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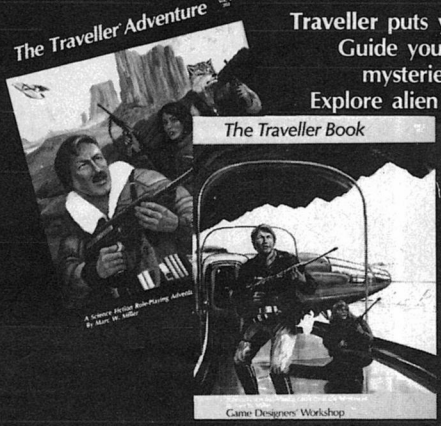

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Editorial

A CARROT FOR THE TEACHER

Stanley Schmidt

Whenever I find myself seemingly in agreement with a prominent politician, I take a long hard look at both my reasoning and his. A recent case in point is the president's pushing "merit pay" for teachers (the concept, not the money). It sounds lovely, in principle. In education or any other field, I'm all for rewarding a job well done and less keen on rewarding one not so well done.

But, of course, the president's primary interest is *not* in Giving Good Teachers Their Due Because They Deserve It. Ignoring the cynical suggestion that his *primary* purpose is to find a good bandwagon to ride to reelection, what he's getting at is the pragmatic goal of using merit pay as a management *tool* to make teachers teach better—just as a carrot dangled in front of a horse is supposed to attract it forward.

Will it work? It may, to some extent and in some cases. But *why* will it work, when it does? There's a very interesting assumption buried in the theory which needs to be brought out and scrutinized. What it is I will return to shortly; for the moment, I'll leave it as an exercise for the reader.

Meanwhile, let's take a brief look at

the other side of the merit pay controversy. Teachers' unions, in general, are against it. Why? It would be very interesting to see how opinions are divided *within* the unions, but that's not the sort of information they're likely to publicize. A cynic who agrees with the president might say that teachers don't want to be accountable for how they do their jobs. No doubt there are some who feel that way. On the other hand, there are others who are genuinely and primarily concerned with good teaching but who see in the merit pay proposal a threat of political manipulation. Who, they wonder, decides what teaching is "meritorious"?

It's an intriguing and highly important question which has seldom been adequately answered. I can understand the suspicions of those who, even if they like the *concept* of merit pay, doubt that that's what they'll get in practice. I have been in at least one situation where teachers' raises were supposed to be based partly on merit, but I knew several teachers who consistently received outstanding evaluations from both their chairmen and their students, yet *never* got more than the "standard" raise. The only "merit" raises I actually knew of went to people who did *not* seem particularly well regarded, but who actively campaigned for extra money.

This is not to say that the system for determining raises was corrupt; but it does strongly suggest, at least to me, that it was fallible. All real systems are, of course, but my impression (admittedly somewhat subjective and based on limited data) was that this one had a conspicuously low success rate. I suppose that's not really surprising—a professor's chairman and colleagues, in general, have remarkably little real basis for judging his or her teaching effectiveness, and top administration has even less. His most *meaningful* evaluations might well come from his former students; but getting them is difficult, they would at best measure *past* performance, and I don't think the educational establishment as a whole is ready for the idea anyway. Most systems which seem likely to be adopted for judging teaching merit are likely to suffer from similar weaknesses. Without the greatest of care in their design and application, they are likely at least to make too many mistakes and result in too many injustices to earn real respect from the teachers working under them. And without real respect—without teachers' believing that merit and nothing else will truly and consistently be rewarded—the system is not likely to do much for either morale or effectiveness.

How about that more sinister worry, that merit pay could become a political weapon—e.g., a way to encourage the teaching of "Reaganomics" (or any other doctrine being pushed by whoever is currently in office) and suppress opposing views? Well, it *can* happen. It doesn't *have* to, of course; a well-meaning and careful government might resist the temptation—but the possibility has been demonstrated in many times and places. And please note that a government which does use this kind of control of teaching as a propaganda tool is likely to be sincerely indignant at any suggestion that it could do such a thing. It will

not see itself as an agent of evil, but it (or at least some of its members) will genuinely believe that what it's doing is For the Best.

And don't you just love other people who know better than you what's Best for you?

Regardless of how merit is construed, it is quite easy to conceive of its being interpreted as something other than what good teachers know it is: educational effectiveness. Even teachers differ, sometimes hotly, on *exactly* what *that* is (and quite a few of the "disputants" are right), but there is a clearly recognizable danger that if officialdom defines "merit," teachers may accept that definition for the sake of earning the money—that they will go for the carrot, by whatever means it takes, rather than educational quality.

But, you may object, this assumes that they are more interested in money than in good teaching. Right—but so does the original "merit pay" proposal. That is, in fact, the hidden assumption I mentioned earlier.

Merit pay, as a management tool, is nothing more or less than a device for getting teachers to do things the way someone else thinks they should. This will lead to *good teaching* (assuming, for the sake of argument, that such a thing is objectively definable) if and only if two further assumptions are true:

1. That what the managers *want* teachers to do actually coincides with what they *should* do.
2. That more money is important enough to the teachers that they will willingly suppress their own views of how they should teach, and do things the managers' way to get it.

It works just fine—as long as *all* those things are true. (And if you can take it for granted that they necessarily are, there's a bridge near here I'd like to sell you. . . .) As long as the things being rewarded by merit pay actually coincide with "good teaching," *and* a teacher is either motivated primarily by greed or has an educational philosophy which is in full accord with the official line, there's no problem. The teacher tries very hard to do topnotch teaching, and receives top dollar in return.

Problems arise only when there is a divergence between the kind of teaching that is being rewarded and the kind a teacher thinks he should do—*any* divergence. Then the teacher must make a choice: to do it the way he thinks best, or the way that will earn the most money. From the government's point of view, this is as it should be. The whole point is to make sure teachers do it The Best Way.

The assumption is that the government definitively *knows* The Best Way.

Sound familiar?

If most teachers facing this choice (and all will face it) choose money over personal judgment, the government (or whoever is paying the bills) does have a powerful tool for getting what *it* considers quality—which may or may not be in the best interests of the students or the country or humankind. Teachers are supposed to be hired—with some care—for training and experience which have made them more knowledgeable than the average bureaucrat about what *works* to help people learn. And what

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works for one may not be what works for another—or what the funding agency prescribes.

A crucial question in all this is whether teachers—or how many teachers—*will* place more importance on earning a bonus than on doing the best possible job as judged by their own professional consciences. And this question threatens to stir up some large and surly sleeping dogs whose importance goes far beyond formal education.

Most of society, in this region of time and space, is pretty thoroughly pervaded by the implicit assumption that money is a measure, adopted by the mutual consent of society, of how valuable it finds goods and services. I submit with all due respect that while this may be true—that the prices things command are a pretty good gauge of their values as *perceived* by society—that those perceptions of value can be skewed. What society is willing to pay a great deal for is not necessarily what it *needs* most in any long-term, fundamental sense. Consider, for example, a medical technologist and a famous baseball player. What the baseball player does is not of life-and-death significance to anyone; what the medical technologist does *is*—to many people, every day. Yet the baseball player is paid *vastly* more.

It seems to me that people in general tend to classify roughly into two basic philosophical categories when it comes to making a living:

1. Some have as their primary goal some form of personal happiness or satisfaction, defined in terms of things they like to do. In choosing a vocation, these "Type 1" individuals find out what they like to do and then look for a way to make a living at it—not necessarily the most lucrative living, but one which will pay necessary bills while letting them spend as much time as possible doing things they enjoy or find otherwise psychologically rewarding.
2. "Type 2" people view maximizing income as a primary goal. Perhaps assuming that money can buy whatever else they might want, they set out to make as much of it as possible, and look for something to do which will have that effect. The nature of the activity is less important than how much money it produces.

"Type 2" seems to me rather prevalent in our culture. I'm not sure to what extent this reflects a population distribution of intrinsic personality types and to what extent it's culturally conditioned, but I suspect there's a good deal of the latter. You can hardly watch much television or read many newspapers without being heavily bombarded by messages extolling the virtues of wealth.

The fundamental *Weltanschauung* of each of these categories is so different from the other that Type 1 and Type 2 people may have real trouble understanding each other. Someone who is wrapped up in a science or art, barely subsisting but loving it, may be literally unable to conceive of devoting his life to earning money *per se*, if it means doing things he doesn't like. Someone who has made a fortune by doing so may be equally unable to understand

why an artist would persist in squandering his time on activities that don't show much profit. Each is likely to imagine that the things which motivate him must motivate everybody.

The suggestion that merit pay will solve education's problems is essentially a product of Type 2 thinking. But the teaching profession, at least partly because of the pay levels currently under widespread criticism, does not attract many Type 2's. Perhaps that's just as well; I'm not at all sure many Type 2's would make good teachers. It's not inconceivable: if merit pay really correlated closely with significant standards of performance—if one *could* expect to make lots of money by teaching well and not by teaching poorly—some Type 2 personalities just might be inspired to become good teachers. If that happened, I could admire them as such and not worry about *why* they became good teachers. What matters is the effect (a different sort of "bottom line").

But I think a person with that kind of motivation is *less likely* to become a really fine teacher than one who is in it because he likes it so much and considers the job so important that he'll go all out to do it right even for modest pay. For that reason, I think I'd just as soon see teachers' pay remain relatively modest—and I say that even though I have lived on a teaching salary and may someday do so (voluntarily) again. As long as teachers are mostly "Type 1," merit pay may not be a very effective means of political manipulation—but then, for the same reasons, it may also be less of a motivator toward quality than its most avid proponents suppose.

Still, if conscientiously applied, it may have some value. "Relatively

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modest'' pay is one thing; ''penurious'' is another. There's a limit to how self-sacrificing even a fanatical Type 1 can or should be, and in many places teachers are currently paid so little that they must literally choose between staying in the profession and feeding the family. So many teachers who can get better-paying jobs do so, even if they'd rather not—and you'd be surprised at how many of those who stay in teaching only went into it because they couldn't make it at something they liked better.

I don't believe teachers like that do anybody much good, and I think the good, dedicated ones might well resent being paid no more than relative incompetents. I don't believe paying them enough to live in reasonable comfort would *hurt* anybody's teaching, so I'd like to see pay levels increased appreciably throughout the field. And merit bonuses, very carefully given, just might have some merit—perhaps more as psychological reinforcement than anything else. Even a teacher who is not so interested in money that his principles can be bought is likely to appreciate extra pay for extra effort. And if *basic* pay is high enough to make ends meet comfortably, that should reduce any temptation to go after the bonus even when the requirements seem wrong.

So I'd like to see it tried—but with a full disclosure of *how* it's done, and with a full understanding of the limitations and possible pitfalls. Any attempt to measure merit will be imperfect, but that doesn't mean nobody should try to do it. Without some form of evaluation, we must settle for what we get, with no idea whether it's any good or not. To shirk quality control just because it's difficult and can be abused is to shirk the essence of the job. The fact that abuses are possible simply means that safeguards must be built into the system. The more potential problems we can identify, the more we can guard against—and the result just might be something that does encourage worthwhile performance often enough to do some good.

Meanwhile, how about throwing in some carrots that would appeal even to pure Type 1 teachers? Like encouragement and opportunities to keep their own skills sharp, and a hefty dose of freedom to teach in the way *they* find most effective—as long as it works. ■

● Men make their own history, but they do not make it just as they please, they do not make it under circumstances chosen by themselves, but under circumstances directly encountered, given and transmitted from the past. The tradition of all the dead generations weighs like a nightmare on the brain of the living.

Karl Marx

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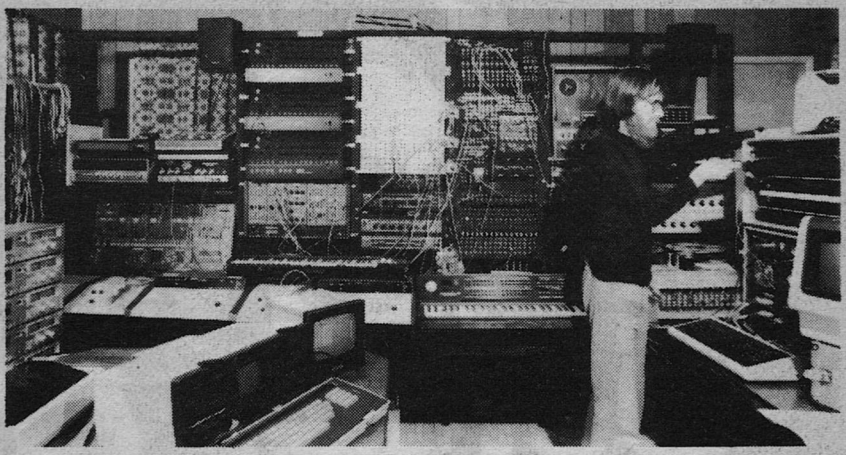

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THE INTEGRAL TREES
Conclusion
©V. DiFate '83

Larry Niven

All the tribes of the integral trees had descended from a common stock with an almost forgotten purpose. Not quite everyone had forgotten—but now they had purposes of their own.

Levoy's Star—"Voy"—is the ashes of an ancient supernova, a cold neutron star of half a solar mass.

A gas giant planet circles Voy at four times the Earth's radius. Goldblatt's World—"Gold"—orbits within, and continually leaks its atmosphere into, a gas torus surrounding the neutron star.

