a little. Wilmer opened his faceplate and sniffed the air.

"Warm enough," he said. "I suggest we all open our faceplates and conserve air in the suits—we may need it."

He took another cylinder from his case. "Here." He handed it to Elissa. "This will improve the atmosphere. Bleed this into the central circulator for the dome, then we can take that face mask off Peron."

"Is he alive?"

"For the moment—but he's still in danger."

Elissa took the cylinder across to the air circulation unit and snapped it into position. She cracked the nozzle. At first it seemed that nothing had happened. Then the chilly air of the dome took on a heavy, perfumed weight, as though the oxygen in it was bleeding away. Elissa turned frowning toward Wilmer. She noticed that he had closed the faceplate of his suit. She wanted to ask him what he was doing, but she could not phrase her thought. The moment stretched. Wilmer was motionless, watching and waiting. There was a final, odd sense of detachment, as though she were rising to the ceiling of the dome and leaving her body behind.

And now . . . she was awakening . . . to find Peron standing anxiously over her. She blinked her eyes to clear the blurred image.

"Elissa? Are you all right?"

He put his arm around her shoulders and raised her to a sitting position. She shivered uncontrollably, from a mixture of emotion and freezing cold. She looked down at herself. She had been wearing thermal clothing in the dome, now she was naked except for a transparent membrane of fine cloth.

Where was she? How had she come here? She struggled to think clearly. In

the moment of waking it was hard to be logical. And what did logic matter? Peron was here, alive. She felt peculiar, chilled but fluffy-headed and giggly. Explanations could wait for a few more seconds. She snuggled into Peron's embrace.

"Here I am," she said. Everything was pleasant and vastly amusing. "But Peron, I'm cold."

"Good, you're waking up." He pointed to an assortment of garments in a heap by their side. "Help yourself to any that fit you. I've got to see how the others are doing."

"Peron!" She shivered, then reached out and gave Peron a hug strong enough to make their ribs creak. "Explain. What's happening to me?"

"Tell you later." He returned the embrace with interest. "Come on. I may need help to get Lum out. He should have been called Lump."

Elissa rummaged through the pile and found an adequate set of coveralls while Peron opened the door of the next tank and did his best to pull out its occupant. There was a good deal of grunting and swearing. Lum was semi-conscious, and offering plenty of disorganized resistance.

"Here. Let me have a go at him." Elissa moved round to the other side and leaned over. She took hold of Lum's hair and gave it a great tug. He came suddenly upright, his eyes popped wide open, and he yelped in protest.

"No need to do that. I'm awake." His eyes closed again, and he started to sink back. "It's all right, I'm awake, I'll be up in just a minute."

"Pull his hair again, then give him a hand with his clothes," said Peron. "See if you can find anything big enough. Kallen's next, but I bet he'll be easier. Rosanne told me Lum sleeps like a dead man, even under normal conditions."

In a few more minutes Rosanne and Kallen had been brought back to groggy wakefulness. Peron left them sighing and shivering and searching for warm clothes. Sy was processed last of all. He went instantly from sleep to full attention. Even as his eyes popped open he was twisting sideways like a cat, moving his body to a defensive posture.

"Relax," said Peron. "You're with friends."

Sy gave Peron one brief, incredulous look, then stared around him. "Where am I? Last thing I remember we were in the Whirlygig dome. What happened?"

"That's a long story. Get some clothes on, and follow me. I'll explain as we go."

Peron led them to the dining room, where Ferranti and the others were finally showing signs of movement. Garao was halfway to the door, one foot clear of the floor.

"I wanted each of you to see this to save arguments," said Peron. "Or you might have told me I was chewing dillason weed. Fourteen hours ago I was in that condition. That's S-space. Remember how much we were troubled by the idea that the Immortals could travel to the stars in days?"

"I still don't believe it," said Sy. "They can't exceed lightspeed."

"You're right—but you're wrong, too. Here's a question for all of you. How far does light travel in one second, or in one year?"

There was a brief silence.

"We all know the answer to that," said Rosanne. "So I assume it's a trick question."

"In a way," said Peron. "The answer depends on your definition of a second and a year. We've been thinking about S-space all wrong. It's not some sort of parallel universe, or hyperspace. It's the same space we live in—but S-space is a *state of changed perception*. If you want proof, look at these people."

Kallen had been watching Olivia Ferranti very closely. "She seems to be unconscious," he said softly. "And her skin is cold. But her eyes are open. They're alive, that's clear. Are they hibernating?"

"No. Each of them is fully conscious. In that condition you feel normal except for a few subtle differences. But their metabolisms have been drastically slowed—two thousand times slower than usual. That's S-space, and it changes your perception of everything. In one of our seconds, light travels three hundred thousand kilometers. In one of *theirs*, it travels six hundred *million* kilometers. To us, Sol is eighteen light years away. To them, it's only a little more than three light days. That's why we heard that the Immortals can travel between the stars in days—*their* days. Their time is passing so slowly that what feels like a day to us is less than a minute for them."

Peron went close to Garao and passed his hand slowly in front of the other's face. "See? They don't even know we're here." He moved over to the stationary figure of Atiyah, removed the belt from around the man's tubby middle, and looped it around Olivia Ferranti's neck. "In about twenty minutes he'll notice that his belt is missing. In another hour of our time he'll begin to wonder where it went. It will be an hour more before he can do anything to get it back."

The others made their own inspections, touching skin and fingering hair.

"How did they get this way?" asked Lum.

"The same way that I did, when Wilmer operated on me back on Whirlygig. I know that's not much of an answer, but it's the best one I can give you. There has to be a complicated treatment, but it must be fairly standardized—and it's fully reversible. I've been both ways, and so has Captain Rinker. He had to go back to normal living to fix a mechanical problem with this ship. Let's take a look at the ship now. We'll all need that information later."

Peron led the way back through to the suspense room. As they went he responded to their torrent of questions. The ship they were traveling on was deep in interstellar space, heading for the headquarters of the Immortals. That headquarters was far from any sun or planet, a full light year away from the Cass system. They were moving at only a fraction of lightspeed—probably no more than a tenth. During their journey, nearly ten years would pass back on Pentecost.

The other Planetfest winners were not on board. Their fate could only be conjectured, but Peron thought they were all still back in the Cass system, probably living on The Ship. That was where the Immortals lived in the Cass system. The other winners would probably be-

come Immortals themselves after some kind of indoctrination. They would prefer to live in S-space for the longer subjective life span it offered, and they would return to normal life, as Wilmer had done, only for special duties.

"How long does an Immortal live?" asked Sy. "It's obvious that nobody can be truly immortal."

"Seventeen hundred years."

There was another long silence. Finally Elissa said: "You mean seventeen hundred *subjective* years? That's two thousand times seventeen hundred ordinary years back on Pentecost—three million four hundred thousand. They live three million four hundred thousand years!"

"Right," said Peron cheerfully. Adjusting to that idea hadn't been easy, and he was glad to see that others had the same reaction. "Of course, that's only a conjecture. As Dr. Ferranti pointed out, they can only make estimates of full life span—because no one has lived it yet. It's only twenty thousand years or so since we left Earth, and no one was living in S-space there."

"But what about side effects?" said Elissa. "When you make such a profound change . . ."

"I only know of a couple," said Peron. He brushed his hand through his hair. "See? It has stopped growing, and I think I was starting to lose it in S-space. Better get ready to lose those beautiful locks, Rosanne. I think that when you change metabolic rates for a while you become hairless. That's what happened to Wilmer, and the other contestant Kallen met. Back on Whirlygig I couldn't believe it when Wilmer told me that he had been in trouble there three hundred years before. But it makes sense now. That was just a few months in S-space. He was living there until he was with us in the 'Fest. A hundred years on Pentecost would be only a few weeks for him."

"That would explain why we only saw videos of former winners," said Lum. "They didn't come back to Pentecost. But there'd be no problem with videos. They could take them at S-space speed, then speed them up so they'd look normal. Personal appearances would be impossible unless they had moved back to normal time—N-space, you called it."

"And they'll be reluctant to do that," said Peron. "They lose the benefit of extended life expectancy when they leave S-space. You have to eat special food there, and you don't feel quite normal. But people will put up with a lot to increase their subjective life span by a factor of twenty."

They were again in the suspense chamber. Peron led them into and through one of the caskets, using it as a convenient path to the other parts of the ship. There was a substantial temperature change as they passed through the suspense tank, and they all loosened their warm clothing.

"I'll tell you one thing I still don't understand," Peron said. "When I was in S-space, I felt as though I was in a one-g environment. Now we're in exactly the same part of the ship, but we're in free-fall. I don't see how that can happen."

There was silence for a while, then Kallen made a little coughing noise. "T-squared effect!" he said softly.

"What?"

"He's quite right," said Sy calmly. "Good for you, Kallen. Don't you see what he's saying, Peron? Accelerations involve the square of the time: distance per second per second. Change the definition of a second, and of course you change the perceived speed. That's why they can travel light years in what they regard as a few days. But you change perceived acceleration, too—and you change that even more. By the *square* of the relative time rates—"

"—which is another reason the Immortals don't go down to the surface of planets," said Lum. "They want to spend their time in S-space to increase their subjective life-spans, but then that forces them to live in a very weak acceleration field. They can't take gravity."