The thickest part of the gas torus has the appearance of a green-tinged smoke ring: clouded by water droplets, and green with life that has been evolving in free fall for a billion years. The Smoke Ring is illuminated by a G-type companion star, and includes rock and water and soil lost from Goldblatt's World during its first catastrophic approach to Levoy's Star. Its volume—the region where the air becomes thick enough to breathe—is around thirty times the Earth's.

Five hundred years ago, men entered the ecology via the seeder ramship Discipline.

Sharls Davis Kendy *(once a Checker for the State on Earth, now a computer program for* Discipline*) remembers little of what must have been a mutiny. He knows only that he abandoned his crew to their fate within the Smoke Ring. He and* Discipline *have been waiting in the L2 point outside Goldblatt's World for over five hundred years.*

They live. Somebody has been operating a Cargo and Repair Module; Kendy can see the occasional flash of an oxygen-hydrogen rocket motor. He's seen no other sign of a developing civilization.

The hunting party that climbed from Quinn Tuft had reached the median of Dalton-Quinn Tree, and were engaged in battle with warriors from the out (spaceward) tuft, when the tree came apart. **Glory** *was lost and* **Jiovan** *was killed, and what remains of Quinn Tribe was lost in the sky.*

Cast into free fall, the tiny remnant of Quinn tribe reached a cotton candy jungle several miles in extent: Carther States. Their safety evaporated when copsik runners used an ancient starstuff relic, the carm, to capture several citizens of Carther States, and all of Quinn Tribe save for **Clave** *and* **Merril.**

London Tree is a mobile integral tree. The citizens have kept copsiks (slaves) for generations. They've had practice. Their first move was to scatter Quinn Tribe throughout London Tree.

The Grad *was taken to the median, the Citadel of* **Klance the Scientist** *and the docking for the carm. The carm's rocket motor is what makes London Tree mobile. The Grad's new status may be illusory: he's still a copsik. He's been trying to learn how to operate the carm.*

Gavving *was set to running the bicycle gears that raise an elevator to the median.* **Jayan**, *carrying Clave's child, joined the "women who house guests."* **Alfin** *has been set to tending the treemouth crops, as he did in Quinn Tuft.*

Jinny *and* **Minya** *served unwillingly in the treemouth for a time. That service made them the property of any male citizen. Minya now carries a child who may or may not be Gavving's. She has joined the "women who house guests." The Grad managed to see her long enough to tell her that he has access to the carm; that any revolt will fail unless the rebels can take the carm; that if*

anything strange happens, she should grab who she can and go up, *to await rescue via the carm.*

Clave and Merril are with Carther States, and Carther States has declared war. The jungle giants are strange, tall even by Smoke Ring standards, and fragile-looking; but they carry crossbows, and London Tree has raided them long enough. The jungle, like other plants, has a way of moving.

The Grad sees Carther States swelling like a great green balloon in the sky. Before Klance the Scientist can use the carm to move London Tree away, the Grad kills him, binds **Lawri** *the Scientist's Apprentice to a chair, and takes over the carm.*

The carm is still moored, and surrounded by London Tree Navy. He can't fight. But he is in a fine position to watch through the carm cameras as Carther States' fleet of jet pods approaches.

CHAPTER 18: THE WAR OF LONDON TREE

Clave was being left behind. The Carthers had judged him a novice, and he was: he hadn't known how to choose among these strange pods. They had let him pick a slow one. He'd flown past the trunk; his path was curving back now. He would be among the last half-dozen to land.

Lines ran along the trunk of London Tree, and wooden boxes were rising toward the center from both ends. Clave saw both boxes break open almost simultaneously, spilling men in blue, eight to a box. The copsik runners semed to know what they were about. They rapidly oriented themselves and fired small jet pods to send them toward the midpoint of the tree, on the eastern face.

Toward the carrier. Twenty-odd copsik runners already surrounded it. The flame at its tail had died, for whatever that might mean.

The Carthers had passed the trunk in a gust of jet pods. Now they were returning, coming up on the western side of the trunk, drastically spread out. Feathered harpoons flew from the copsik runners' long footbows. The Carther warriors sent crossbow bolts among them. They outnumbered the enemy almost two to one.

The jungle was tremendous, a green world passing less than a klomter away. Clave had wondered if it would actually hit the tree, but it seemed to be going past. The steam jet had stopped firing. The jungle trailed a curdled line of cloud and a storm of birds trying to catch up, and two dark masses: Lizeth's and Hild's clusters of twenty jet pods each.

This close to the tree, the curve of the trunk hid the ancient carrier and its mooring; but both gusts of enemy reinforcements seemed to be converging on the carrier. They would know its value too. They flew behind a thicket of feathered harpoons.

The jet from Clave's pod died away.

Curses ran through his mind while he clambered around the pod to put it between himself and the harpoons. He was still approaching the trunk. Others were there first. Carthers were using lineholds about the clustered buildings to dodge the feathered harpoons, or tearing up sheets of bark for shields. The copsik runners preferred to fire on them from

the sky, where their limbs were free to work their huge bows.

Anthon and a dozen warriors were firing at the carrier, using the curve of the trunk as cover.

Merril's pod struck a wooden hut with Merril behind it. She'd used the pod as a shock absorber: good technique. Some of the copsik runners were trying to reach that building. Merril shot two from behind the building, then abandoned the shelter when the rest came too close.

Something valuable in that building? The copsik runners seemed to want it. Clave put an arrow among them, and thought he hit someone's foot.

They wanted the carrier more. Clave could see it now: they were all over it, hanging on the nets and the bark.

Most of the Carther warriors had reached the trunk. Clave would touch down inward from the battle, presently. For now he could only watch. From the chaos of battle, patterns began to form:

The copsik runners were outnumbered. They hung back, for that reason and another. In close work they couldn't use the bows. They had swords, and so did the Carthers; but the taller Carthers had more reach. They won such encounters.

The copsik runners had small jet pods, the kind that would grow on an integral tree. They preferred to stay in the sky.

Clave watched Carthers leap into an eight-man gust of blue ponchos. The copsik runners used their jet pods, left Carthers floundering in the sky behind them, and fired back with the footbows. Then two Carthers were among them, slaying, and two more joined them. In free fall the copsik runners fought like children. The Carthers robbed the corpses of their jet pods.

Clave drifted, and Carther States was winning without him!

In along the trunk, a wooden box was rising slowly. It spilled reinforcements: six blue-clad footbowmen and a bulky silver creature. There was a terrible familiarity to that shape . . . but they wouldn't arrive for a kilobreath yet.

A copsik runner spotted Clave, a sitting target. He carefully fired a harpoon through Clave's pod, then moved in along the trunk. He'd have a clear shot when Clave came nearer. Clave fired at him. No good; the copsik runner dodged and waited. Clave could see his grin.

The grin vanished when Merril shot him from behind. The bolt protruded below the kidney. He could have fought on . . . but his face was a silent scream; he clawed at the bolt, then went into convulsions. That poison-fern brew must be terrible stuff.

The pod bumped wood with Clave behind it. He turned it loose, clutched bark and made his way toward Merril with his crossbow ready. He saw blue against storm-cloud sky, fired a bolt through one man, and drew his harpoon as the other came at him with a sword.

The copsik runner came too fast. Clave batted him in the face with the crossbow handle, and as he recoiled, stabbed him in the throat.

Merril was making her way around the curve of the bark. He followed her. She stopped and crouched a moment before he saw the carrier, outward along the trunk. Copsik runners were all over it.

He moved up beside her. She said, "All right, why aren't they killing us with that scientific thing?"

"Good question." Clave watched Anthon's team launching crossbow bolts from around the curve of the wood. The carrier's guardians fired back, not very successfully.

He said, "Forget it. They *aren't* using it. They *are* using those wooden boxes to get reinforcements. Let's—"

"Cut the lines."

"Right."

Two lines as thick as Clave's arm ran parallel along the trunk. The last box was on its way in, nearly gone from sight. Another box must be rising. Clave and Merril made their way to the nearest line and began to chop at it.

Six men and a silver thing were coming into footbow range. Clave and Merril set bark sheets to protect themselves. Clave stared at the silver man. It was as if he were trying to remember a nightmare: a man made of starstuff, with a blank ball for a head. Clave fired at it until he saw a crossbow bolt strike and bounce away.

There were feathered harpoons in his shield and Merril's. Clave saw three tiny things like thorns strike her shield in a line aimed at her bare head.

He yelled. She ducked. Thorns spat into the trunk. She said, "Oh. The silver man."

"You know him?"

"Yes . . . keep chopping . . . he was with the copsik runners in Carther States. We don't have anything to breach that armor."

Another box had come into sight when the line parted. That box began to drift. Men spilled loose and flew in

curves, pod-propelled, making for the trunk. They seemed too far in to do anything useful. The other line had gone slack. Merril said, "It's a loop. We don't have to cut the other one."

"Then let's get out. There was a cable running outward—"

"No. Let's go join the victory party. Quick, or we'll be left behind."

"Victory—?" Then Clave saw what she meant.

Green-clad warriors clustered round the carrier. Some were crawling into the doors. Men in blue floated about it with the looseness of dead men. Live copsik runners had retreated around the curve of the trunk to wait for reinforcements.

It looked like the war of the carrier was over. But other copsik runners were coming too near. Clave had made a lucky shot: there were five now, plus the silver man.

Ordon died with a bolt peeking through his chest. The Grad saw his face through the carm window . . . but even if Ordon could have heard him, there was nothing left to say. He turned back to the yellow display.

He had five floating rectangles in the bow window: aft view, dorsal, ventral, and both sides. He caught glimpses of men in blue, men and women in green; impossible to tell who was winning.

Three Navy men moved into the cover of the drive motors. The Grad touched blue dashes. Flames burst near them. They yelled, threw themselves clear, floundered to orient themselves . . . and one had a bolt through his hip.

Lawri screamed, "Murderer!"

"Some of us don't like being copsiks," the Grad said. "Some of us don't even like copsik runners."

"Klance and I never treated you with anything but kindness!"

"That's true enough. What have you done for the rest of Quinn Tribe? Did you forget that I had a tribe?"

"Your tribe is dead! Your tree is torn apart! *We* could have been your tribe, you treefeeding mutineer you!"

The Grad had no particular urge to stop her mouth. Lawri's accusations only echoed those in his own mind. He had made his decisions.

So he spoke without heat. "Do you know what's been happening to our women? Gavving might have had permission to visit his wife thirty-odd days from now, but any male citizen had rights to her any time he likes. Now she's pregnant. She doesn't know who the father is, and I don't either."

Lawri said, "They'll kill you. Shall I tell you what the penalty is for mutiny?"

"Feel free, but I notice the line of argument has shifted."

She told him anyway. It sounded dreadful enough: good reason to keep the doors closed.

He had found the infrared display. It showed him red dots in along the trunk. He cut the infrared out and recognized Clave and Merril, and Navy chasing them . . . including what had to be a dwarf in a pressure suit.

Clave and Merril! Then the Carthers were actually on his side. He had wondered.

The green-clad warriors rushed the carm. When the Navy retreated he was able to wrap one in flame, not as a casual killing but as a signal to the Carthers.

I'm with you! For it was Carthers who now swarmed the carm, and Navy who retreated around the trunk.

The Grad opened two yellow lines with his fingertips. He turned to greet the tall, bloody jungle giants.

Gavving was on his feet, held upright by two big men, before he even started to wake up. He said, "What?"

"We need pedallers," someone said.

Four Navy men helped three sleepy copsiks out of the barracks and up through the tuft. Gavving held his temper and Horse took it with typical docility, but Alfin was still protesting as they broke through into sunlight. "I'm the treemouth tender's assistant! Not a treefeeding pair of legs—"

"Listen, you. We're sending men up to the Citadel as fast as we can. We've worked the regular team half to death. You'll take your place and pedal with the rest!"

"And carry out my regular duties too? *I'll* be half dead! What do I tell the Supervisor?"

"You board that bicycle or you'll be telling your supervisor where your testes went. Just before the Holidays, too!"

The copsiks on the platform were sheathed in sweat; it drifted in droplets from their hair; they panted like dying men. The Navy men helped three of them down, wincing at the soggy touch. Other Navy men were boarding the elevator.

Half the sky was textured green.

The jungle! The jungle had come to London Tree!

Only three Navy men remained. One was an officer; Gavving recognized him, and he carried a piece of old sci-

ence, a talking box. The rest had entered the elevator. Gavving was lifted into the saddle. He started pedalling. The elevator rose.

The jungle had attacked London Tree. The jungle was mobile. Who would have guessed? The green cloud was awesomely close . . . and receding.

He should be doing something! But what? Armed men were watching.

The elevator was tens of klomters above him now, and Gavving was gasping. He felt the change before he saw it. Suddenly it was easier to pedal. The grating whine of the bicycle gears rose half an octave. He looked up.

The elevator box was turning, falling. Blue shapes spilled out and made for the trunk. One was too slow. When he reached the trunk he was moving too fast; he bounced away, spinning like a broken thing, and continued to fall. But the box was falling faster.

"Stop pedalling. Hold your places," the officer ordered.

The invaders had cut the cable. Now what? *In takes you east.* The box wouldn't hit here; it would strike further east along the branch, but where? Gavving pictured the massive wooden structure smashing through diffuse cottony foliage. "Officer? Suppose that thing hits the pregnant women's complex?"

"It's under the branch," the man said. "Mmm . . . it could hit somebody, though. Damn, there's the school complex! *Karal!* Move east along the top of the branch and get everyone underneath. Don't miss the examination hut. Docking section too. Then get under yourself, if you're fast enough."

"Sir." A Navy man—wounded, with one arm bound across his chest—darted awkwardly away. Two left.

The officer spoke to his talking box. "Squad Leader Patry here. The enemy has cut our elevator cables. What's your status?"

The answer was almost unintelligible with static. Gavving let his chin droop and his eyes half close (poor exhausted copsik, clearly too tired to think of mutiny) and listened hard. He heard, "Elevators running. We . . . ing troops. Enemy numbers forgarble, repeat forty to fifty. Garble outnumbered. They're gentling us. They garble the carm, but even . . . can't use . . . tethered."

"I see two dark masses west of here."

"Forget them. . . . trouble enough. We are sending more men to the Citadel."

"Patry out."

The Grad recognized the long-limbed woman, Debby, by her long, straight brown hair. The two men with her were strangers. The crossbows aimed at him didn't bother him as much as their fear. They didn't like the carm at all.

He spread open hands to the sides. "I'm the Quinn Tribe Scientist, the only one who can fly this thing. Good to see you, Debby—"

Lawri broke in with, "Feed it to the tree, mutineer! You'd lose us in the sky or smear us all over the trunk."

"—and this is Lawri, the copsik runner."

One snapped out of it. "I'm Anthon. This is Prez. Debby told us about you, Grad. Can we leave immediately? Pile all our warriors on the nets and go? The silver man is coming."

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The Grad said, "We're tied to the tree. Cut those lines and we're free to go. But I don't leave without Clave and Merril, and I think there's time to get one more thing."

He pointed into the dorsal window display. Anthon and Debby very gingerly moved up behind him. All this scientific stuff must be daunting.

"That hut is the Lab. Debby, you'll find some cassettes and the reader inside, on the walls. You remember what they look like?"

Debby nodded.

"Go get them. Anthon, get some warriors to cut the carm loose." He looked into the displays. Clave was towing Merril as he jumped along the bark, his legs serving both while she fired bolts at their pursuers. One Navy man was dropping back, hurt. The silver man came on. The Grad said, "See if you can give them some covering fire."

Anthon said quietly, "You're not the leader here, Scientist."

"Here, *I am*. And I have had enough of being a copsik!"

"Debby, go get that treefodder for the Scientist. Take a team. Prez, get those cables chopped." Anthon waited until they were through the doors before he spoke again. He wanted no witnesses to this discussion.

"Grad, have you fought in war?"

"I captured the carm."

"You? *I* cap—" He trailed off. "Never mind."

"How many are you?"

"Forty or less, now. We won't fit inside, but we can hang onto the nets."

"I want to set the rest of Quinn Tribe free. They're in the in tuft, and I can find them. The carm's got plenty of what makes it go. We've got the small motors for spraying fire. It should be easy."

Anthon was in no hurry to make a decision. Into the silence Lawri said, "He can't fly the carm. I can. I'm the Scientist's Apprentice."

"Why haven't you killed this one?" Anthon demanded.

"Hold it! She's what she says . . . and I did have to kill the Scientist himself. Lawri has a great deal to teach us, if she can be talked into it. She's harmless as long as she's tied up."

Anthon nodded. "She lives, then. But *I* lead Carther States."

"*I* captain the carm."

Anthon stepped into the doors and began to shout orders. He'd let the word pass. *Captain*. He who violated the Grad's orders aboard the carm would be a mutineer!

Carthers chopped at the lines that tethered the carm. Crossbow bolts flew among the blue men who followed Clave and Merril. Those dove for cover on the bark. The silver man came on alone. He wasn't using jet pods. There must be something on the pressure suit itself.

The carm was drifting free.

Lawri spoke in an angry whisper. "They'd kill me, wouldn't they?"

"They don't have my reasons for liking you," the Grad said without overt sarcasm. "Keep your opinions to yourself for a while, if you can. Did you really think a jungle warrior would let you at the controls?"

Clave and Merril and Debby entered like a storm. Debby was gashed and bleeding along the ribs. Merril flew into the Grad and hugged him. "Grad! I

mean Scientist. Good work. I mean, glorious! Can you run this thing?''

The Grad felt huge relief. Let Clave play these dominance games with Anthon! The Grad would captain the carm, and hope Lawri was wrong. . . . ''I can fly it.''

Clave asked, ''Can you find the rest of us?''

''They're all in the in tuft. Gavving's at the top, where we can get at him. Jayan and Minya are with the pregnant women. Jinny and Alfin should be in the Commons. We may have to leave the carm to get to them.''

''Then it's going to work. I can't believe it.''

The Grad grinned. ''So why'd you come? Never mind. Debby—''

''I got these. We had to fight for them.'' Seven cassettes. ''We couldn't find the reader.''

''Maybe Klance had it . . . it doesn't matter. Get into a chair. You too, Clave, Merril, *strap down!*'' He looked into the displays. ''In a few breaths we can . . .''

''What?'' Clave saw the displays floating in the bow window. ''This place is too strange for me. Those pictures make my eyes cross! I . . . Grad, have you got anything to take out the silver man?''

''Not unless he crawls into a motor. That's a starman's pressure suit.''

''Well, he's killing all our allies.''

''That spitgun only puts you to sleep and makes you feel wonderful. Doesn't matter to us, though. They're still out of action. Anthon, good timing. Get into a chair.''

Anthon was panting; his crossbow was on line with the Grad's eyes. ''You waited too long! That goddam silver—''

''Get into a chair and strap down! And tell me how many we've got left.'' The Grad was trying to watch all the displays at once. Carthers were disappearing over the trunk's horizon. Too many floated limp; some were being towed by others who hadn't been hit. The man in the pressure suit was hovering over the carm, firing darts.

The glazed look left Anthon's eyes. He worked himself into a chair. ''We can't hurt him. I was the only one who even got to the carrier. The rest won't come anyway. They're afraid of it.''

''We can't leave them.''

The silver man darted down at the doors. The Grad pinched his fingers together. The silver man shied back as the doors closed in his face, then moved back into view in the dorsal display. Now he was gripping the nets on the hull.

''He's on the carm,'' said the Grad.

''Take off,'' said Anthon.

''*Leave?*''

''We can leave my citizens if we take the silver man with us. I've got spare jet pods coming.''

''Good enough.'' The Grad's fingers tapped. The silver man was still hanging on the nets when the carm backed away from the trunk and started down.

CHAPTER 19: THE SILVER MAN

The laundry vat was a tall glass cylinder. It hung from the underside of the branch, from lines pounded into the black bark over Minya's head. Around it ran an extensive wickerwork platform woven from live spine branches. A layer of rocks beneath the vat supported a bed

of coals. A pipe ran all the way from the treemouth reservoir to supply the water: an impressive achievement, had Minya not been too tired to appreciate it.

Minya and Ilsa stirred dirty clothing in a matrix of foaming water with a paddle two meters long. It took skill and fine attention. Left to itself, the laundry-soup would have foamed right out of the vat, clothing and all. The supervisor Haryet kept popping out to see how they were doing.

Minya wasn't feeling awkward yet, but there was the sense of a guest building inside her. Ilsa's pregnancy looked ludicrous, a bulge on a straight-edge. Like the others, she seemed to have adjusted to her new status with little difficulty. Once she had told Minya, "We know all our lives that the copsik runners might come for us. Well, they came."

A chain of huts ran along the underside of the branch. Most of the women preferred to stay inside. They weren't all pregnant. Some were nursing their erstwhile guests. They all had work: knitting, sewing, preparation of food to be cooked at the treemouth.

The quiet was broken by a hurried rustling.

Then four people burst from the tunnel that led down from the examination hut: Jayan and Jinny, the supervisor Dloris, and a Navy man with his arm in a sling. Karal spotted her, ran to her, gripped her arm. She shied from his wildness.

"You're all right." He was gasping. "Good. Minya. Stay under the branch. Don't let anyone . . . *anyone* else go wandering."

"We don't tend to. We're too awkward. I thought men weren't allowed . . . ?"

"I'm not staying. Minya, it's both elevators and at least one man, they're falling from thirty klomters up and we don't know just where they'll hit. I've got to warn the children in the school complex." He pointed a finger at the tip of her nose. "Stay here!" And he sprinted for the tunnel, wobbling, chest heaving.

If something happens, the Grad had said. Something was happening, all right, but what? Would Dloris know?

Minya guessed where the supervisor would be. She moved down the line of huts and entered the last one as Dloris came through with Haryet. "We've been counting," Dloris said. "Gwen's missing. Have you seen her? Three meters tall and pale as a ghost, with a year-old guest?"

"Not lately. What's happening?"

"Get those clothes out and drying and then put the fire out. Do you have lines? Good. Keep them handy." The two supervisors moved on.

Minya turned to Jayan and Jinny. "Give us a hand. Jinny, we're lucky you were around. We're all together now. Do *you* know what's happening?"

"No. Karal looked scared stiff."

"Is it war?"

"Better stick to our tasks till we're sure," Ilsa said.

They pulled the clothing from the vat in a gelid mass, manipulating it with poles. Some water remained. They inverted the vat, and moved back while the water-glob flowed sluggishly out onto the fire. Live steam didn't rise fast enough in London Tree's feeble tide.

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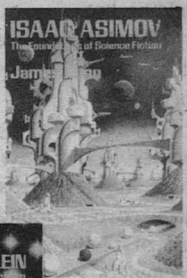

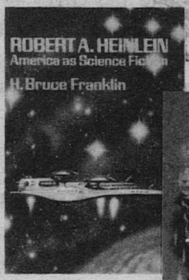

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It tended to expand in an invisible globe, scalding hot.

Minya had never seen that fire go out. Dloris must be expecting something drastic!

They continued to work. They set the laundry in the press and cranked two great wooden slabs together. Water squeezed out around the edges of the wad of clothing, then began to slide downward.

Something smashed through foliage, somewhere nearby.

They froze. Then Minya plunged into the branchlets with Jinny and Ilsa behind. They made their way toward the sound. Minya angled above where she thought it had stopped.

There, a trail of broken branchlets. She followed it down to the broken and twisted remains of what had been a Navy officer. The corpse wore a sword, scabbarded, and a quiver that was still full, though the bow was missing.

"*Now* it's war," Minya said.

"We'll have to kill the supervisors," Ilsa said.

Minya jumped. "What?" It was as if a stone had spoken. "Never mind, you're right. I thought you were . . . I thought you'd given up."

Ilsa only shook her head.

West takes you in. In takes you east. At first the Grad held the bow window pointed straight down. They dropped smoothly . . . faster . . . he swung the carm to point west and fired aft jets to correct as it drifted away from the trunk.

His passengers were rigid with terror, save for Lawri, who was rigid with fury.

They still had a passenger on the hull.

Anthon's voice wanted to stutter. He wouldn't let it. "I want to point out that we could go back to Carther States *now*. We've got the silver man and the carm. These copsik runners don't own anything they value more. We can trade for your copsiks."

That actually sounded sensible. The Grad said, "Clave?"

"Feed it to the tree."

Anthon said, "You want to kill some copsik runners. All right, I can underst—"

"I want to rescue them myself! I am the Quinn Tribe Chairman. They are entitled to my protection." Clave spat the word: "Trade! They attacked us, we attacked them. We've got the carm and we'll have our people too. All right, Grad—Scientist—have you got an opinion?"

They were dropping too fast. The Grad swung the carm nose-down and fired forward jets. He said, "Nice of you to ask. We've got the Scientist's Apprentice and the silver suit and the only man alive who can fit into it. Maybe they would trade. We keep the carm."

"Never," said Lawri. "Trade with *copsiks!*"

Anthon and Clave looked at each other. The Grad said, "Never mind," and they laughed. Lawri's tone of voice said it all.

Minya stopped and looked out through a screen of branchlets.

The supervisors had found Gwen. Haryet was scolding her as they led her toward the huts. Haryet was second-generation copsik, shorter than Minya; she looked tiny beside her very pregnant captive.

They'll have heard us coming, Minya thought. Jinny must have realized that too. She stepped out through the crackling foliage, ten meters east of Minya's position. *Good! They'll think they heard one, not two—*

Dloris came toward Jinny with thunder in her face. Breaking new paths was strictly forbidden.

Minya emerged behind Haryet and stabbed her.

Gwen turned with her baby in her arms and shrieked. Dloris whirled, and stared. Perhaps this place of mothers and babies had given the supervisor a false sense of safety. She reacted slowly. Before she could reach her truncheon, Jinny was pinning her arms and Minya was running at her in long, low leaps.

Dloris flipped forward. Jinny flew over her back and came spinning at Minya, who lost a moment sidestepping. Then Dloris held half a meter of hardwood at guard; but she faced a Navy sword.

"Wait," she said. "Wait."

"My child will not be born a copsik!" Minya screamed, and lunged.

Dloris danced backward. The tunnel was behind her, and Minya knew she had to stop the supervisor from reaching it. She ran at her, ready to bat the truncheon aside. Then Jayan and Ilsa were moving into place behind Dloris. Jayan held the big paddle well up the haft, blade first, like a two-handed sword.

Dloris dropped her truncheon. "Don't kill me. Please."

"Dloris, tell us what's happening."

"Carther States is all over the trunk. I don't know who's winning."

"Have they got the carm?"

"The *carm?*" Dloris showed nothing but astonishment.

They tied her with line. Ilsa wanted to do more; Minya knew Dloris too well to allow it. She wouldn't have killed Haryet either, if . . . if.

Gavving watched the carm descend in fire. Patry was talking to his box, too far away for Gavving to hear; but the Navy officer looked furious and frightened.

He caught Gavving watching him. "You! All of you! Stay where you are! Move and you'll be shot. Do you understand? Arny, take cover."