"Not even a weak field," added Rosanne. "They'd fall over before they even knew they were off balance. What did you say the time factor was?—two thousand to one? Then even a millionth of a gravity would be perceived by them as a four-g field. They *have* to live in free-fall. They have no choice about it. But they perceive even a four-millionth of a g as normal gravity."

Peron looked around him in disgust. "All right. So everybody saw it easily except me. Try another one. Tell me what's going on outside the ship. One reason I thought at first that S-space had to be some kind of hyperspace was the view from the ports. When you look out, you don't see stars at all. All you see is a sort of faint, glowing haze. It's yellow-white, and it's everywhere outside the ship."

This time there was not even a moment's pause.

"Frequency shift," said Sy at once. "Let's see. Two thousand to one. So the wavelengths your eyes could see would be two thousand times as long. Instead of yellow light at half a micrometer, you'd see yellow at a millimeter wavelength. Where would that put us?"

There was a hush.

"The Big Bang," whispered Kallen.

"The three degree cosmic background radiation," said Rosanne. "My Lord. Peron, you were seeing leftover radiation from the beginning of the Universe—actually *seeing* it directly with your eyes."

"And it's uniform and isotropic," added Lum. "That's why it looked like a general foggy haze. At that wavelength you don't get a strong signal from stars or nebulae, just a continuous field."

Peron looked at Elissa. "Don't say anything. You'll tell me it's obvious, too. I guess it is. But it was a lot more confusing when I had no idea I was dealing with a difference in time rates. I couldn't imagine where I might be, for the universe to look like that. Here. Try your hands at something else. This time I think I know what's going on, but I need help—especially from Sy and Kallen. You're our computer specialists."

He led them back along narrow corridors to the chamber where the patient robots sat in their silent rows. The others watched warily as three of the little machines came to life and glided past them along the passage.

"Don't worry," said Peron. "They don't move fast enough to be dangerous. We can get out of the way, or even move them around if we have to. They're the

maintenance crew for the ship. All normal functions are automatic and under computer control. One person can run everything, and even he may be unnecessary except for emergencies. But the robots certainly made my life confusing. When I first found myself in S-space I thought I was going mad. Those machines were a big part of the reason. The other people on the ship could make things happen by magic. They asked for something to be done, or they asked to be taken somewhere, and it was accomplished instantly.'' Peron snapped his fingers. ''Just like that. I tried to do the same thing, and it wouldn't work for me. When I reached this chamber and saw the robots I finally understood what had been happening. The machines respond to commands given by people in S-space. The ship's computer must be voice-coded through the terminals. When a command is given by someone whose voice is recognized and accepted by the system, the computer mobilizes the robots to carry out the instructions. They don't move very fast, but they don't have to. They're quick enough to be invisible in S-space. Even if it takes the robots ten minutes to bring you a drink, or carry you from one part of the ship to another, you don't notice. That's only a fraction of a second as you perceive it.''

The others had moved closer to the ranks of robots and were looking at them curiously.

''They look pretty standard,'' said Sy. ''I've never seen this design before, but they're computer controlled. We should be able to understand their instruction procedure.''

''But why?'' said Rosanne. ''Even when we understand it, what are we supposed to do with it?''

''Dig into the coding,'' said Peron. ''Change it. Make it so that *our* voices can give acceptable commands, too. And maybe make it so that the system won't respond to Captain Rinker and the others in S-space.''

''But what good will all that do?'' asked Elissa. She was looking puzzled.

Lum grinned at her. ''Isn't it obvious?'' He turned to Peron. ''I have it right, don't I? Rinker is correct, Peron, you *are* a troublemaker. You intend to take over this ship. Then we can go and visit Immortal Headquarters —wherever that is—on *our* terms.''

Chapter 21

Olivia Ferranti blinked her eyes. The texture of the illumination seemed a little different, not quite the way she remembered it before she last went to N-space; and her body was light, floating away, as though she were leaving part of herself on the padded floor of the container.

She shivered and slowly sat up, rubbing at her chilled forearms; then she suddenly jerked to full wakefulness. She was being observed. Five faces were peering in warily at her through the transparent top of the suspense tank. She pulled herself forward to the casket's door and eased it open. Peron was standing there, nervously watching.

''You read our message?'' he said.

''Of course we did—you were watching us, weren't you?''

He nodded. ''We told you to send someone at once. But it seemed to take you an awfully long time.''

Olivia Ferranti was breathing deeply,

adjusting to the familiar but surprising taste of the air in her lungs. She shrugged her shoulders, as much for muscular experiment as for any body message.

"Four days—four days *here*. But we only talked for a few minutes in S-space. I call that a fast response." She looked around her, at Peron and the others. "Relax. I was only sent here to talk. What do you think I'm going to do, knock the lot of you down and tie you up? Any one of you could beat me in a fight. You're the Planetfest winners, remember?"

"We remember," said Peron. "We just want to be sure that *you* do. You and the others. Why are you here, and not Rinker?"

"He made the transition very recently, just a couple of hours ago, when the automatic systems were going wrong. Transitions too close together have bad effects. In fact, frequent transitions shorten subjective life expectancy. And he doesn't trust you, either."

She licked her lips. "I guess he thinks I'm more expendable. Look, I know you're in a hurry to talk, but I'd like a drink of water."

Peron glanced briefly at the others, then led the way back through the winding corridor, taking them once more to the central food processing chamber of the ship.

"He didn't really want anybody to talk to you," said Ferranti as they moved along the corridor. "But he agreed that there was no choice. 'They'll be like a band of wild apes,' he said. 'Fiddling around with my ship! They don't know how anything works—my God, there's no way of knowing what they may do to it and to us!' "

She looked around her at the intent young faces that watched her every movement. "I must say that I have to agree with him. I'm sure you're feeling pretty cocky at the moment, with everything under control. But you could kill this ship by pure accident. It's frightening—you're smart, but there are so many things you simply *don't know*."

"So why don't you tell us some of them," said Sy in a surly voice. "You'll find we're all quick learners."

"I'm not supposed to tell you much—and some things I don't even know myself. And before you get paranoid as to why I'm holding some things back from you, I'll tell you the reason for *that*. There's a sound logic for why you weren't told everything back on Whirlygig."

They had reached the food chamber. Olivia Ferranti bent over a water spigot, took a long, leisurely drink, then sighed and shook her head.

"That's one of the things that I really miss. Water just doesn't taste right in S-space." She turned to face the group. "How much do you know about the history of your civilization on Pentecost?"

"We know that the first settlers came off The Ship," said Peron. "It was called *Eleanora*, and it started out from a planet called Earth, thousands of years earlier."

"That's a beginning." Olivia Ferranti settled herself cross-legged, floating a handsbreadth above the floor, and gestured to the others to gather round her there. "And if you're anything like most of the candidates we get from Pentecost for indoctrination, that's almost *all* that you'll know. So make your-

selves comfortable. I need to give you a bit of a history lesson. You may not like some of it too well, but bear with me.

"*Eleanora* was the biggest and most advanced of half a dozen arcologies built as colony ships in the Sol System, more than twenty-five thousand Earth-years ago. The arcologies were all constructed in orbits close to Earth. Just as *Eleanora* was close to complete, and the Colonists had arrived on board it, the nations down on Earth did what we'd all been afraid they would do for generations. They went mad. Someone pulled the trigger, and after that there was no stopping it. It was a full-scale nuclear war.

"When that war happened, there were about thirty-five thousand people living away from Earth. They were working on mining and construction, or on applications satellites and stations, or they were inhabitants of the colony ships. We were all helpless, watching the world explode before our eyes. And at first none of us knew what to do next. We were numb with shock and horror."

"You said 'we.' You mean you were *there*—yourself?" asked Elissa.

"I was. Me, myself. I was a physician on one of the orbiting space stations." Olivia Ferranti shook her head and rubbed gently at her eyes. She seemed to be staring far beyond the circle of her listeners, out across space and time to the death of a planet. "Initially we just wouldn't believe it. Earth couldn't destroy itself like that. We knew it must have been terrible on the surface, because we had seen the whole globe change in a few hours from a beautiful blue-green marble to a dusky purple-black grape, and the smoke plumes had risen well into the stratosphere. Even so, emotional acceptance was beyond us. Somehow, beyond logic, we believed that the damage was temporary and the surface nations would recover. We waited for radio signals from survivor groups, messages that would tell us that civilization was still going on beneath those dark clouds of dust and smoke. The signals never came. After a few weeks we sent shuttles down into the atmosphere, shielded against high levels of radioactivity and designed to go down below the clouds and examine the surface. There was so much dust in the northern hemisphere that we could see nothing, not even from low altitude. We tried south of the equator, and after a couple of months we finally knew. It was the end.

"We knew we couldn't rule out the possibility of isolated survivors, clinging on to existence down there in the darkness. But as time went by even that hope seemed less and less likely.

"Some plants would survive, we knew that; and we felt sure there would be life in the sea—but we had no idea how much. We tried to calculate what would happen to the whole food chain when photosynthesis was reduced to less than a tenth of the usual value, but we had no faith in our answers. Anyway, they didn't really make any difference. For mankind on Earth, it was the end. And we felt as though it were the end for us, too. We seemed like a handful of mourners, circling the funeral pyre of all our friends and relations.