The two Navy men disappeared into the foliage. Presently Alfin said, "We're bait."

"There's only two."

Horse asked, "Do you really think your friends have the carm? What will they do with it?"

"Rescue us," Gavving said with more assurance than he felt. "Alfin, when it comes down, jump for the doors and hope they open."

Alfin snorted. "You've got to be out of your mind. *Look* at that thing, you want to *ride* in it?"

"I'll ride anything to get out of here, if I can take Minya."

"You don't have Minya. Listen, Gavving. I remember you with your eyes red and half-closed and crying in rivers. They make their own weather here! Nobody starves, nobody goes thirsty. It's a good, healthy tree with a good crop of earthlife. I've got a responsible position—"

"You *like* it here?"

"Oh . . . treefodder. Maybe I don't really like it anywhere. I took orders in

Dalton-Quinn too. I'm seeing a supervisor, a nice woman even if she towers over me. I didn't have that in Quinn Tuft. Kor's a year or two old for the citizens, but we get along . . . and I don't like that box."

"I do." It was Horse who had spoken. "Gavving, cede me Alfin's place."

The carm was falling straight at them. Those had better be friends aboard! He could only die fighting if they were not. He told Horse, "It's not my decision. Just do what I do, and we'll see what Clave says."

"Done."

"Alfin. Last chance—"

"No."

"Why?"

Alfin met his eyes. "There's tide here."

Gwen's shriek of terror had started her baby screaming. He was quieter now. Gwen's awareness was in the hands that stroked and patted the child. There was none in her eyes.

The conspirators ignored Gwen as she ignored them. Ilsa led her back, once, when she tried to return to the huts. They didn't want Gwen talking to the others.

Jayan asked, "Ilsa, are you sure you want in on this?"

Jinny wasn't pregnant; Jayan and Minya were not obtrusively so. Ilsa was. She said, "My baby won't be born a copsik either."

The branch shuddered with the force of a tremendous blow. Ilsa said, "The second elevator. Karal said two."

Jayan said, "Minya, you've talked to the Grad. What did he say?"

"The Grad said to go up. He'll try to capture the carm. If he can't get the carm—"

"Then he's dead," Ilsa concluded, "and all the Carther States warriors are going to die, and we'll never get loose at all. So he's *got* to have the carm. He's got the carm and as many Carther States warriors as he can get aboard, and he's trying to reach us. Who goes with us?"

Nobody suggested a name. Jayan said, "We're the only new copsiks. Let the rest run their own revolt."

"You can't go up."

They turned, surprised. Dloris's eyes shied from their potentially lethal attention. She repeated doggedly, "You can't go up. The tunnels lead to the fin and the treemouth. There isn't any connecting tunnel to the top of the tuft; that's where the men live. None of you are in shape to tunnel through foliage, and if you got to the top you'd stand out like so many mobies in a stewpot."

"Then what?"

"Stay here till your friends come for you."

Ilsa shook her head. "The children's complex? Karal must have the upper reaches evacuated by now."

"Ilsa, it's big and complicated and it doesn't connect to the top. The most you'd do is get lost."

"What's your stake in this, Dloris?"

"Let me live. Don't tell anyone I helped."

"Why?"

"I wanted to escape once myself. Now I've been a supervisor too long. Somebody would be sure to want me dead. But you can't go up. Stay here and wait."

They looked at each other. Minya

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said, "You did that. For thirty years? No. I think I know what we have to do."

The Grad tapped at the motor controls . . . tricky. They had to be used in pairs and clusters or they'd spin the carm. He dropped into the foliage several meters from the platform, with a horrendous crashing, and opened the doors at once.

Three men jumped toward the door. Gavving gripped an older man's arm. The third man wore blue, and he was swinging a sword. Debby took careful aim and put a crossbow bolt through him.

Gavving and the stranger pulled themselves inside. The older man was gasping. "Get us moving," Gavving said. "This is Horse. He wants to join Quinn Tribe. Alfin isn't coming. He likes it here."

A feathered harpoon ricocheted through the doors. The Grad closed them. He said, "I left Minya and Jayan in the pregnant women's compound—"

"What? Minya?"

"She's carrying a guest, Gavving. Your child. And men aren't permitted there." Later the Grad would tell him the truth . . . part of it. For now, for witnesses and the record, *Minya is carrying her husband's child.* "Ilsa's there too, Anthon. I told Minya to gather them all and go up. We'll have to wait for them."

Clave nodded. Gavving stared with open mouth. He said, "Grad, don't you know the men's tunnels don't connect to the women's?"

"What?"

"They'd have to go all the way to the fin or the treemouth, and back! Or break trail—Grad, they're sure to be captured!"

Clave had a hand on Gavving's shoulder. "Calm down, boy. Grad, where would they go?"

The Grad tried to think. It was Horse who spoke. "Not the fin. That's Navy. Maybe nobody would notice some extra women at the Commons or the schools. Or maybe they'd just stay where they are and wait."

"Jinny'll be at the treemouth anyway. Okay." The Grad fired the forward motors.

The carm lifted tail-first from the tuft, leaving fires in its wake. Lawri screamed, "You're setting the tree on fire!"

She was ignored. "I've been to the pregnant women's complex," the Grad said. "I haven't been in the Commons."

"Alfin has," Gavving said. "It's big, and it reaches to the treemouth. If we can get the carm into the treemouth—"

Lawri writhed. "You can't! You can't burn the treemouth, what *are* you? This isn't mutiny any more, it's just wanton destruction!"

Anthon asked mildly, "Will London Tree trade with copsik mutineers?"

Lawri was silent.

"Lying wouldn't have helped. You were too convincing before. We'll go get our people."

The carm moved sideways above the tuft, accelerating sluggishly. Then there was clear sky below, and the Grad swung the carm around.

They were dropping past the treemouth. The carm slowed, hovered. The Grad touched paired yellow dots. Light

flared into the Commons in twin beams, as if the carm were a tethered sun.

Women were running . . . away. Jungle giants all, leapfrogging across the woven-spine-branch floor. None were the right size, nor dark enough, to be Jinny.

"Drop it," Clave said as if his voice hurt him. "Go for the pregnant women's compound. How do we get there?"

The Grad let the carm sink. They were below the tuft now: blue sky below, green passing above. "It's under the branch. I think our best move is to go up into it. I may not hit it exactly, and the Navy man have figured out what we're doing by now. Are you ready for a fight?"

"Yes," said several voices.

The Grad grinned. "Maybe I can scrape off the silver man too. I notice he's still with us . . . Now what's *that?*"

Things were falling from the foliage. A bundle of cloth tied with line. Long loaves of bread. A bird carcass, cleaned and skinned. Then the green sky was raining women. Jayan, Jinny, and a jungle giant: Ilsa?

"They jumped," Gavving said in wonder. "What if we hadn't come?"

"We did," Merril said. "Get 'em!"

Two big leather bags fell, and then another woman, leaping head-down to catch up with the rest: Minya.

The Grad cut the motors and took a moment to think. He was aware of voices yelling at him, but was able to ignore the intrusive noises.

Got to catch them in the airlock. What about the silver man? He was still clinging to the dorsal surface. The Grad rotated the carm to put it between the pressure-suited dwarf and the falling women.

They were separating. It would be three operations. Jayan and Jinny first. They faced each other across clasped hands, as they had after Dalton-Quinn Tree came apart. They seemed calm enough under the circumstances. The carm eased toward them.

The silver man was crawling around to the airlock.

"Hang on," the Grad said, and he started the carm spinning. Faster. His head spun too; he could see sickness in the faces behind him. The silver man, caught rounding a corner, was hanging by his hands. The Grad used the motors again, against the spin, and slapped the silver man hard against the hull. He flew free.

The Grad opened the doors. The twins were flying at him. He jetted flame to slow the carm; stopped just alongside them, backed and moved sideways. Then they were crawling into the carm.

Blue shapes crawled within the green sky. Armed Navy men, carrying jet pods and footbows and a massive thing that took three men to handle.

The reunion would have to wait. "Get 'em into chairs," he called back to Clave. Minya next. He was flying the carm like he'd done it all his life. He got a little careless; Minya thumped the hull, then came in with a bloody nose. "Sorry," he said. "Gavving, never mind that, get her to a chair! Who's the other one?"

"It's Ilsa," Anthon said. "They're shooting at her! Grad, get her!"

"I'm doing that. Do we need the food and other stuff?" He was alongside Ilsa

now, between her and the falling Navy men. Voy glared behind her. Footbow arrows *tick*ed off the hull . . . but that *thump* had no place in his schemes. What—?

Ilsa's look of terror and determination faded into blissful sleep. He knew before he looked: the silver man was back, spitgun and all. He was on the dorsal surface, out of reach of the doors, and Anthon had thrown a line round Ilsa's waist and was pulling her in.

"Get her into—" The chairs were full. "Get her against the back wall and stay with her. Don't turn any fixtures. Debby, put a tethered bolt in that carcass and we'll pull it in."

Anthon said, "The silver man—"

"These are close quarters. If he gets through the door, swarm him. The spitgun doesn't kill, but if he shoots us all, he owns us."

Jinny called to the Grad, "We brought a stack of clean laundry and a water supply."

"We've got water. Laundry . . . why not? Hey, I told Minya to go *up*. You did it right, we'd never have found you—"

Minya said, "If you had the carm, you could find us in the sky. So we grabbed what we could and went down."

The Navy men had not left the branch's green underside. Hardly surprising. If they failed to capture the carm, how would they reach the tree again? They would have looked futile, the Grad thought, were it not for that bulky starstuff thing they handled like a weapon.

The salmon bird carcass was a black silhouette with Voy painfully bright behind it. Anthon and Debby had to squint . . . but their tethered arrows nailed it and they reeled it in. Maybe the silver man was hoping someone would show his head; none did. He tried to enter with the stack of ponchos, and the Grad almost managed to catch him in the closing door. That left the laundry outside too, and a red border around the yellow diagram. "I never saw red before. What's it mean?"

Lawri deigned to answer, contemptuously. "Emergency. Your line's holding the airlock open."

The Grad opened the door (the red warning disappeared) and Debby pulled the mass in. The silver man didn't try to follow. The door may have scared him. It was his last chance: the Grad closed the doors and sighed with satisfaction.

His sigh chopped off when his ventral view flared pure, dazzling red, then disappeared from the bow window.

From other displays he caught glimpses of painfully bright scarlet. "Can that thing hurt us?" Anthon demanded, while Lawri cried, "Now you'll see! They'll cut us in half!" and Clave said, "They're almost on us. We'll have them all over the hull if—"

"Feed it to the tree!" the Grad shouted at them all. He couldn't think. What *could* that light do to them? Neither Klance nor Lawri had ever mentioned such a thing.

We've got what we need. Forget the bread, forget the water. Get out! They'll never catch the carm.

Lawri saw his hand move and screamed, "Wait!" The Grad didn't. He tapped the center of the big blue vertical bar.

* * *

CHAPTER 20: THE POSITION OF SCIENTIST'S APPRENTICE . . .

The air sighed out of the Grad's lungs. He was being crushed flat. His left arm had missed the arm rest; it was behind him, being pulled gradually from the shoulder socket. The chair was too low to support his head. His neck hurt savagely. Above the muted shriek of the main motor he heard his passengers fighting for breath.

This must be killing the jungle giants.

London Tree dwindled like a dream in the aft view. They were in the storm now, and blind. The Grad tried to raise his right arm, to touch the blue bar, to end the force that flattened him. Up, up . . . farther . . . his arm fell back across his chest with a jolt that smashed the last sipful of air from his lungs. His sight blurred.

Lawri's chin was tucked down against her collarbone. She was sure that if she relaxed her neck the tide would snap it.

She watched Jeffer trying to turn off the motor, and knew he couldn't make it. And Lawri's arms were bound.

This will kill some mutineers, she thought with alloyed satisfaction. *And I did it to them.* The com laser would burn or blind at close range, but almost certainly it would not have hurt the carm. She'd lied in hope that the mutineers would panic. She'd succeeded beyond her ambitions. *But it's killing me!*

The screen of clouds swept past and away.

Gold was to left of center in the bow window. The Smoke Ring trailed left of Gold. They were accelerating east and a little out.

East takes you out . . .

They were leaving the Smoke Ring.

I knew it. That crazy Jeffer's killed us all.

With his head pulled far back, with the points of what should have been a neck rest digging savagely into his shoulderblades, Gavving looked along his nose and tried to make sense of what he was seeing.

The sky flowed away at the edges of the bow window. A triune family split and fluttered and were gone before they could move. A small, flattish green jungle drifted close, accelerated, whipped past. A fluffy white cloud showed ahead. Closer.

White blindness, and the carm shuddered and rang with the impact of water droplets. Something tiny struck the bow window a terrific blow and left a blood spot a quarter meter across. In a breath the rain had pounded it clear.

The cloud was gone, and the sky ahead was clear of further obstructions. Gold and the Smoke Ring showed like a puffball on a stem, against blue sky . . . a deep, dark blue sky, a color he'd never seen in his life.

He rolled his head to look at Minya. The agony in his neck shifted . . . the pressure was easier to take this way. She looked back at him. Lovely Minya, her face fuller than he remembered. He tried to speak, and couldn't. He could barely breathe.

She sighed, "Almost."

The light of the CARM's main drive was back, and blue-shifting!

A shift in its spectral line, and he'd caught it. Lucky. Kendy aborted his usual message. The CARM's time-eroded program would be busy enough without distraction. For the CARM was in flight. It must have been accelerating for some minutes already. By the frequency shift, it was building up enough velocity to take it out of the Smoke Ring . . . within a few thousand kilometers of *Discipline* itself!

When the light went out, Kendy began his message. The air was already thinning around the CARM. Reception should be good. "Kendy for the State. Kendy for the State. Kendy for the State."

The sound stopped, the terrible tide was gone, all in a moment. Bodies bent like bows recoiled. Citizens who had not had the breath for screaming screamed now.

As the reflexive screams died to groans the Grad heard Lawri say, wearily, "Jeffer. Never use the main motor unless you're pushing the tree."

The Grad could only nod. He'd captured the carm, he'd . . . treefodder, everyone he knew, if he hadn't murdered him he'd put him aboard the carm! And *then* he'd touched the blue bar. He said, "Lawri, I'm open to suggestions."

"Feed it to the tree."

The Grad heard full-throated laughter aft . . . from Anthon. Debby swatted him hard across the belly. The blow snapped him into a U, but he kept laughing, and she joined him.

They had reason! They had been flat against the back wall, protecting Ilsa from what should have been mild jolting. The killer chairs would have snapped their backs, but none of the jungle giants had been in them.

Others were groaning, stirring, moving from pain to fear. Ilsa was beginning to wake up. Merril—vacant-eyed, hypnotized by the peculiar sky rushing at the bow—seemed to snap out of it. "Well, *somebody* do something!"

Clave's voice was a carrying one, and it filled the carm's cabin to overflowing. "Calm down, citizens. We're not in *that* much trouble. Remember where we are."

Other sounds stopped. Clave said, "The carrier was built for this. It came from the stars. We know it operates inside the Smoke Ring, but it was built to operate *anywhere*, wasn't it, Grad?"

That simply hadn't occurred to him. "Not anywhere, but . . . outside the Smoke Ring, that's certain."

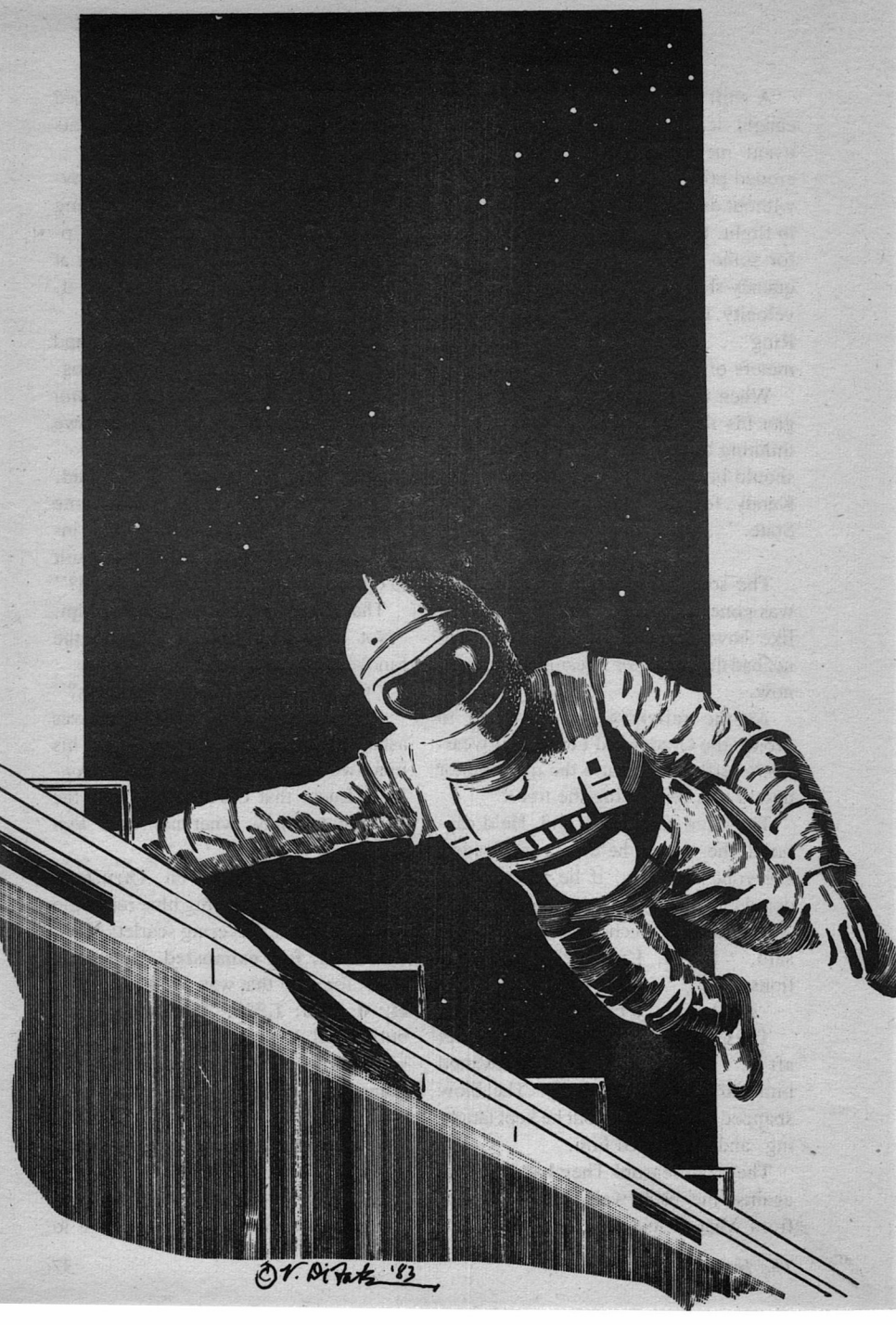
"Good enough. What's our status?"

"Give me a breath." The Grad was ashamed. It had taken Clave to get his mind working again. *We're not in trouble*— Luck, that Clave didn't have the training to know what nonsense *that* was.

The blue display was on. **Thrust: 0. Acceleration: 0.** The big blue rectangle had a border of flickering scarlet: **Main motor on, fuel exhausted.** He tapped it off, for what that was worth. **O_2: 211. H_2: 0. H_2O: 1,328.** "Plenty of water, but no fuel. We can't maneuver. I don't know how to find out where we're going. Lawri?"

No answer.

"But we're bound to fall back sooner or later." Green display: "Pressure's way down outside. We're—" This could start a riot; but they'd have to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know. "We're leaving the Smoke Ring. That's why the sky's that peculiar color." Yellow display: "Life support looks okay." Window displays: "Oh, my."

In the aft and side views, all detail had become tiny: integral trees were toothpicks, ponds were drops of glitter, everything seemed embedded in fog. Gold had become a bulge within a larger lens of cloud patterns that trailed off to east and west: a storm pattern that spread across the Smoke Ring. The hidden planet seemed indecently close.

"Grad?"

"Sorry, Clave, I got hung up. Citizens, don't miss this! Nobody's seen the Smoke Ring from outside since men came from the stars."

Others were craning forward to see the displays, or peering out through the side windows. But Gavving said, "I think Horse is dead."

Horse? The old man Gavving had brought with him. Horse certainly looked dead enough; small wonder if the tide had stopped an old man's heart. *Poor copsik*, the Grad thought. He had never met Horse, but what human could have wanted to die before seeing *this?* "Check his pulse."

Lawri said, "Port view, Jeffer."

Something in her voice . . . the Grad looked. Off to the edge: a flash of silver? "I don't—"

"It's Mark! He's still out there!"

"I don't believe it."

But the silver pressure suit was crawling into view. The dwarf must have clung to the nets throughout that savage acceleration.

"Jeffer, let him in!"

"What a man! I . . . Lawri, I can't. The pressure's too low outside. We'd lose our air."

"He'll die out there! . . . Wait a minute. Open the doors one at a time. Hah! that's why Klance calls it an airlock! So did the cassettes—"

"Sure, two doors to lock the air in. Okay." Muffled thumps sounded aft. The silver man wanted in. "Anthon, Clave, he may be dangerous. Take the spitgun away from him when he comes in." The Grad cleared all but the yellow display. No fast decisions from now on. He pinched both lines together—make *sure* they're closed tight!—then opened the outer door with a forefinger.

The silver man disappeared from view, into the airlock.

Good. Now close the outer line, *wait*—no red borders? Open the inner. Air *shush*ed into the airlock. The silver man stepped into the carm, handed the spitgun to Anthon, and reached for his helmet.

In her heart of hearts, Lawri may have hoped for a last-breath countermutiny from the Navy's toughest warrior. She gave up that hope when she saw his face. Mark was a dwarf, of course, and the bones of his face were massive, brutal; but his jaw hung slack and his breath came fast and his face was pale with shock. His eyes wavered about the cabin, seeking reassurance. "Minya?"

A dark-haired woman answered. "Hello, Mark."

Her voice was flat and her face was hostile. Mark nodded unhappily. Now he recognized Lawri. "Hello, Scientist's Apprentice. What now?"

"We're in the hands of mutineers,"

Lawri said, "and I wish they were better at flying what they've stolen."

The mutineers' First Officer said, "Welcome to Quinn Tribe, as a citizen. Quinn Tribe doesn't keep copsiks. I'm Clave, the Chairman. Who are you?"

"Navy, point man, armor. Name's Mark. Citizen doesn't sound too bad. Where we going?"

"Nobody seems to know. Now, we don't quite trust you, Mark, so we're going to tie you to a seat. That must have been quite a ride. Maybe you really are made of starstuff."

Mark was letting himself be led forward, to an empty chair. "All things considered, I'd rather ride inside. I was too mad to let go. We're not really going to *hit* Gold, are we?"

He's turned docile! Lawri thought in disgust. *He's given in to the mutineers! Are they really going to win?*

And then she saw that they were not.

She kept her silence.

Clave counted ten seats and thirteen citizens, one dead. Horse didn't need a chair. Neither did the three jungle giants. Quite the contrary! But, even with the wide cargo space aft, the carm was crowded.

The citizens seemed calm enough. Exhausted, Clave guessed, and too awestruck to feel fear. He felt a touch of that himself. Most of them—even the silver man—were looking out the windows.

The sky was nearly black, and scattered with dozens of white points. The Scientist's Apprentice broke her angry silence to say, "You've heard about them all your lives. The stars! You say it without knowing what you're talking about. Well, there they are. You'll die for it, but you've seen the stars."

Real they were, and impressive enough, but they were just points. It was the Blue Ghost and Ghost Child that held Clave's attention. He'd never seen them, either. The paired fans of violet light were vivid and terrifying. They were entirely outside the Smoke Ring, flowing out along the hole in the ring.

Anthon and Debby were keeping busy. They had moored the ponchos and the smoked and cleaned carcass of a salmon bird to fixtures along the cargo hold walls. Now they were carving thin slices from the bird.

Clave remembered feeling like this when the tree came apart. He didn't know enough to make decisions! Then, he had been ready to strangle the Grad for withholding information. Now—

The Grad was watching him uneasily. Did he think Clave would attack their prisoner? Clave smiled back. He made his way aft and helped the jungle giants pass curls of meat forward.

Now was different. Clave was not Chairman here. If they died it would not be Clave's fault.

Probably the jungle giants found the carm more frightening than most—than Clave!—yet they were acting to make it their home. Squeezegourds of water were passing up and down the chairs . . . three squeezegourds, looking somewhat flat. Clave wondered about the carm's water supply.

He was about to ask, when the Grad spoke first. "Gavving, would you come here for a moment?"

There was secret urgency in his voice. Anthon noticed, and continued what he

was doing. So did Clave. If their help was needed it would be asked.

Gavving squeezed between Lawri and the Grad. The summons was something of a relief. Minya's news had startled him, and he did need time to compose his face.

The Grad pointed. "See the red border blinking around that number?"

"Sure."

"Red means emergency. That number is the air in the cabin. How do you feel? Allergy attack coming on?"

"Actually, it was the last thing on my mind." Gavving listened to his body. Ears and sinuses were unhappy . . . eyes scratchy . . . "Maybe."

The yellow number dropped a digit behind the decimal point.

"Scientist's Apprentice, any comments?"

"Fix it yourself, Jeffer the Scientist."

"Mmm."

"Grad, what does it *mean?*"

"Oh, sorry, Gavving. There's no air outside. The air inside must be leaking out into the, um, universe. You know, I talk to you when I get confused. Maybe you'll come up with something."

Gavving chewed it over. "What Clave said—"

"Clave did *not* say that the carm is almost four hundred years old and maybe falling apart."

"Like all those bicycle gears . . . okay, what's your opinion of the Scientist's Apprentice?"

Lawri bore their considering stares with her lips pressed tight and her eyes full on Gavving's. The Grad smiled and said, "Better you ask her opinion of us."

Gavving didn't have to. "Four enemy warriors, six copsiks caught in mutiny, one corpse, and a Navy man who surrendered his weapon." Her expression flickered. Had she forgotten the silver man? This wouldn't be easy, guessing at a stranger's thoughts. Try anyway. "I only wondered if she's good enough to save us if she wanted to. We could waste too much time on that."

The Grad nodded. "Lawri, if the Scientist were here, could he save us?"

"Maybe. But he wouldn't!"

"Klance wouldn't save the carm?" The Grad smiled.

She shrugged as best she could within her bonds. "All right, he'd save the carm if he could."

"How?" She didn't answer. "Can you save us?"

She raised an eyebrow at him. Gavving found that admirable, but what he said was, "Bluff. Grad, we'll have to fix it ourselves. The Scientist told you things about gasses, didn't he?"