"We were too shocked to think logically, but we were certainly far more than

a handful. As I said, there were thirty five thousand of us, with slightly more men than women. And we had ample power and materials available. There was no question that we could survive very well if we pooled our resources and all worked together. We knew it might be centuries before Earth could be revisited and repopulated, but there was no reason why we could not go on indefinitely as a stable, spaceborne society."

Ferranti smiled bitterly. "God knows, many of us had said we wanted just that for long enough. Then when we had no choice, most of us in our dreams imagined ourselves back on Terra.

"There's one good thing about humans; we forget. Despair can't last forever. We pulled ourselves together, little by little, and began to think again. On Salter Station we finally arranged for a radio conference of all the space groups. It was difficult to handle, because one arcology had been out near Mars, and we had long radio lags. But we pulled everyone into the circuits—all the arcologies, the mining groups that had been smelting from the Amor Asteroids, and the scientists who had been building the farside station up on Earth's moon. Everything in space had always been controlled from Salter Station, so it seemed natural that we would still be the organizers.

"Natural *to us,* on Salter Station. But others didn't see it that way.

"The arcologies had been set up to be as self-sufficient as possible, with independent power plants and six-nines recycling systems. The other space facilities were different; they were dependent on supplies provided from Earth, or on spaceborne resources provided by the mining and extractive industries.

"The first planning session to discuss pooling of resources went smoothly. Everyone participated. But when the time came to act, three of the arcologies backed out. I believe that they each operated independently, without even discussing it among themselves. They were afraid, you see—scared that the *total* group might not be stably self-sustaining, even though they had no doubt about their own ability to survive. There were other reasons, too. From the very beginning the arcologies had been developing their social and political preferences and differences. Like called to like—colonists tended to apply to the same place as their friends, and to avoid a colony where their views would be ridiculed or in the minority. The last thing that *Helena, Melissa,* and *Eleanora* wanted was a merger with Salter Station and the other arcologies. They didn't ever admit that they were not going to cooperate; they simply cut off radio contact and moved farther out, away from Earth.

"The rest of us were angry with them, but we didn't take as much notice as you might think. We had our own hands full without them for the first few years. We had to establish our own system, self-sufficient and as foolproof as we could make it. That took ninety-nine percent of our energies. And the rest went into the work on reduced metabolic survival—what we finally called S-space existence. As a doctor I was naturally interested in that, and after a while I began to work on it exclusively. Within a couple of months of the first experiments with human subjects on Salter

Station it was clear that we had something absolutely revolutionary, something that changed all our ideas about perception and human consciousness. But it took several years more before we saw the other implications. With our work, humanity had found the easy way to the stars.

"There was no need for multi-generation arcologies, or for faster-than-light drives—"

"—which seem to be impossible," murmured Sy softly.

"Which *may be* impossible," said Ferranti. "Keep an open mind. Anyway, we didn't need them. The drive system research on Salter Station would allow us to accelerate a ship up to better than a tenth of light speed, and that was enough. In Mode Two consciousness—S-space—a human being could remain fully aware, live an extended subjective life, and travel across the whole Galaxy in a single lifetime.

"That led to a new crisis. Everyone loved the idea of an extended subjective life span—if it was safe. But everyone was terrified of possible side effects.

"We split into two groups. Some of us said, let's move to S-space, and wait there at least until Earth is habitable again. No one knew how long that would be, but in S-space we could afford to wait centuries and perceive them as only a few weeks. Others were afraid. They argued that there were too many unknowns and too many risks in S-space living; until those were pinned down it was better to stay with our normal perception."

Olivia Ferranti smiled ruefully. "As it turned out, both groups were right. Earth recovered slowly. It took more than a thousand years to develop new and stable plant and animal communities. None of us had ever dreamed it would be so long. And at the same time, we were discovering serious physical consequences of S-space living.

"Fortunately we didn't fight over our differences of opinion on the move to S-space. Maybe the destruction of Earth had taught us all something about the need for peaceful resolution of conflicts. We agreed we would pursue both actions. Most people elected to stay as they were, creating a decent society in the spaceborne environment. After a few generations it was clear that a life in space was as satisfying as most of us had ever hoped. By then a few hundred of us had long since moved to S-space, using ourselves as the subjects for experiments that might reduce the risk for those who followed. While we were doing that we discovered a new mode of metabolic change, this one a true suspended animation. Five of you have personal experience of that cold sleep, here on the ship. We still don't know how long someone can remain safely unconscious in that mode, but it's certainly a long time—thousands of years at least.

"The move to S-space had two other important consequences. First, we realized that we *couldn't* go back down and live on Earth, or anywhere with a substantial gravity field, even if we wanted to. That had been deduced when the experiments were still all on animals, and it was one major reason for moving the work out to orbit and away from the surface of Earth. You see, perceived accelerations—"

"We understand," said Peron. "Kal-

len and Sy''—he pointed to them —''figured it out.''

''Smart.'' Olivia Ferranti looked at the group appraisingly. ''When I'm through, perhaps you'll tell me a little more about yourselves. All I know so far is what I was told by Peron and by Captain Rinker.''

''Won't he be wondering what's happening?'' said Rosanne. Then she stopped and put her hand to her mouth.

''He might—in a few more days.'' Ferranti smiled and Rosanne grinned back at her. The initial tension of confrontation was fading. They were all increasingly absorbed in the first-person tale of remote history.

Olivia Ferranti leaned against the wall and pushed back the blue cowl from her forehead, to reveal a mop of jet-black tight curls. ''We have lots of time. At the moment, Captain Rinker and the others hardly know I've left.''

''But you've got hair!'' blurted out Lum.

Olivia Ferranti raised her dark eyebrows at him. ''I'm glad to hear that you think so.''

''It's what I told them,'' said Peron. ''I thought S-space made you bald.''

''It does. Didn't you ever hear of wigs, down on Pentecost? Most of the men in S-space don't worry about it, but I don't care to face the world with a naked scalp—my ideas on the right way for me to look were fixed long before I ever dreamed of S-space. Anyway, I have a lumpy skull that I have no great desire to show off to others.'' She patted her dark ringlets. ''I much prefer this. The nice thing about it is that it will never go gray.''

''What else does S-space do to people?'' asked Sy. More so than the rest of them, except possibly for Kallen who had typically not spoken at all, Sy seemed reserved and unwarmed by Olivia Ferranti's open manner.

''I'm getting there,'' she said. ''Let me tell you that in a few minutes. I want to do this in a logical order, and explain what happened after Earth had been destroyed. It's important that you know, so you'll understand why we behave the way we do in the Cass system.

''While we were still busy working out the stable society for life away from Earth, and some of us were also learning how to live in S-space, we didn't have time to worry about what was happening to *Eleanora* and the other arcologies. And to tell the truth, we didn't really give a damn. They'd selfishly deserted us, said our logic, so to hell with them. As far as we were concerned they could fly away and rot.

''But after a while those of us who were living in S-space—I was one of the first twenty people to take Mode Two hibernation—became pretty curious. You see, we knew we had the stars within reach. We had the drive we needed, and the time we needed. And *Helena, Melissa*, and *Eleanora* had all headed off outside the Solar System, in different directions. We didn't know how much of the reason for their departure was an interest in exploration, and how much of it was fear of reprisals from us. We weren't planning revenge of any kind, but how were *they* to know that? All three of them had shown signs of paranoia, back when they were first colonized. We got more and more curious to know what had happened to those three arcologies.

"Eventually we equipped four ships with service robots, similar to the ones on this ship, and with limited life-support systems. We didn't need perfect recycling, only enough for a few months of travel in S-space. The final design gave the ships a useful exploration range of up to fifty light years. At the slow speed of the arcologies, we knew they couldn't be farther out than that. And the stellar profiles in the neighborhood of Sol gave us a fairly good idea where the colony ships were likely to be headed. Political systems change, but the physical constraints are still there. We thought we'd find them about twenty light years out.

"When we had everything ready, our ships set off with their volunteer crews. We had no shortage of people willing to make the trip—I put my own name in, but didn't make it. There were many with better qualifications than mine for interstellar cruising.

"As it happened, we had overestimated the distance they had gone. We had made insufficient allowance for the difficulties that *Melissa* and the others might be having on board. It hadn't been a smooth ride by any means. There had been a civil war on *Melissa*, an economic collapse on *Eleanora*, and a power plant failure on *Helena*. Those variables affected both their speeds and their directions. *Helena* actually reversed direction and started back for Sol for a while, until the trouble was fixed and she could head outward again.

"Our ships had no trouble tracking and finding the arcologies. After all, they had no reason to expect pursuit, and nothing to be gained by concealing their presence. But when we reached them, we found that no arcology had found a habitable planet, and all three were still in deep interstellar space. After reporting back to us—S-space radio signal time was only a couple of days—it was agreed that we would not establish contact with them. We decided to do nothing, and not to interfere in any way unless an arcology was in actual danger of extinction. They hadn't asked for help, and we didn't want to give it. Your ancestors would be allowed to wander around until they found a habitable planet, or they decided that a permanent space life suited them better. Then we would reconsider possible contact.

"Our ships left automated tracking probes to follow the arcologies and report on their movements, and headed for home.

"It may seem strange to you that we had so little interest in the arcologies. But we were in no hurry. We could wait in S-space and see what developed. And certainly we had plenty of other things to interest us, because by that time Earth was finally being visited again on a regular basis.

"Still we had doubts that humans could thrive there. The long dust-winter had exterminated ninety percent of the plant species, and all land-based animal forms bigger than the rat—and I mean an *Earth* rat, not one of the thirty-kilo monsters you call rats on Pentecost. We also found that the surviving plants and animals had changed from their old forms. The grasses were unrecognizable. Many of the old food plants tasted wrong in subtle ways, and some had lost all their nutritional values. We all realized that it would take millennia to

restore Earth and make it a place worth living. But oddly enough, we all thought it a worthwhile effort—even those who had found life on Earth absolutely intolerable before the holocaust.

"By the time the Earth visits began we were feeling much more comfortable about S-space. Some of us had been living there for many Earth-generations, and we were all feeling fine—better than fine, because we didn't seem to be aging at all. Our best estimate, based on limited data, was that the aging rate was twenty times as slow *subjectively* as it was in normal living. That extrapolated to a seventeen hundred year subjective lifetime—and even if we were wrong by a factor of two, that was still a mighty attractive thought.

"When our result became known, naturally more and more people wanted to move to S-space. It didn't happen overnight, but as time went by we learned how to make the transitions both ways, with minimal danger. By then we also knew the big problem with S-space existence."

"You keep referring to problems and never telling us about them," said Elissa. "*What* problem?"

"I've not been talking because I'm not *supposed* to talk," said Ferranti. "No one back on Pentecost should know what I'm telling you until they've been through indoctrination, and not one of you has; but you'll realize the problem for yourselves in a minute as soon as we arrive at local Headquarters, so I'm not revealing any great secrets."

Olivia Ferranti moved her thin hands to her cheeks, framing her eyes. "You'll find no children at Headquarters," she said abruptly. "A woman cannot conceive in S-space, or a man produce active sperm. S-space is a wonderful place for an individual, but it's an evolutionary blind alley. Worse than that, anyone who makes frequent transitions between S-space and normal space suffers reduced fertility.

"That presented us with a terrible choice. Did we opt for extended personal lifespan in S-space, or would we guarantee the survival of the human race by staying in normal space?

"While we were still agonizing over that, we received a signal from the probe that had been tracking *Melissa*. The colony ship was in the Tau Ceti system, and it had finally found a habitable planet. They were exploring it. We eventually found out that they had named it *Thule*.

"It was twelve light years from Earth, which made it a four week one-way journey in S-space when we allowed for acceleration and deceleration. I don't think I mentioned it, but no matter how we tried we had been unable to come up with an economical drive that would take us much faster than a tenth of light-speed. But it wasn't important any more. As you can see, that's good enough when you live in S-space.

"Our ship went out, and in due course it made contact with *Melissa*. That first meeting was traumatic for the *Melissa* inhabitants. They had left Earth twelve thousand years earlier—five hundred generations of shipboard life. Earth was nothing but a distant legend. It was something that was still talked about, but stories of Earth's destruction were regarded as of the same practical importance as tales about the Garden of Eden. When our crew contacted them

and claimed to *remember* the death of Earth, that was too much for the Melissans to take.

"After we had learned something of their history since leaving the Solar System, we could see why. They had never had a stable and trustworthy government that lasted for more than a century. We found historical evidence of every form of rule from water-control to neo-Confucianism. When they discovered Thule they were just recovering from the effects of a long dictatorship. Their mistrust and suspicion were considerable. Even the most rational of them found difficulty in believing that our intentions were wholly innocent, nothing more than curiosity to learn how another culture was faring after so long without any kind of planetary home. They would not let us visit their colony on Thule. Putting it mildly, they suspected our motives."

Olivia Ferranti slowly shook her head. "And, of course, they were wholly correct in doing so. Even in S-space, one is not completely protected from accidents and disease. There would inevitably be deaths, and without replenishment we foresaw our society shrinking—not at once, but over many thousands of Earth years. In *Melissa* and the other arcologies we saw a possible answer.

"Either we were unusually stupid, or we were simply naive. To make the Melissans believe us, and to show how we could be people who actually remembered Earth's final war, we explained about S-space to them.

"They went crazy. They wanted S-space more than anything else in the Universe. You see, we were misled by our own experiences. We had been slow to accept and move to S-space. We didn't realize that our reluctance wouldn't apply to them. They hadn't been there for the early, risky experiments. To them, our existence *proved* that S-space must be safe. So they thought we were deliberately goading them, tormenting them with a look at immortality while refusing to share its secret with them.

"Most of our ship's crew had gone on board *Melissa*. They took them, eight men and six women, and tried to draw the secret of S-space from them by force. It was useless, of course. The conversion equipment was on the ship, as it is on this ship, and the crew had used it to go from S-space to the perception rate of the Melissans. But they didn't know the *theory*, any more than Garao or Captain Rinker knows the theory.

"The inquisitors tortured those crew members to death. Only the two who had remained on our ship were able to escape and come back to tell us what happened.

"That's when we adopted our first rules for interaction with *all* colony ships and colony worlds. We would have limited contact, and it would be handled with great care and with fixed rules. We would never again return ourselves to normal space for the purpose of contact, as was done with *Melissa*. Contact would be done with robots as intermediaries; and we would *never*, under any circumstances, allow ourselves to fall into the hands of the colonists."

Olivia Ferranti shrugged. "There's another rule we've broken on this trip. Well, let's skip forward four thousand years. That's when another of the ar-

cologies, *Helena*, finally found a habitable planet. They named it Beacon's World, colonized it, and moved on. That's when we learned another lesson. Beacon's World was settled long before we sent a ship to visit it. When our ship finally got there we found that the population had increased from the original few thousand to forty million; but along the way much of their scientific knowledge had been lost, or had degenerated to hearsay and legend.

"We tried to help. We reintroduced the basis for a more advanced technology. They were keen to receive the information from us—but they applied it to weapons development. Then they started a war, between the two major settlement centers on Beacon's World. Our ship and crew felt helpless, watching while they slaughtered each other. But we felt we had to do *something*—it was impossible to stand by, uninvolved, when we knew the information we provided had allowed the conflict to be so savage. The crew of our ship tried a desperation tactic: through our robots, they *ordered* the warring parties to stop fighting—without saying what would happen if the order were disobeyed.

"It worked. The fighting stopped.

"We had learned another important truth. By being 'Immortals,' with a technology and a life pattern that was incomprehensible to the colonists, we could have enormous influence.

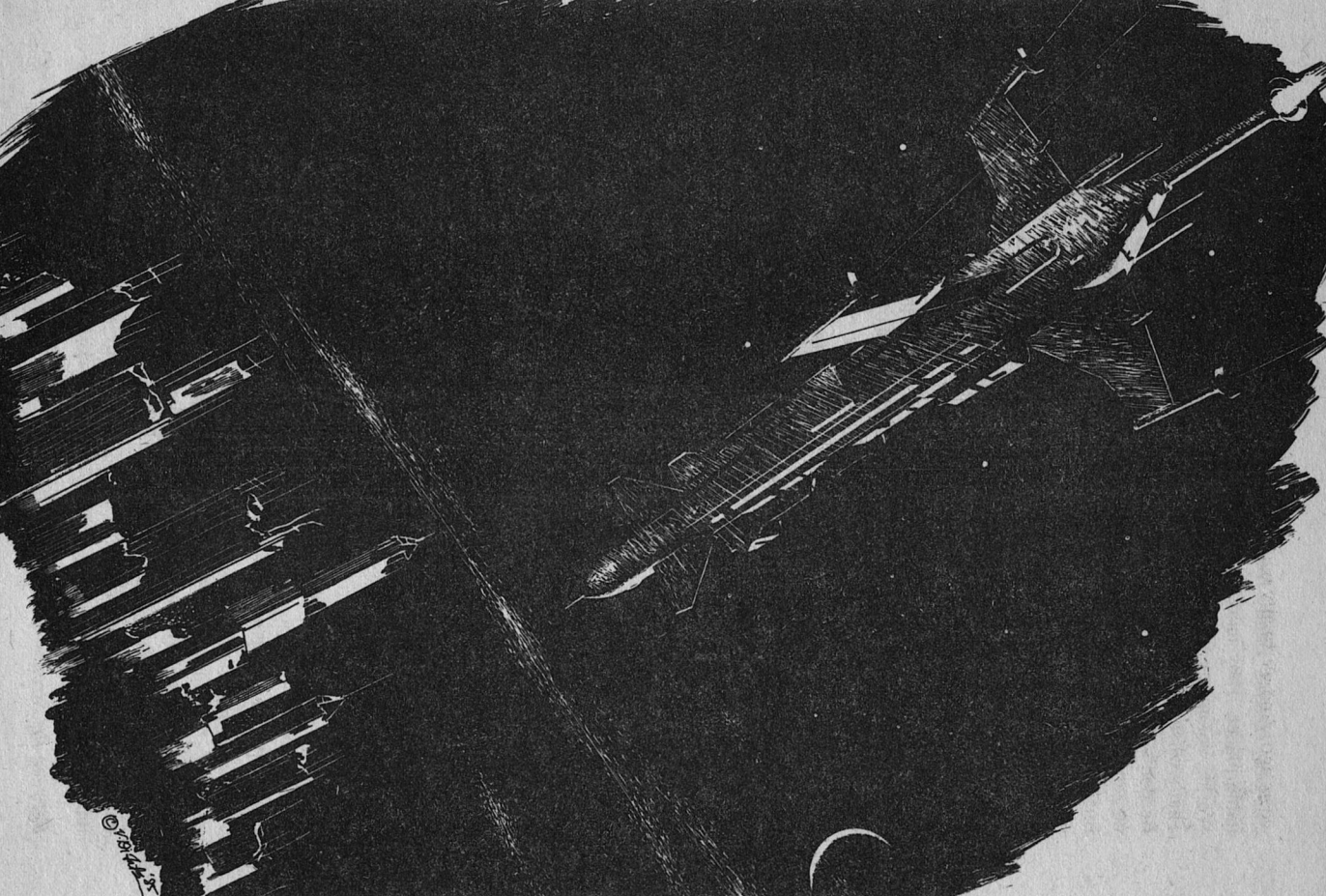
"That provided us with our next rule of contact: remain as aloof and mysterious as possible. And if we recruited anyone to join us in S-space—we wanted only exceptional specimens—we would introduce them to our society gradually, through a long and thorough indoctrination.