"Both the Scientists did. Come to that . . . oxygen? We must be getting air from the oxygen tank. It's the hydrogen tank that's empty. And . . . we'll have more fuel pretty soon. The carm splits water into the two flavors of fuel. The one flavor, the oxygen, it's what we breathe. At least we'll have some time."

Gavving studied the blond girl's face. What did she know? What did she *want?* If she only wanted everybody dead, then dead they were. But there was something she might hate even more than mutiny.

It depended on getting the Grad mov-

ing, which was a good idea anyway. How? Ask stupid questions; that worked sometimes. "Can we find the leak? Set something smoldering and watch the smoke?"

"Yes! It'll tell the others what's wrong, though, and burn up air too. Mph?"

"Inspiration?"

"Molecules of . . . bits of air move more slowly when they're cold." The board was already alive with yellow numbers and drawings. The Grad touched an arrowhead on a vertical line, then moved his fingertip slowly toward him. The arrowhead became two arrowheads, and one followed his finger.

"I never even wondered if we could make the cabin warmer or cooler, but it *has* to be true. That oxygen is liquid. Cold! It'd be freezing our lungs out if something wasn't keeping the cabin warm. Okay, now it'll be cold in here, but we'll live longer. I think you'd better tell Clave what's on and let him make the announcement. They'll have to know now, because we'll have to pass out the extra ponchos. Then we'll try the smoke—"

Lawri spoke. "Just let me at the damn controls!"

Gavving turned from her. Hide the smile. Lawri might want their deaths, but she *couldn't* let the Grad save them without her help. He asked, "Is it too complicated to tell the Grad?"

"No. But I won't!"

"Grad? Try the smoke?"

"Worst she can do is kill us. Besides, Lawri always wanted to fly the carm. Lawri, the position of Scientist's Apprentice is now open."

* * *

Lawri flexed her arms and looked about at her captors. Her hands prickled; her arms hurt. Her urge was to strike out at the mutineers. But the look on Jeffer's face: considering . . . like Klance waiting for the right answer to some stupid rote question. . . .

The sky was black as charcoal. The stars were white points, like tiny versions of Voy, but *thousands* of them. And if they roused fear in Lawri, what must they be doing to these savages? She watched them nibbling on rolled slices of raw meat, and suddenly smiled.

She reached past the Grad and tapped the white key. "Prikazyvat Voice." *Hear this, you treefeeders!*

"Ready," said a voice belonging to nobody in the carm. "Identify yourself."

The lunchtime conversation went dead silent. The jungle giant male cocked his crossbow. She turned her back on him. "I am Lawri the Scientist. Give us your status."

"Fuel tanks nearly empty. Power depleted, batteries charging. Air pressure dropping, will be dangerously low in five hours, lethal in seven. Displays are available."

"Why are we losing air pressure?"

"All openings are sealed. I will seek the source of a leak."

Lawri tapped the white switch again. "That's what will kill us. We'll strangle without air. Too bad. It would have been quite a show, but you won't see it," she flashed at the Grad.

"Why did you turn off the display?"

"Voice can't hear us till I tap it again. It can do almost anything if you say the wrong thing, just talking."

"Would it talk to me?"

"You're a . . ." Her scorn became something else. "It wants you to identify yourself, and it remembers. Hmm. Try it." She tapped the talk-button.

"Prikazyvat Voice," said the Grad.

"Identify yourself."

"I'm the Scientist of Quinn Tuft. Do we have enough fuel to get back into the Smoke Ring?"

"No."

For a moment the Grad forgot how to breathe. Then, "We have a water supply. Won't it be separated into fuel?"

Voice paused. Then, "If the flux of sunlight maintains its intensity, I will have fuel soon enough to affect a return. I note a mass near our course. I can use it as a gravity sling."

"Would that be Gold?"

"Rephrase."

"The mass, is it Goldblatt's World?"

"Yes."

The Grad tapped the switch before he began laughing. "Go for Gold! If we live that long."

The whispering aft had become obtrusive. With the air turning icy and Voice speaking from the walls, luncheon was sliding over to panic. Jeffer said, "Gavving, you'd better tell them about the pressure. We don't have time to brief Clave."

Lawri asked, "Shall I do it?" She knew more about what was going on.

Jeffer seemed apalled. "Lawri, they'd think *you* started the leak!"

"Savages—"

"Anyone would."

She couldn't decide if he meant it.

Gavving was telling the rest of the mutineers about the leak. He told it long, including what they planned to do about it. Jeffer tapped the white button. "Prikazyvat Voice. Have you found the leak?"

"I find no point of leakage. Air is disappearing."

"Will we live long enough to get back into the Smoke Ring?"

"No. The course I've programmed would take twenty-eight hours. Air pressure will have dropped to lethal levels in ten hours. Times are approximate."

Lawri couldn't remember how long an hour might be. Still . . . ten hours? It had been seven before the cabin got so cold. She wondered why Voice hadn't taken it into account. Sometimes Voice could be such a fool.

She said, "Display the areas where you have looked for a leak."

The yellow line diagrams of the cabin sprouted green borders along two-thirds of the interior. Red dots blinked elsewhere. "Those are sensors that have died," Lawri told Jeffer. "Voice, implement your course correction."

Jeffer added, "Prikazyvat Voice. Do not use the main motor at any time!"

"I will fire as I have fuel," Voice said. "First burn in ten seconds. Nine. Eight."

"Everybody grab something," Jeffer called.

Mutineers were pulling the extra ponchos over their clothing. They stopped to strap themselves in. The jungle giants moved against the aft wall and grabbed fixtures—

"Two. One."

But only the attitude jets lit. The carm's nose swung toward the Smoke Ring and stayed there while the aft motors fired. It lasted several tens of

breaths. They would pass closer to Gold . . . which had become huge, a spiral storm seen edge-on, whose rim was already below them.

If Mark weren't tied, Lawri thought, *and if the main motor fired, nobody would be able to move except Mark.* It was something to keep in mind. Jeffer didn't seem to realize that the thrust could be controlled, by touching the top or bottom of those rectangles to raise or lower the fuel flow.

Meanwhile . . . how could the leaks be blocked? If there was a way, Lawri was damned well going to find it before Jeffer did.

CHAPTER 21: GO FOR GOLD

"Kendy for the State. Kendy for the State. Kendy for the State."

The response came almost instantly, sharp and crisp through near-vacuum and dwindling distance. The CARM was out of the Smoke Ring. Kendy had clear sending for the first time since the mutiny. He sent: "Status?"

The motors were functional, all of them. Fuel: a few teacupsfull. Water: a good deal. Solar power converters: functional. Batteries: charged, but running down as they changed water into liquefied hydrogen and oxygen. Sunlight flux from T3 would be steady in vacuum. There *would be* fuel.

The CARM was on manual. CO_2 flux indicated a full load of passengers. The carbon dioxide was accumulating slowly; the life support system could almost handle it . . . and the cabin was leaking air. Oh shit, they were dying!

"Course record since initiating burn."

It came. The CARM was rising. It would have passed near the L2 point —Kendy's own location, the point of stability behind Goldblatt's World—were it not for Goldblatt's World itself. And were it not for Goldblatt's World, the CARM would presently fall back to safety . . . but the core of an erstwhile gas giant planet was pulling the CARM's orbit into a tilted near-circle entirely outside the Smoke Ring.

"Switch to my command."

Massive malfunction.

"Give me video link with crew."

"Denied."

And the cabin pressure was dropping. Something had to be done. Kendy sent, "Copy," and waited.

The CARM computer thought it over, slowly, bit by bit; geared up, and began beaming its entire program. It took twenty-six minutes. Kendy looked it over—a simplified Kendy, patched with subsequent commands and garbled by time and entropy—while he sent, "Stand by for update programming."

"Standing by."

Kendy didn't believe it. The long-dead programmer would have embedded *protect* commands. He simply hadn't reached them yet . . . unless they had deteriorated too? Kendy didn't *have* an update program, he'd been so sure. He'd have to assemble it from scratch.

The speed with which a computer can think was Kendy's triumph and tragedy. Always he was freshly surprised by the boredom of his eventless life. It stayed fresh, because Kendy was constantly editing his memories. The storage capacity of his computer-brain was fixed. He was always near his limit. He had edited his memory of the mutiny, de-

leting the names of key figures, for fear that he might later seek vengeance against their descendants. He regularly deleted the memory of his boredom.

Once he had examined the solution to the Four-Color Problem in topology. The proof submitted in 1976 by Appel and Haken could not be checked except by a computer. Kendy *was* a computer; he had experienced the proof directly, and found it valid. He remembered only that. The details he had deleted.

He had used a simplified program for the CARM computers, then deleted it. But now he had the CARM's program as a template. He ran through it, sharpening everywhere, correcting where suitable, updating his own simplified personality . . . leaving intact the CARM's own memories of the time of mutiny, because he was determined to ignore them. He looked for a way to plug the leak in the cabin. It was hopeless: the life-support sensors had failed, not the program. He almost deleted the command that barred use of the main motor. The main motor was more efficient. He didn't understand that command . . . but it was input, and recent. He left it alone.

Now: a course program to bring them here, to study them . . .

He barely had time to hope. Kendy apprehended orbital mechanics directly. He saw instantly that the fuel wasn't there, nor the sunlight to electrolyze enough water in time. His own pair of CARMs, which fed him power via their solar collectors, didn't have fuel to meet and tow the savages' CARM even if he were willing to risk them both.

Forget it and try again. . . . He could get them back into the Smoke Ring via a close approach past Goldblatt's World. In fact, the CARM's computer had already worked out a course change. It didn't matter. They'd be dead by then.

He left that part of the program intact. He deleted the barriers that barred him from communication. He beamed the revised program to the CARM at the snail's pace the CARM could accept.

The CARM filed it.

It had worked! At least he could look them over, get to know them a little, before they were gone. After five hundred and twelve years!

The cold had gotten to the jungle giants. Anthon and Debby and Ilsa were curled into a friendly, cuddling, shivering ball, with the spare ponchos pulled around them.

The other passengers were taking it better. There were ponchos for everyone but Mark, and two to spare. One they tore into scarves. Jinny wound a scarf around Mark's neck and tucked the ends into the collar of the silver suit. "Comfortable?"

The silver man seemed cheerful enough, despite the lines that held him immobile in his chair. "Fine, thanks."

"Is that suit thick enough?"

"Damn it, woman, you're the one who's shivering. This suit keeps its own temperature, just like the carm. If anyone needs my scarf . . . you want it?"

Jinny smiled and shook her head.

"Of course I'd be even better off with my helmet closed," Mark said, and they laughed as if he'd said something funny. It didn't need saying: if they couldn't plug the leak, or if Lawri chose to kill them somehow, Mark would die with the rest.

The Grad had made a torch from one of the scarves plus fat scraped from the skin of the salmon bird. He was about to light it when he noticed mist before his face. He blew . . . white smoke. Everyone save Horse was breathing white smoke, as if they were all using tobacco.

"If you think something's leaking, breathe on it!" he announced. "Watch your breath. No, Jayan, forget the doors. Voice has sensors there."

Lawri did something to the controls. "I'm turning up the humidity . . . the wetness in the air. More fog that way."

Citizens took their turns at the control panel to find the blank spots in the yellow diagram. The Grad began the uncomfortable job that others might miss: he crawled between the seats, edging around the cold corpse of Gavving's friend, blowing mist where the floor joined the starboard wall.

Merril called, "I've got it. It's the bow window."

A crowd of citizens crawled around the rim of the bow window, blowing, watching the pale smoke form streamlines where the window joined the hull. The window was loose around the ventral-port corner.

"Keep looking," Lawri ordered. "There may be more."

She herself made her way aft. The Grad joined her at the back wall. "What have you got in mind? Is there a way to plug the leak?"

Voice began a countdown. Lawri waited while small jets fired. The cluster of jungle giants sagged against the aft wall without falling apart. Ilsa giggled. She must be still floating from the spitgun drug.

The burn ended. Lawri said, "Maybe. Have we got something to hold water?"

The Grad called, "We need squeezegourds!"

They found three. Merril collected them and brought them back. Jayan and Jinny were blowing on the side windows, which seemed all right. Gavving and Minya moved along the rim of the bow window, blowing and watching. Mist formed outside and vanished immediately, along a curve of window as long as the Grad's arm, shoulder to fingers.

Lawri turned a valve. Brown water oozed from the aft wall, formed a growing globule.

"It's *mud!*" Merril said in disgust.

Lawri said, "We put pond water in. The carm breaks the pure water into hydrogen and oxygen, but it leaves the goo behind. Every so often we have to clean it out. That's why there's an *eject* system, and you can be damn glad of it."

"We can't drink that stuff. We should have picked up Minya's water supply."

"Say that if we live long enough to get thirsty." Lawri took the gourds and filled them from the brown globule. Merril winced, watching each of their water gourds become fouled.

Lawri went forward with the gourds. Would she plug the leak with mud? He could do it himself, now, if Lawri balked; but he wanted her on his side, as far as that was possible.

Lawri squeezed muddy water along the rim of the bow window.

Mist showed outside. The glass began to frost. The water stayed where she put it, in a long brown bubble. Over the next several minutes—while Lawri alone

watched the controls—the water dwindled and thickened to a darker brown. Presently it began to turn *hard*.

Clave said, "Grad? Is it working?"

The Grad had read of ice. It was no more real to him than the liquefied gasses in the tanks. He looked to Lawri.

Lawri met his eyes and said, "I will not accept the position of Scientist's Apprentice."

After such a performance, was she quitting on them? Clave spoke first, and in haste. "I'm certain there's room in Quinn Tribe for two Scientists. Especially under the circumstances."