"Our rules worked very well. People joined us from Maremar and Jade—two other planets settled by *Helena*—and have been working in those systems and at Headquarters for thousands of Earth-years.

"Finally, there was your world. You probably don't know it, but Pentecost is a very recent addition to our planetary visits. We found you only a few months ago, as we perceive time in S-space, and it was a minor miracle that we found you at all.

"You see, *Eleanora* was the unlucky one of the colony ships. The other two arcologies found several planets suitable for settlements. But your ancestors had to wander the interstellar wilderness for over fifteen thousand years, without ever once approaching a habitable world. We know why, now. For the past four thousand Earth-years we've been able to predict pretty well the stellar systems and planets likely to support life. And *Eleanora* just went to the wrong star systems, in terms of our new knowledge. Unfortunately, that same knowledge led us astray in following *Eleanora*, when our tracking probe finally wore out. As it happens, the Cass system is generally *not* suited to life, or the occurrence of habitable worlds. The existence of Pentecost, Gimperstand, Fuzzball, and Glug is an accident, the by-product of resonance locks between planetary orbits.

"We could have found you on Pentecost four thousand years ago if we had thought to look. As it was, we only detected your radio emissions a few hundred



years ago. And we finally made contact with you.

"We followed our standard rules. Slow and limited contact, and don't try to change the government of the contacted world. As it happens, Pentecost has had a classical totalitarian regime ever since first contact—a government more concerned with remaining in power than anything else, and sublimely uninterested in interstellar affairs. From our point of view, that was perfect. Everything worked according to plan for hundreds of your years—until this Planetfest, when Headquarters was informed that an unusual group of winners was likely. *You* don't know who the winners will be in advance, you see, but our people down on Pentecost had a pretty good idea. We expected trouble, but we didn't know what. Personally, I think *something* would have happened even if Wilmer hadn't taken the action he did on Whirlygig. Your profiles are all too far from the standard patterns. But that's my speculation. The main thing is, something *did* happen. And" —Olivia Ferranti looked at the intent young faces around her and shook her head— "here we are. We have to decide what will happen next.

"I'll accept that you have control of the ship. And I hope you'll accept my word when I tell you your control could be dangerous, with the limited knowledge you have. The present situation is bad for everyone, including you. So let me start the ball rolling for more discussions, by telling you that I was sent here with a proposition from all of us—including Captain Rinker."

The group around her came to life. They were suddenly fidgeting, looking at each other questioningly. For over half an hour their present situation had been pushed into the background by interest in the fate of others. The return to the present was an uncomfortable one.

Peron met the eyes of each of them in turn. Finally he nodded.

"We've nothing to lose by listening to you, so long as you remember that we have physical control of you and of the ship. So all right. We'll listen. What's your proposition?"

Chapter 22

Slowly, millimeter by infinite millimeter, Olivia Ferranti's eyes were opening. A thin line of white had appeared behind the long false eyelashes. It broadened, to become a slender crescent. The lids crept apart, at last to reveal dilated pupils and the luminous brown irises, flecked with gold.

"That's it," said Peron finally. "She's in S-space. At last. There's no way that anyone could fake an awakening like that. Let's get back to the chamber and talk."

Every one of the six had known that a discussion was urgently needed; but the urge to watch Olivia Ferranti had been irresistible and tacitly admited by all.

They had gathered around the great tank as she prepared to enter. They watched in silence while she, impressively calm, went inside. And as soon as the heavy casket door slid into sealed position she lay back, stared up at them through the transparent upper surface, and gave a little wave of her fingertips. Then she reached for the interior control

panel and hit the key sequence to initiate her return to S-space.

After a few seconds, clusters of contact sprays moved to drift a fine fluid vapor over her limbs and body, while delicate catheters snaked from the casket walls and insinuated themselves gently into the orifices of her head and trunk. A dense yellow-green vapor sluggishly filled the interior of the tank, rising after a few minutes to hide Olivia Ferranti's still form in a soft-edged shroud.

There was little to see after that, but they had stood waiting for almost two hours, exchanging brief phrases in hushed tones. Only when the air in the casket finally cleared and Olivia Ferranti began to stir again to slow consciousness were they able to think of other matters.

And now, watching her eyes creep open, they all felt a renewed and ridiculous sense of urgency. Logic said that another day or two of their thought and discussion would pass unnoticed to Rinker and the others in S-space, but the sense of haste went beyond logic. That feeling dimmed a little as they moved back to the computer chamber, and found the control settings and service robots exactly as they had left them.

"So what do you think?" said Peron abruptly, as they settled down in a close circle by the gently flickering displays of the main computer console.

"I believe her," said Rosanne at once.

"I don't," added Sy promptly. "She was lying to us."

"Lum?"

"Some of each." Lum massaged his full cheeks with one hand, and furrowed his brow. "Mostly I believe her. She kept pretty close to the truth, but I think she exercised selective memory. She left some things out."

"She sure did." Sy's thin face wore a scowl. "Things she didn't tell us. I could list ten of them. What happens if we reject their suggestion? Who makes the rules that decide what we ought to know, and when? What's supposed to happen if a Planetfest winner doesn't swallow the party line? Where do *they* go? One thing's for sure, they don't go back home to Pentecost. I wonder if they have convenient 'accidents' in the Cass system—we know there's ample scope for that around the Fifty Worlds."

"We're getting ahead of ourselves," said Lum. He wriggled uncomfortably inside his jacket, a brown garment too tight in the chest and short in the sleeves. "Let's take Ferranti's story one piece at a time, and see what we agree on. Anything?"

"I thought her history lesson sounded genuine," volunteered Elissa.

"So did I," said Peron.

"More to the point," said Lum, "I can't see what advantage she would gain by lying. And I believe her when she says that we are now on our way to their headquarters. But some of her other statements struck me as false. For one thing, I don't really believe that we're a danger to the ship and to ourselves, just because we're strangers here and in normal space. We didn't get through the Planetfest trials without learning caution. We know how to be careful, and we look before we leap. I think she said we were in danger because they *want* us in S-space, where they can keep an eye on us. They want to be in control.

Well, we can't afford that. Sy, how's the reprogramming going for the service robots?''

''Done. They'll obey our voice commands now. But Kallen and I have a question. Do we want it so the computer will activate the service robots in response to our voices, and no one else's? Or should we leave it working for Ferranti and the others, too?''

''Must it be one or the other?'' said Lum. ''Couldn't you set a trigger, so that we can cut the others out of control if we choose to, based on our voice command? Then we'd be quite safe.''

Sy raised his eyebrows inquiringly at Kallen, who pursed his lips and massaged his scarred throat.

''Think so,'' he said after a moment. ''I'll try it.''

''All right.'' Lum nodded. ''Before you do that, let's think a bit more about what we were told by Ferranti. What about their headquarters? According to her, it's about a light year away from Pentecost. But why put it there? If the rest of her story is true, there are *fewer* colonies near the Cass system than anywhere else. It would make more sense to locate Immortal Headquarters near Tau Ceti, or some other star with more habitable planets.''

''I can answer that,'' said Peron. ''When I was first awakened, Ferranti referred to *Sector* Headquarters. That means there ought to be others, in other systems. Remember, according to Ferranti *all* the colonies are twenty light years or less away from Sol. For S-space travel, that's at most a five-week trip. I'll bet there are several Sector Headquarters, one near each stellar system that was colonized.''

''So where is General Headquarters?'' asked Elissa. ''Is there one?''

''I'll bet there is,'' said Lum. ''Even the Immortals would need some sort of overall organization of resources. And didn't you get the feeling that at the headquarters we are headed for most of the rules are *followed*, not made?''

''So where is the central one?'' repeated Elissa. ''Where's main headquarters?''

Lum put his hands up to his head and rubbed at his thick shock of mousy-brown hair. ''Lord knows. We have to rethink *everything*, if travel to the stars is so easy for them. Headquarters could be a hundred light years away from here. That's only a six-month trip in S-space. But it wouldn't make much sense. Even in S-space, it would be hard to manage an organization where messages take weeks to get around the system.''

''You're making it hard,'' said Sy softly. ''Think simple.''

''You mean Sector Headquarters is the only one?''

''No. Think Sol.''

The others looked at him, then at each other.

''He's right, as usual,'' said Peron. ''All the ships started from Earth. It was the center of the sphere of expansion, so it's still the natural hub for coordinating colonies and sector headquarters. Main headquarters ought to be Earth.''

There was another silence.

''*Earth!*'' said Rosanne at last. Her voice was hushed, and the word came from her lips like a benediction. ''If General Headquarters is back on Earth, maybe we can go there . . .''

''Not actually *on* Earth,'' said Lum.

"We know you can't go down to a planet's surface if you live in S-space."

Kallen was shaking his head. "No. Can't live on planet. We could *visit*." He looked greatly excited.

"He's quite right, you know," said Sy. "We all agree that anyone in S-space wouldn't be able to keep his balance in more than a micro-gravity field. But perception and physical tolerance have nothing to do with each other. Your body could stand gravity all right. You'd have to be supported and restrained, but you could visit the surface of Earth—or of Pentecost—living in S-space."

"That would be enough," said Rosanne suddenly. "Even a short visit, in S-space or in normal space. I want to go to Earth, see where everything began. We've talked about it and thought about it so much. Can you imagine flying down through the atmosphere, and walking on Earth's surface?"

"Steady on," said Peron. "Don't get carried away. Sol is eighteen light years from here. I know that's only a few weeks travel in S-space, but it's nearly two centuries back on Pentecost. Everyone we know there would be long dead before we even reached Earth, let alone came back to Cass."

Rosanne shrugged. "I can't speak for you, but I already said goodbye to all my best friends. It's curious, but I think we were set up for it. We said our farewells before we lifted off from Pentecost. Remember, they encouraged us to do it, and we thought it was in case we died in the off-planet trials? But it makes sense. If winners go through indoctrination and move to S-space, they would outlive all their contemporaries on Pentecost in just a few S-space weeks. Do you realize that the people we left back home have already aged five years since we last saw them?"

"I've been thinking about that," said Lum. "I'm not like you, Rosanne, I really miss some of the friends I left—and I'd like to see them again sometime. That's something else we ought to be worrying about. We've been dealing with Olivia Ferranti on the 'united we stand' basis, as though we all have identical objectives and want the same things. But we don't. I know you all well enough to be sure that's not true. We should get our personal preferences out on the table, so we'll know what we're bargaining for with the Immortals."

"But what are our options?" said Elissa. "We can go to Headquarters, I suppose, and live in S-space there. Or we could return to Cass and live on The Ship, and work with the government of Pentecost. But I'm sure they won't let us go back down to the surface of Pentecost, and live the way we used to do, even if we want to. We know too much. Maybe they'd let us go to one of the other colonies. Or maybe we can go to Earth."

"That's why I'd like to know what we *want*," said Lum. "We each have our own desires and priorities—but what are they?"

"Why don't you start?" said Rosanne. "It's your question, and it gives the rest of us more time to think."

"Fair enough." Lum took a deep breath. "I've known what I want ever since the moment when I found out there are other planets and colonies, and a way to reach them in a reasonable time.

Ferranti mentioned at least seven inhabited planets, and I'll bet there are more. I want to move to S-space, and see *everything*. I'd like to visit every planet, and every arcology, and every headquarters. If I could do it, I'd like to see every planet in the Galaxy—even if most of them prove to be like Glug."

Rosanne nodded. "I don't know if that's all possible, but at least you're voting for a move to S-space—otherwise you'd be dead long before you reached your first colony. Sy? What about you?"

"Wandering around forever isn't for me." Sy was smiling, but there was something in his look that suggested his disdain for Lum's travel plans. "I want to visit Immortal Headquarters—whichever one is the most appropriate, wherever their science is furthest developed. What we learned on Pentecost is probably generations out of date. After that, I'd like to visit the galactic center."

"That's thirty thousand light years!" said Peron.

"Sure it is. I don't mind. If I have to go back to cold sleep for a while to get there, I'll do it. The rest of us have all been under once, and it wasn't a bad experience."

Rosanne was staring at him and shaking her head. "Sy, I worked with you on the Planetfest trials, and I know you're pretty much all right—but you're certainly *weird*. The galactic center!"

He grinned back at her. "So? Let's hear from somebody normal, then. Where do you want to go?"

"Well . . ." She hesitated. "I like the Cass system, and I liked Pentecost. But I agree with Elissa, they wouldn't let us go back there for a long time. So forget that. I'd certainly like to see Earth—who wouldn't? Apart from that I suppose I'm a lot like Lum. I want to see lots of other places, wander around the colonies and the habitable planets, see what's there . . ."

Elissa winked at Peron. *I told you so,* said her look. *I win that bet. Rosanne's a lot more interested in Lum that she'll ever admit.* "What about you, Peron?" she said loudly.

Peron looked as perplexed as he felt. "I'm not at all sure, and I just wish I knew. I want it *all*—to be back home on Pentecost, to travel, and to take a really close look at the Immortals."

"You're not much help!"

"I know. I suppose the best answer is that I can't say for the long term. But for the moment I want to know more about S-space, and the only way to do that is to move there for a while. Olivia Ferranti makes me feel like a child in the cradle. She didn't exactly say it, but she must think we're upstart babies. When I think of all that she has seen and done, and the things she told us about . . ."

"Not to mention all the things she has seen and done, and *not* told us about," said Sy drily. "Kallen, it's your turn."

The tall youth nodded. He stood silent for a while, as though organizing his words.

"Rosanne told Sy he was strange," he said at last. He smiled shyly. "I am afraid that she will judge me even more so." He cleared his throat, and spoke louder than any of them had heard before. "Back on Pentecost, I lay awake at night with my own dreams. I won-

dered what we are, as a species, and what in time we might become. It has always seemed to me that humans are best regarded as a transitional stage, something between animals and what may come after. I speculated. What will that next phase be? The question always seemed an unanswerable one; but no longer. I want to see the future—the far future. And like Sy, I will be happy to return to cold sleep in order to accomplish that.'' He smiled again. ''*After* I have had a good look at S-space, not before.''

''I always told the others you were the dreamer,'' said Elissa. ''The far future? You're worse than Sy. Let's see, what conclusions do we have? We're quite a mixed bag. We've got two votes for the colonies, and for taking the grand tour; one for science and the galactic center; one for the future; and one who's not sure just what he wants. What else? We all think we're not getting the whole story, and that Olivia Ferranti knows things about S-space life that she hasn't told us. Nobody relishes the notion of spending a long time at local headquarters, but we know we'll have to start there. And I gather we're all itching to take a trip to Earth if we can find a way to do it. That's my summary. Anything missing?''

''At least one thing,'' said Peron. ''There's still one person we've not heard from. What about *you*, Elissa—what do you want to do?''

She gave him a peculiar stare. ''You mean, where will I go? Peron, you're a bone-headed idiot and a blind tardy. Are you trying to embarrass me?''

To Peron's surprise there was a burst of laughter and incoherent comments from the other four.

''You name it, Peron!'' said Lum.

''Name it. Name what?''

''Anything you like.''

''Lum's right,'' said Elissa. She moved across to Peron and hugged him, while the others cheered.

''You name it.'' She ran her knuckles along his ribs. ''Shake me loose—if you can. I'm going where you're going, and it would be kind of nice if you'd make up your mind and tell me where that is. But you don't have to do it now, because it looks like we all agree on the next step. We go to S-space, then to Earth. Think it's feasible?''

''We'll have to do some arm-twisting,'' said Lum. ''But we have an awful lot of power so long as one of us is here in normal space. Do you realize that a tiny boost from the engines of this ship, one we wouldn't notice, would make it impossible for anyone in S-space to stand up? You can bet that *they* all know it—they must be wondering what we might do next.''

''So let's tell them we're ready for the next round of bargaining,'' said Peron. ''And let's insist that it be done here, not in S-space. That's going to make many of them uncomfortable, and eager to get back to their usual environment. Agreed?''

The others nodded.

''I can hardly wait to see S-space,'' added Rosanne. ''I hope that Kallen and Sy changed the control program correctly. I like the idea of all my wishes being granted.''

CONCLUDED IN NEXT ISSUE

brass tacks

Dear Stanley,

Who is watching the store?

Note page 132 September issue in the otherwise excellent article by Albert I. Berger: ". . . imminent demise of *Unknown* (whose November issue would be its last)." What? Are you sending a lot of collectors looking for a non-existent issue of that beloved magazine? My set has a 39th issue dated October, 1943. We must be accurate even in the small details.

Is there some reason that volume III of Tuck never got a review in *Analog*? I know you only have so much room but in my own biased view it is a seminal work in our field.

As an addendum to your editorial, which I do agree with, the only two engineer presidents Hoover and Carter turned out to be poor politicians. That ought to tell us something about either engineers or politicians.

ED WOOD

Hurst, TX

Or maybe just two specimens of each.

Dear Sir:

I am required by personal interest to take strong disagreement with your October, 1984 editorial. Specifically, I must disagree with your implied conclusions regarding the presumption that all people are warlike by custom.

All people are not warlike; this is a very simple observation. However, all civilizations that are competitive with us are warlike. If they were not warlike, or not good enough at war, they would have been destroyed as a culture many years, decades, centuries, or millenia ago by their more warlike neighbors.