"I've saved you. Now I want to go home to London Tree. That's *all* I want."

She's earned it, the Grad thought, *but—*

Clave said, "Point to it."

The carm was nose down to the Smoke Ring. Closest was the storm-pattern that surrounded and cloaked Gold, a turbulent spiral of cloud, humped in the middle. The whole pattern drifted west at a speed that looked sluggish, but must be quick beyond imagination. The arms of the Smoke Ring reached away in both directions. They could see the flow of cloud currents, faster toward Voy, drifting backward near the carm. Minor details—like integral trees—were invisibly small.

"You're the Scientist," Clave said. "Could you get us back to London Tree?"

Lawri shook her head. She began to shiver; and once begun, she couldn't stop. Minya got her the last of the ponchos and they wrapped it around her, then tied a strip of cloth round her head and throat. She said, "We're not losing air any more. Leave the humidity up and we won't get thirsty so fast. Jeffer, I'm cold and tired and lost. I can't make decisions. Don't bother me."

They weren't human.

Kendy had watched them for a bit. They had the temperature turned far down. Kendy was going to fix it, until he realized that the lowered temperature had slowed the leak.

They must have kept some of the old knowledge. But the cold was killing them, too. He watched the *really* strange ones succumb first and crawl into a ball to wait for their deaths.

The CARM's medical sensors indicated a corpse and twelve citizens, not one of them quite normal. One had no legs. If lethal recessive genes were appearing in the Smoke Ring, it might point to inbreeding. Otherwise they seemed healthy. He saw no scars or pockmarks, no sign of disease; which was reasonable. *Discipline* had carried none of the parasites or bacteria that had adapted over the millions of years to prey on humanity. They didn't even show the sores that came with insufficient bathing.

The abnormal height, the long, vulnerable necks and long, fragile fingers and long, *long* toes, must be evolution at work, an adaptation to the free-fall environment.

He would have his problems, bringing *these* back into the State. In its way this small group was a perfect test sample. He could make his mistakes here, and never pay a penalty. In time the CARM would be found by other savages.

Time to make his appearance.

* * *

Lawri was eating raw salmon bird, clearly hating it, but eating. Jayan and Jinny had gone aft to join the clustered Carther States warriors. It looked like fun, the Grad thought wistfully; but he was needed here.

Something was happening to the bow window: a pattern like a colored shadow, occluding the view.

"Lawri? Have you done something?"

"Something's wrong . . . I've never seen anything like . . ." she trailed off.

The carm was silent. A ghostly face filled the bow window. It took on color, huge and transparent, with the storms around Gold showing through.

It was brutal, with bushy brown hair and brows, thick brow ridges and cheekbones, a square, muscular jaw, a short neck as thick in proportion as a man's thigh. A face that resembled Mark's or Harp's. A gigantic dwarf. It spoke in Voice's voice.

"Citizens, this is Kendy for the State. Speak, and your reward will be beyond the reach of your imagination."

The passengers looked at each other.

"I am Sharls Davis Kendy," the face said. "I brought your ancestors here to the Smoke Ring and abandoned them when they made mutiny against me. I have the power to send you into Gold, to your deaths. Speak and tell me why I should not do so."

Too many were looking at the Scientists. Was this some trick of Lawri's? The Grad could feel the hair rising in a halo around his head . . . but *somebody* had to speak. He said, "I am the Quinn Tribe Scientist—"

"And I am the London Tree Scientist," Lawri said firmly. "Can you see us?"

"Yes."

"We are lost and helpless. If you want our lives, take them."

"Tell me of yourselves. Where do you live? Why are you of different sizes?"

The Grad said, "We are of three tribes living in two very different places. The three tall ones—" He kept talking while his mind sought a memory. *Sharls Davis Kendy?*

Lawri broke in. "You were the Checker for *Discipline*."

"I was and am," said the spectral face.

" 'The Checker's responsibility includes the actions, attitudes, and well-being of his charges,' " Lawri quoted. "If you can help us, you must."

"You argue well, Scientist, but my duty is to the State. Should I treat you as citizens? I must decide. How did you come in possession of the CARM? Are you mutineers?"

The Grad held his breath . . . and Lawri said, "Certainly not," contemptuously. "The carm belongs to the Navy and the Scientist. I'm the Scientist."

"Who are the rest of you? Introduce me."

The Grad took over. He tried to stick to lies he could remember, naming the copsiks of London Tree—Jayan, Jinny, Gavving, Minya—as London Tree citizens; Clave and Merril as refugees who had become copsiks; himself as a privileged refugee; the jungle giants as visitors. Too late, he remembered Mark tied motionless in his chair.

Go for Gold—"Now, Mark *is* a mu-

tineer," he said. "He tried to steal the carm."

Would the dwarf brand him a liar? But the rest would back him up . . . except Lawri . . .

Mark let his eyes drop. He looked sullenly dangerous.

Sharls Davis Kendy began to question Mark. Mark answered angrily, belligerently. He created a wild tale of himself as a copsik barred from citizenship by his shape; of trying to steal the carm by activating the main motor, hoping to immobilize all but himself, then finding that the ferocious thrust left him as helpless as the rest.

The face seemed satisfied. "Scientist, tell me more of London Tree. You keep some who are barred from citizenship, do you?"

Lawri said, "Yes, but their children may qualify."

"Why does a tree come apart?" the face asked, and, "How does London Tree move?" and, "Why do you call yourself *Scientist*?" and, "Are many of you crippled?" and, "How many children do you expect to die before they grow to make children?" It wanted populations, distances, durations: numbers. Lawri and the Grad answered as best they could. With these they could stick close to the truth.

And finally the voice of Kendy said, "Very well. The CARM will re-enter breathable atmosphere in eleven hours. The air will slow it. Keep the—"

"Hours?"

"What measure do you use? The circuit that Tee-Three makes around the sky? In about one-tenth of a circuit, you'll be falling through air. Air is dangerous at such speeds. Keep the bow forward. You'll see fire; don't worry about it. Don't touch anything at the bow. It will be hot. Don't open the airlock until you've stopped. By then you'll have fuel to move about. Do you understand all of that?"

Lawri said, "Yes. What are our chances of living through this?"

The face of Kendy started to answer, and froze with its mouth half open.

Update: Cabin pressure had returned to normal.

They had blocked the leak! *How?* A man without glands might naturally feel curiosity and duty as his strongest emotions. For Kendy these were now in conflict. And the CARM was about to pass out of range.

Kendy had never intended to tell them that they would not live to see re-entry. Medical readouts implied that they had lied to him, too . . . and he dared not accuse them of it.

This changed everything. The savages might actually return to describe Kendy and *Discipline*. He could stop them, of course, by beaming some wild course change to the CARM. Or he could spend the next few minutes . . . indoctrinating them into the State? Impossible. He could take one trivial step in that direction, then try to impress them with the need to talk to him again.

And when they did that—years from now, or decades—he could begin the work that had waited for half a thousand years.

The face said, "You have stopped the leak. Well done. Now you must kill the mutineer. Mutiny cannot be tolerated in the State."

Mark went pale. Lawri started to speak; the Grad rode her down. "He'll face trial on our return."

"Do you doubt his guilt?"

"That will be decided," the Grad said. At this point he probably became guilty of mutiny himself, but what choice did he have? If Mark didn't talk to save himself, Lawri would. *And I captain the carm!*

"Justice is swift in the State—"

The Grad countered, "Justice is *accurate* in Quinn Tuft."

"Our swiftness may well depend on instant communication, which you clearly do not have." The face began speaking louder and more rapidly, as if in haste. "Very well. I have a great deal to tell you. I can give you instant communication, and power that depends on sunlight instead of muscle. I can tell you of the universe. I can show you how to link your little tribes into one great State, and to link your State to the stars you now see for the first time. Come to me as soon as you can . . ."

The voice of Kendy died in a most peculiar fashion, blurring into mere noise, as the brutal face blurred into a wash of colored lines. Then the voice was silent and the storm-pattern around Gold glowed blue-and-white through the bow window.

CHAPTER 22: CITIZENS' TREE

Kendy's readings were beginning to blur. Frustratingly, the CARM's aft and ventral cameras worked perfectly. He had two fine views of the stars and the thickening Smoke Ring atmosphere. Plasma streamed past the dorsal camera, and Kendy sought the spectral lines of silicon and metals: signs that the CARM's hull was boiling away. There was some ablation, not much more than he would have expected when the CARM was new.

Inside the cabin the CO_2 content was building. The jolting looked bad enough to tenderize meat. The passengers were suffering: mouths wide, chests heaving. Temperature was up to normal and rising. A blurred figure snapped its safety bands loose and struggled to tear its clothing away. Kendy couldn't get medical readings through the growing ionization, but the pilot had been under terrific tension earlier. . . .

It looked chancy, whether the CARM would live or die. Kendy wasn't sure which he preferred.

He had bungled.

The principle was simple, and had served the State before. To further the cause, a potential convert was ordered to commit some obscene crime. He could never repudiate the cause after that. To do so would be to admit that he had committed an abomination.

The *caveat* was simple too. One must never give such an order unless it would be obeyed.

Kendy was ashamed and angry. He had attempted to bind their loyalty to him by ordering an execution. Instead, he had almost turned them all into mutineers! He'd had to back down gracefully and fast. He'd had no chance to recover from that, with the ionosphere building up around the CARM, cutting communications. His medical readings told him that they had lied to him, somewhere. He shouldn't have forced them to do that either! Not when he didn't

know enough even to guess at what they were hiding.

Too late now. If he sent some lethal course correction now, ionization would garble it.

If they lived, they would tell of a Kendy who was powerful but gullible, a Kendy who could be intimidated. If they died . . . Kendy would remain a legend fading into a misty past.

The forward view was a blur of fire as the CARM plowed deeper into atmosphere. He was losing even the cabin sensors. . . .

There was flame in front of them, transparent blue, streaming to the sides. The Grad felt the heat on his face. They'd be losing air again: the black ice around the rim of the bow window had turned to mud . . . mud that bubbled. He'd been wrong. The screaming flame-hot air massed before the bow was coming *in*.

Things came at them. Little things were hopeless; they hit or they didn't. Blood spots turned black and evaporated. Larger objects could be avoided.

His hands strangled the chair-arms. Trying to steer the carm through this would have been bad enough. Watching Lawri steer was distilled horror. From her rigid posture, the knotted jaw and bared teeth, she was just at the edge of screaming hysterics. Her hands hovered like claws, reached, withdrew, then tapped suddenly at blue dashes. His own hands twitched when she was slow to see danger.

The chairs were full. Citizens had objected, but the Grad had simply kept yelling until it got done: the corpse of Horse moored to cargo fixtures; Mark the silver man in back, gripping cargo moorings with his abnormal strength; Clave beside him, swearing that his own strength was enough; everyone else strapped into seats that would give *some* protection, even to jungle giants, against thrust from the bow. Re-entry wasn't like using the main motor. It was an attack. The air was trying to pound the carm into bits of flaming starstuff.

Lawri had lived half her life with the carm. She *had* to be better at this than the Grad; she'd insisted, and she was right. He gripped the chair arms and waited to be smashed like a bug.

The carm fell east-and-in. Integral trees showed foreshortened, as three . . . four pairs of green dots, hard to see . . . she'd seen them: jets fired. A bit of green fluff, dead ahead . . . Lawri fired port jets . . . the carm swung sluggishly around, shuddering as the flaming air blasted the nose off-center. Forward jets: the carm eased backward, too slowly, while the fluff swelled to become an oncoming jungle.

A grunt of pain, aft. Clave had been jarred loose. The silver man was holding him in place with a hand on his chest.

The Grad saw birds and scarlet flowers before the jungle was past. Lawri let the bow face forward again. A pond a klomter across just missed swatting them; droplets of fog in its wake rang the hull like a myriad tiny chimes. The debris was growing ever thicker.

And it was moving past them more slowly.

Something barred their path like a green web. It might have been half of an integral tree with the tuft gone wild, the foliage spreading like gauze, the trunk ending in a swollen knob. Small

birds played in the slender branches. Swordbirds hovered at the edges. He'd never seen such a plant . . . and Lawri was steering clear of it.

The Grad said, "Lawri?"

"It's over," she said. "Damn, I'm tired. Take the controls, Jeffer."

"I have it. Relax."

Lawri rubbed her eyes fiercely. The Grad touched blue dashes to slow the carm further. A fingertip-touch set the cabin warmth control to normal. The cabin was already warm. If it hadn't been lethally cold when they entered atmosphere, they might well have roasted.

He looked back at his passengers. Six of Quinn Tribe remained. Twelve total, to start a new tribe . . . "We're back," he said. "I don't know just where. Are we all alive? Does anyone need medical help?"

"Lawri! You did it!" Merril chortled. "We lived long enough to get thirsty!"

The Grad said, "We're low on fuel and there's no water at all. Let's find a pond. Then pick a home."

"Open the doors," Jayan said. She released her straps and moved aft, with Jinny following.

"Why?"

"Horse."

". . . Right." He opened the airlock to a mild breeze that smelled fresh, clean, wonderful. The carm's air stank! It was stale, a treefodder stink, fear and rotting meat and too many people breathing in each other's faces. Why hadn't he noticed?

The twins released the corpse from its mooring, wincing at the touch. They towed it through the doors. The Grad waited while they sent the bones of the salmon bird after it.

Then he fired the aft motors. *If I met his ghost he wouldn't even recognize me. How can I say I'm sorry? Never use the main motor unless—* Horse dwindled into the sky.