Unfortunately, war exists in our world as the only survival mechanism for a culture, as any culture that was not good at the practice of war is no longer with

us. War is an activity that, once invented, can not be stopped.

But this is too simple an answer. It is not easy to get the cream of the adult males of a culture and go out and try to kill off the cream of the other culture. The social organization and tradition that makes this a feasable attainment is what separates the existing cultures from the no-longer-existing cultures. The cultures that have made the best war are those that we are descended from and those that did not make war well are no longer with us; they have no descendants.

Far from being a sign of barbarism or some such, war is the highest social custom. It is the entire basis for the organization of the dominant cultures of the Earth.

If we wish to stop war we need to do one thing, which would be the goal of every social scientist if social science were a science. That is to develop a social form that will permit the survival of a society when opposed by a warlike neighbor.

Until such a social form is developed, war will remain the highest social function.

MATT GIWER

Arlington, VA

I would take equally strong exception to your characterizing war as "the highest social function," but that may be at least partly because "highly" is such a connotatively loaded and denotatively vague term. But I must agree with your empirical observation that so far non-warlike cultures have not done well in survival terms—and your conclusion therefrom that if war is to be eliminated, we need ways for non-warlike cultures to survive in the face of it. So let's get on with it!

Incidentally, the words "by custom" at the end of your first paragraph significantly change the meaning of my original argument, which questioned the widespread belief that all people are warlike by nature.

Dear Stanley Schmidt:

How in the name of responsible science could a quality SF magazine capable of running a fine article on quantum mechanics (November 1984) be willing in the same issue to publish a totally irresponsible article on parapsychology? The author, self-styled superpsychic Alan Vaughan, believes everything from psychic levitation to paranormal spoon bending. Your biographical note praises his "accurate" forecasts of the future. Let's glance at the record.

In 1971 he predicted that thousands would be killed by the eruption of Mt. Pelee, that Nixon would be re-elected president in '74, and Ted Kennedy would become president in '76. In the October 2, 1974, issue of *The National Enquirer* he said that when Ted became president in '76 the "people in this country will gain strength . . . and experience a tremendous spiritual awakening" aided by an "advanced religion" brought to us by friendly extraterrestrials.

"I feel," he told the newspaper, "that within the next two years—most likely in '76—we will be visited from outer space by a gigantic craft capable of enormous speeds. Or it could be a small planet controlled by some form of superintelligence. This craft or planet will be in the shape of a gigantic sun, and it's people will be able to assume any shape they like."

In 1980 he predicted that Carter would be re-elected (Reagan would not even be a candidate), and that after seven hostages died in Iran, the rest would be rescued by Marines and Khomeini would fall from power.

This is the man you chose to tell your readers about the "technology of psi"? If readers of *Analog* care to read a detailed account of how Vaughan miserably failed a simple test of his ESP ability, they will find it in the Summer 1981 issue of *The Skeptical Inquirer*. This is published by the organization that Vaughan cruelly maligns in his article. It is the only periodical that surveys the current psi scene from a rational perspective. The address is Box 229, Central Park Station, Buffalo, NY 14215.

MARTIN GARDNER

The biographical sketch of the author, like all such sketches on articles, is the author's own (funny how nobody has ever questioned one when the author was in a "legitimate" field) and is not necessarily inconsistent with your version—he did not claim to be a perfect *predictor, but only the most accurate in a given file.*

If you can look past your emotional reaction to the article, you may notice that the essence of what it does is to describe some of the experiments that have been done, and give a bibliography where interested readers can follow the claims up and draw their own conclusions. I credit them with the intelligence to do that, and nowhere in or around the article did I express a judgment for or against the validity of the author's claims. I do not believe that "responsible science" means saying, "We're not going to talk about this or tell you where to read about it because CSICOP says there's nothing worth reading." The case is not that one-sided or closed. I would not encourage readers to take the word of Alan Vaughan, Martin Gardner, Stanley Schmidt, or anyone else as beyond dispute.

Dear Mr. Schmidt:

I have some doubts about the claim for "Fact" in the November '84 issue. I would expect to find a self-congratulatory article like "Toward a Technology of Psi" on the "science" page of the *National Enquirer*, with the banner headline "Scientist confirms amazing (astounding etc) psi talents."

The author omitted the most important qualification for the observer of positive psi effects, mainly gullibility, seasoned with a large dollop of rationalizing naiveté. As the cold, rigid, egoistic observer usually recognizes and exposes the artifacts employed by the psychic performer, it is hardly surprising a practicing psychic would prefer not to be evaluated by a realist.

I am personally distressed that an article praising the psychic successes of vested self interest groups such as SRI received legitimate recognition in *Analog*. Such subjects should be subjects of editorial comment, as they were in the Campbell days. I remember the Dean machine, the Hieronymus machine, and other flights of fancy John was enamoured of. And I read many good fictional stories written concerning the possibilities of the devices, real or not.

But I don't remember his ever saying that those devices actually existed and performed per claim. As I recall, he lamented the lack of professional examination of the devices by qualified objective technicians.

As it happens, the SRI techniques and the SRI personnel conducting the very tests so highly praised in *Analog* have been evaluated, and found wanting, in the pages of the *The Skeptical Inquirer*, the publication of the Committee for the Scientific Investigation of Claims of the Paranormal.

The Skeptical Inquirer is actually a depressing document to read for a period of time, as it details the incredible

lengths humans will go to to delude themselves. I bet archeologists have unearthed curiously twisted objects, purpose unknown, but were really used as "spoons" by con-Neanderthals to demonstrate what is currently referred to as "spoon bending." Uri the Axe probably made a good living with his act, as his descendant does today.

Oh shit. I just flashed on Telzey. You have to believe in psi, don't you. Could you please leave the flights of fancy to the editorial pages? I would hate to see "Fact" articles on miracles, or witches, or demons, or the Bermuda triangle. In fact, why not leave the twaddle to the *National Enquirer*? They handle it the way it should be handled, aimed as they are to the section of the population that's "a few bricks shy of a full load."

I would not like to see *Analog* get contaminated by the perversions of the intellect demonstrated by the *NE* and the others. And, another fact. That article would NEVER have appeared in Isaac's magazine. As "fact," or fiction. You might consider a science article referee for articles in the pseudoscience fields, as you are too close to the subject to be objective.

PAUL J. BURKE

Palmdale, CA

1. Much as I might like to claim credit for at least some of the Telzey stories, I can't. They were written by James H. Schmitz, as a simple check of even one byline would have told you.

2. I doubt that even he "believed in psi." I don't know how the idea that authors have to believe in everything they write about got started, but it's a long way from true.

3. Your own prejudices are getting in the way of accurate reading. I did not endorse the claims in the article; all I did was allow someone who has worked in the field, space to tell something of what has been done, as he sees it. If you want to know what's really *going on, and what, if anything, it means, you'll follow up some of his sources—as well as* The Skeptical Inquirer. *Like it or not,* both *parapsychology researchers and their debunkers tend to be human beings, with axes to grind and other human foibles.*

Dear Stan,

In the Halloween edition of 1980 (*Analog* Vol C, No. 10, page 44) you had the courage to publish a speculative article of mine—"The Physics of Haunting." The thrust of the article was that ghosts, poltergeists and other types of haunts seem clearly to obey the known laws of physics . . . even before those laws were discovered. Physics concepts of energy and symmetry were used to deduce that, if the human "energy body" or "soul" exists, it might be composed of a not-yet-identified type of energy with a mass-equivalent of between 6 and 20 grams.

Readers of that article inform me that Dr. Duncan MacDougall (among others) had weighed dying human volunteers and had reported his experiment in the 1907 editions of *American Medicine* (April) and the *Journal of the American Society for Psychical Research* (May).

A follow-on article of mine has now been published in *Theta* (Vol 12, No. 1, 1984 Spring, page 12). Some fascinating data reveals a 20 gram plus or minus 8 gram unexplained weight loss at the "moment of death," his data also suggest the existence of two energy bodies in each of two dying volunteers and hint at a possible case of temporary reincarnation; and systems research implies a 72 percent probability of the disincarnate energy body's being alive . . . although possibly of considerably

lower intelligence level than when incarnate.

Both MacDougall's results and mine should be investigated by others to confirm, deny or modify them as appropriate. Without comparison to statistically significant experimental data from several sources, the validity of results to date remains questionable.

But those results *are* intriguing!

DR. DONALD GILBERT CARPENTER
Calhan, CO

Dear Dr. Schmidt:

As a long time reader of *Analog* and *Astounding* (over 40 years), I am acustomed to varieties of viewpoints and opinions by writers. However, I have not previously encountered any story that raised my hackles as much as "Friendly Environment" by W. R. Thompson. I will give Thompson credit for being a good writer, and telling a story well, but his attitudes need some cleaning up.

Thompson lumps together all people who are against the progress of SCIENCE as environmentalists, specifically "Verdants." On page 94, he says: ". . . They'll eat food grown with synthetic fertilizers and pesticides, they'll buy cars made from metals we mined from the asteroids—and then they'll plunk their healthy, well-fed butts into those cars and drive to a rally against 'dehumanizing' science." (Even today, what other food is available except in a few places where organically grown foods are to be found?) Scientists, on the other hand, must be scrawny and underfed, eating only synthetic proteins and other foods, riding bicycles because they cannot afford those fancy cars.

On page 95, he states: "Hell, look what asteroid mining has done. It's ended resource depletion on Earth, plus strip-mining and the pollution from ore-processing plants." We don't yet have the asteroid mining, but we do have the resource depletion, which is the root of the environmentalist points of view. Incidentally, it is not the scientists who are doing this to the Earth, it's the exploiters, who deplete resources, strip-mine and process ores for profit. Thompson recognizes this on page 108, when he says: "It only required being explicit about things in a dollar-and-cents way. This is something 'everybody knows.' "

On page 98, Thompson says: "Too much had been at stake; humanity's survival depended on the development of space." Why? Because of resource exploitation, pollution and overpopulation, that's why. All of which are things presently being addressed by environmentalists.

His crowning insult against environmentalists, and perhaps his greatest mistake, is on page 102: "The leaflets and pamphlets were confused and virulent, and their shabby intellectual content seemed to be reflected in cheap printing and atrocious grammar." I guess we don't read the same stuff. My experience with material published by environmentalists has been quite the opposite. Many of them are not only scientists, but writers of high quality material. As examples, I can mention Aldo Leopold, Joseph Wood Krutch, John Muir, Rachel Carson and many others. The shabby intellectual content is found in Thompson's story, not in the writings and publications of environmentalists.

Thompson does at least admit that "the environmentalists are basically decent," which is damning with faint praise. I had marked a half dozen more passages, but enough is enough.

And for you, Dr. Schmidt, as Editor, you owe your readers better editing than

you gave that story. You should have rejected it out of hand, or at least discussed some of the obvious points in which the writer is apparently ill informed, misinformed, or just plain ignorant. By the way, I think I remember reading that you are a backpacker. If this is true, then double shame on you!

ROBERT W. GAIL

Burns, OR

And with great weariness I say again, for about the seven millionth time: THE VIEWS EXPRESSED BY THE CHARACTERS IN A STORY ARE NOT NECESSARILY THOSE OF THE AUTHOR!! Furthermore, they are not necessarily intended to represent those of every member of any group to which the characters belong. As a rather ardent environmentalist myself, I would not have been willing to have the Verdants' views represented as those of "all environmentalists"; I thought it was sufficiently clear that the Verdants were a specific group *of somewhat misguided environmentalists, and I'm sorry if it wasn't. But the "lumping together" you complain about is yours, not the author's or mine. Of course there has been some excellent writing by environmentalists, but you're only listing the cream of the crop (and I could easily and cheerfully extend your list myself). But, like any other movement, this one has also attracted a lot of disciples who didn't really understand what they're following, and if you haven't seen the kind of pamphleteering the story described, you've just been lucky. And I will* not *say that the characters in stories we print, even characters claiming to belong to groups which I also belong to, may not express views which I happen to disagree with. If that's really what you're suggesting, I suggest you think Real Hard about the implications.*

Dear Stan,

So far in the discussion of reading, nobody has mentioned a problem specific to the "pattern recognition" system, though Bishop mentioned poor spelling as a result. ("Axes, Saws, and Alphabets," *Analog*, February 1984) I worked for a time with an electrical engineer who had learned to read via PR, and his secretary would bring his letters over to me to decipher before she tried to type them (because I was the resident technical writer and the engineer got angry when questioned). He didn't just misspell; he inserted totally wrong words, as long as the "pattern" was similar to the one he wanted. "Electron" might be rendered as "election," "valence" could become "variety," "distribution" would be "distinction," "connection" might be "concentrate," and so on. (I might add that this was in the days before small companies had Dictaphones—some small companies don't have them now, for that matter.) This man was purely and simply not communicating. He could obtain information from his own reading; he was totally unable to pass this information on to anyone else. He didn't stay long with the company, but he's probably still puzzling people somewhere in the U.S.

ROBERT COULSON

Hartford City, IN ■

● As soon as everybody declares that a device is "perfected," you'd better start selling your stock in that company.

Kelvin Throop III

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a calendar of analog upcoming events

10-12 May
CONJURATION 2 (Oklahoma SF/Fantasy conference) at Camelot Hotel, Tulsa, Okla. Guest of Honor—Mike Resnick, TM—Ed Bryant, Artist Guest of Honor—Robert Daniels. Registration—$9 until 7 April 1985; $11 for three-day passes, $5 for one-day passes. Info: Patricia Benton, Box 690064, Tulsa OK 74169.

10-12 May
MARCON XX (Central Ohio SF conference) at Quality Inn, Columbus, Ohio. Guest of Honor—Larry Niven. Registration—$18 until 15 April, then $20 (attendance limited to 750). Info: Marcon XX, Box 14078, Columbus OH 43214.

11 May
50th Anniversary SF & Fantasy Showcase at Los Angeles, Calif. honoring the 50th anniversary of LASFS. Art/memoribilia exhibition, auction, food, etc. Tickets $20 (adult), $10 (12 and under). Info: LASFS, 11513 Burbank Blvd., North Hollywood CA 91601.

17-19 May
CONQUEST 16 (Missouri SF conference) at Howard Johnson's, Kansas City, Mo. Guest of Honor—George R.R. Martin, Fan Guests of Honor—Buck & Juanita Coulson, TM—Algis Budrys. Registration—$14 until 15 April, $16 at door. Info: Box 36212, Kansas City MO 64111.

24-26 May
V-CON 13 (Vancouver area SF conference) at Totem Residence, University of B.C., Vancouver, B.C. Ghost GoH—H.P. Lovecraft, Fan Guest of Honor—John Berry. The bizarre, the macabre, and the supernatural in SF. Registration—$C18 until 23 May, $C20 at the door. Info: V-Con 13, Box 48478, Bentall Centre, Vancouver BC V7X 1A2, CANADA.

24-26 May
TALLY CON 4 (Western Florida SF conference) at Tallahassee Hilton, Tallahassee, Fla. Guests of Honor—L. Sprague and Catherine Crook de Camp. Registration—$12 until 1 March 1985, $15 thereafter. Info: The Grinning Gremlin, 824-C West Tharpe Street, Tallahassee FL 32303. 904-385-1518.

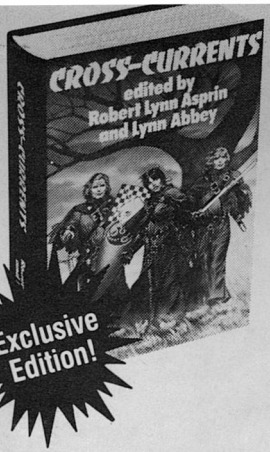
24-27 May
BAYCON '85 (San Francisco area SF conference) at Red Lion Inn, San Jose, Calif. Guest of Honor—David Brin, Artist Guest of Honor—Michael Whelan, TM—Richard A. Lupoff. Registration—$30 until 1 May, $35 at door (one-day passes $15). Info: Box 70393, Sunnyvale CA 94086.

24-27 May
COSTUME CON 3 (SF/Fsy costuming conference) at Columbia Inn, Columbia, Md. Info: GCFCG. Inc., Box 638, Columbia MD 21045.

31 May-2 June
TEXARKON IV (Arkansas area SF conference) at Master Host—Tall Timbers Inn, Texarkana, Ark. Guests of honor—L. Sprague and Catherine Crook de Camp, Artist Guests of Honor—David and Jean Martin, TM—Bob Asprin. Registration—$10 until 1 May, $15 at the door. Info: Route 4, Box 708X, Texarkana AR 75501. 501-645-2459.

30 August-2 September
NASFiC 1985 (North American SF Convention, officially The First Occasional Lone Star SF Convention & Chili Cook-off) at the Hyatt Regency Austin and Palmer Auditorium, Austin, Texas. Guest of Honor—Jack Vance, Artist Guest of Honor—Richard Powers, Fan Guest of Honor—Joanne Burger, TM—Chad Oliver. Registration—attending $35 until 31 December 1984, then $45; supporting—$15. Info: NASFiC, Box 9612, Austin TX 78766.

—Anthony Lewis



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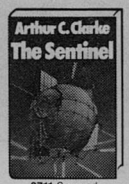

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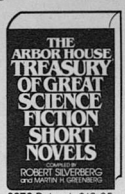

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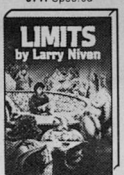

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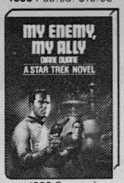

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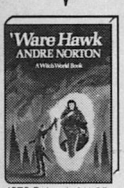

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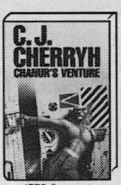

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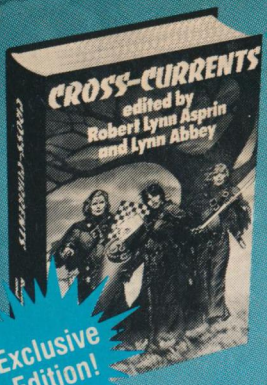

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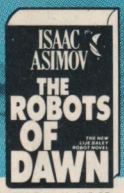

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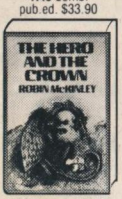

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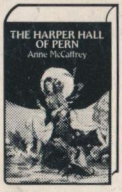

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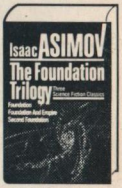

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