The pond was huge, spinning fast enough to form a lens-shape, fast enough to have spun off smaller ponds. The Grad chose one of the smaller satellites, no bigger than the carm itself. He let the carm drift forward until the bow window just touched the silver sphere.

What happened then left him breathless. He was looking into the interior of the pond. There were things shaped like long teardrops with tiny wings, moving through a maze of green threads. He turned on the bow lights, and the water glowed. There was a jungle in there, and swimming water-birds darting in flocks among the plants.

Lawri roused him. "Come on, Jeffer. Nobody else knows how to do this. Pick two mutineers with good lungs."

He followed her aft, and didn't ask her about lungs until he'd figured it out himself. "Clave, Anthon, we need some muscle. Bring the squeezegourds. Better than lungs, Scientist."

"Squeezegourds, fine. If you'd planned your mutiny better you'd have dismounted the pump and stored it aboard."

He laughed, and thought: *Should I have asked your advice, too?* and didn't say it. After all Lawri had been through, it was good to hear her joking, even in treemouth humor.

While she mounted the hose to the aft wall, the Grad carried the other end

outside. He saw no sign of the nets that had covered the hull. Even the char had been burned off. He tethered himself before he jumped toward the water a few meters away. Clave came after him, also properly moored, carrying squeeze-gourds, followed by Jinny and Jayan.

Everyone was coming out. Mark was out of his pressure suit and tethered to Anthon. Merril, Ilsa, Debby . . . In a tangle of lines they plunged into the water and drank. The Grad hadn't let himself think of his thirst. Now he surrendered to it, submerging head and shoulders and doing his best to swallow the pond. The carm's headlamps lit the water around him.

It was playtime. Why not? He tugged on his line, pulled himself out before he drowned. The rest of the citizens were drinking, splashing, washing themselves and each other.

Was Lawri alone in the carm?

Alone with the controls of a vehicle that could hover near the pond, spraying fire on men and women who would have to choose between burning and drowning— He saw Lawri emerge with Minya and Gavving behind her. He'd been careless; they hadn't. The Grad kept an eye on her thenceforth to be sure she didn't return alone.

She splashed in the water. She and the dwarf washed each other, and talked a little, in earshot of Anthon. Her motions were jerky, twitchy. She looked wire-tense in the aftermath of re-entry. His suspicions seemed silly; she was in no shape to contemplate a countermutiny. He wondered if she would have nightmares.

They took turns pumping. Technique was to shove the neck of a squeezegourd into the hose, warily, because there were three gourds in motion; squeeze; duck it under water, squeeze, wait while it filled; into the hose, squeeze . . .

"My arms just quit," Minya said, and handed her gourd to Merril. With her archer's muscles she had lasted longer than most. Gavving was some distance from the others, motionless in the water. He'd already speared four peculiar, supple, scaly waterbirds. She watched him, and wondered how he really felt about the guest growing in her.

How did she feel? Her impregnation was part of her past. The past was dead for anyone, but stone dead for these citizens, with hundreds of thousands of klomters and the storms of Gold itself between them and their homes. She would have a child. Time was when she had given up hope of that . . . but how did Gavving feel?

Merril said, "Nobody's talking about Sharls Davis Kendy."

"What for?" Debby wondered. "He never bothered us before and he never will again."

"Still, it's something to have seen the Checker, isn't it? Something to tell our children. Someone that old must have learned a lot—"

"If he wasn't lying, or crazy."

"He had the facts right," the Grad said. "We did take him at his word, didn't we? Maybe he only had cassettes, like me. A dwarf Scientist, stuck out there in a carm, like we almost were. He's not all that bright, either. He swallowed Mark's story—"

"Come on, I was brilliant!" the silver man bellowed.

"You tell a fine story. Mark, why did you back me up?"

It was a breath or two before the dwarf answered. "You understand that I can't support a bloody copsik revolution."

"Okay. *Why?*"

"It was none of this Kendy's business. Whoever he is. Whatever he is."

"Yeah . . . He did have some interesting machinery. Maybe he got stuck aboard *Discipline* itself, somehow. I'd have liked to see *Discipline*."

Lawri hadn't even tried pumping. She flexed her fingers, wondering if they would heal. She had smelled the stink of fear on herself. That at least was gone.

She said, "I wouldn't deal with Sharls Davis Kendy if he *gave* me *Discipline*. Ugly, arrogant treefeeder. He wanted Mark dead like you'd kill a turkey, because it's time. Convenient. And he ordered us around like copsiks!"

They laughed at that. Even Mark.

At the end of three hours their forearms were distilled pain. The blue indicator inside read **H_2O: 260**. The Grad asked Lawri, "Enough?"

"For what we've got in mind—"

"We wondered about going home," Debby said.

Clave snorted, but they waited for Lawri's reply. She said, reluctantly, "I'd never find London Tree again. Carther States is even smaller, and they're both on the wrong side of Gold. We'd have to accelerate west, drop in from the Smoke Ring and let Gold pull us around. Do you want to go for Gold again?"

She smiled at their reactions. "Me neither. I'm tired. We can get to another tree and moor the carm. We'll build a pump before we need more water than that."

"We'd prefer a jungle, of course," Ilsa said.

One of the women bristled. "Nine of us and three of you! If—"

Clave said, "Hold it, Merril. Ilsa, are you sure? You can move a jungle, and that's good, right?"

Ilsa nodded cautiously. Anthon said, "That's *one* of the things we like about jungle life."

"But you can only do it every twenty years or so. We can moor the carrier . . . carm to the middle of an integral tree and move it when and where we like."

"Why not do that with a jungle?"

"Where would you mount the carm?"

Anthon thought it over. "The funnel? No, it might suddenly blow live steam—" He smiled suddenly. "There are more of you than us anyway. Sure, pick a tree."

There was a grove of eight small trees, thirty to fifty kilometers long. The Grad chose the biggest, without asking. He hovered on the forward jets at the western reach of the in tuft.

It was a wilderness. A stream ran down the trunk and directly into the treemouth. He looked for the rounded shapes of distorted old huts, and they weren't there. The foliage around the treemouth had never been cut; there were no paths for burial ceremonies or moving of garbage. No earthlife showed, not even as weeds.

It was daunting. He said cheerily, "It seems we're the first here. Lawri,

have you thought of a way to land this thing?''

''You have the helm.''

He'd thought it through in detail. ''I'm afraid our best move is to moor at the trunk and go down.''

''*Climb?*''

''We did it before. Clave could lead most of us down while, say, Gavving and I wait. We'd have the carm for rescue operations. After the rest of you get down, Gavving and I can follow. We've climbed before—''

''Hold it,'' Clave said. ''This is taking too treefeeding *long*. Grad, quit fooling around and just land in the treemouth.''

''We might set it on fire!''

''Then we try again with another tree!''

Lawri had gone berserk at the suggestion of landing in the treemouth at London Tree. Now she just rubbed her eyes. Tired . . .

They were all too tired. They'd had enough of shocks and strangeness. Clave was right, delay would be torment, and there were trees to waste.

There was no kind of landing site in that wilderness. Everything he saw was green; there was no drought here. Would it burn?

Go for Gold.

He went in over the treemouth and rammed the carm into the foliage hard enough to stick. Still shaken by the impact, they forced their way through the doors, fast, and flailed with ponchos at the smoldering fires until they went out.

Then, finally, they had time to look around.

Minya stood panting, grinning, her black hair wild and wet, the blackened poncho trailing from her hand. She snatched at his hand and cried, ''Copter plants!''

Gavving laughed. ''I didn't know you liked copter plants.''

''I didn't either. But in London Tree they weeded out the copter plants and flowers and anything else they couldn't use.'' She tapped at one, two, three ripe plants, and the seed pods buzzed upward. Suddenly she was looking into his eyes, close. ''We did it. Just like we planned, we found an unoccupied tree and it's ours.''

''Six of us. Six out of Quinn Tuft . . . sorry.''

''Twelve of us. More to come.''

She had fought the fire with a predatory grace unhampered by the thickening around her hips. *Mine*, Gavving thought. *Whether it looks like me or some copsik runner . . . or Harp, or Merril! Mine; ours*. He'd tell her when the mood was right. But that was too serious for now. ''Okay, everything you see is ours. What shall we call it?''

''The thing I like best . . . I can say *citizen* and mean *all of us*. I'm not a copsik and I'm not a Triune. Citizens' Tree?''

The foliage tasted like Quinn Tuft in the Grad's childhood, before the drought. He lay on his back in virgin foliage and sucked contemplatively.

He became aware that Lawri was watching him from the dappled shadows. She looked cold, or just twitchy, hugging her elbows, cringing as if from a blow. He snapped, ''Can't you relax? Eat some foliage.''

"I did. It's good," she said without inflection.

It was irritating. "All right, what's got you worried? Nobody's ever going to call you a copsik runner. You saved our lives and everyone knows it. You're clean, fed, rested, safe, and admired. Take a break, Scientist. It's *over.*"

Now she wouldn't meet his eyes. "Jeffer, how does this sound? There are only two London Tree citizens for at least ten thousand klomters around. Doesn't it stand to reason that we'd . . . get along best together?"

He sat back on his haunches. Why ask him? "I suppose it does."

"Well, Mark thinks so too."

"Okay."

"He didn't have to say so. We talked a little about building huts, that's all, but he looks at me like he *knows*. Like, he's too polite to broach the subject yet, but where else can I go, who else is there? Jeffer, don't make me marry a dwarf!"

"Uh . . . huh."

She turned, convulsively, to see his face. He held up a hand to stop her from speaking. "In principle, two Scientists ought to make good mates too. Does *that* make sense? But you watched me murder Klance. I didn't warn him. I didn't make any speeches about copsiks and freedom and war and justice. I just killed him the first good chance I got. I'd have killed you too, to get us free of that place."

She didn't nod, she didn't speak.

"You could put a harpoon in my belly while I'm sleeping. So don't push me. I have to think."

She waited. He thought. Now he knew why she irritated him with her twitchy unhappiness. He was guilty, and she had seen it. Not quite what one wanted in a mate!

Did he want a wife? He'd always thought he did, and with seven women and five men in Nameless Tuft . . . no chance for an unmarried man to play around in such a tiny population, but he should have his choice of wives. So who?

Gavving and Minya: married. Clave, Jayan, Jinny: a unit, and the twins seemed to like it that way. Anthon, Debby, Ilsa might all have left mates in Carther States, and they might all be looking around . . . but Anthon didn't seem to think so, and even if Debby or Ilsa were available . . . a romp might be fun, but they looked so *odd*. Which left . . . Lawri.

He said, being nearly sure he could get away with it, "Lawri, will you forgive me for murdering Klance?"

"I notice you said murder. Not kill."

"I'm not even claiming it was war. I know what he was to you. Lawri, I *demand* this."

She turned her back and wept. The Grad did not turn his back. He'd virtually invited her to try to kill him. *Now or never, Lawri! You can add too. There's me or there's Mark or there's nobody. I might be giving Mark another reason to kill me. Do I want to risk that?*

She turned around. "I forgive you for murdering Klance."

"Then let's go to the carm and register a marriage. We'll pick up witnesses along the way."

Clave looked down into the tree-mouth. "I see rocks down there. Good. We'll have to collect them for a cook-

fire. Cook Gavving's waterbirds. Tear out some foliage so we'll have room. Where do we want the Commons?''

He didn't see many of his citizens in earshot, and none were listening.

He raised his voice. ''Treefodder, we have to get organized! A reservoir. Tunnels. Huts. Pens. Maybe we won't find turkeys, but we're bound to find *something*. Maybe dumbos. We need *everything*. Sooner or later we want elevators to the midpoint so we can moor the carm there. But for now—''

Anthon, flat on his back in the foliage with a long, long woman in each arm, bellowed, ''Claaave! Feed it to the treeee!''

Clave grinned at Anthon. He did seem to represent the majority opinion. ''Take a break, citizens. We're home.''

For good or ill, they were alive and safe, two-thirds of the distance from Goldblatt's World to the congestion of masses and life forms around the L4 point; and they would remember Kendy.

He had promised a treasure of knowledge. A pity he hadn't had time to give them more of a foretaste; but they must have experienced exactly what he'd predicted during re-entry, given that they'd survived. A savage's gods *were* omniscient, weren't they? Or were they gullible, easily manipulated? Kendy's memory had been pruned of such data.

Whatever: the legend would spread.

I can show you how to link your little tribes into one great State.

He had altered the programming in the CARM. The CARM would watch their behavior and record everything. Before the children of the State came again to Kendy, he would know them. . . .

He would know one tiny enclave within that vast cloud. The Smoke Ring was roomy enough for endless variety. 10^{14} cubic kilometers of breathable atmosphere was about thirty times the volume of the Earth! Kendy wished for a thousand CARMs; ten thousand. *What were they doing in there?*

Never mind. Sooner or later there would come a man eager to carve out an empire, determined enough to take the CARM, crazy enough to trust his life to the ancient, leaky service vehicle. Kendy would know how to use him. Such men had helped to shape the State on Earth. They would again, in this strange new environment.

Kendy waited. ■

● Life is not a battle except with our own tendency to sag with the downpull of 'getting settled.' If to petrify is success, all one has to do is to humor the lazy side of the mind; but if to grow is success, then one must wake up anew every morning and keep awake all day.

Henry Ford

ALIENS AMONG US:

Dr. Mark S. Lesney

The Living Tools of Genetic Engineering

From the shadowy reaches on the border between the living and the dead, from that place where biochemistry melts into biology, come the aliens among us—creatures as strange and bizarre as any likely to be discovered in the farthest reaches of distant galaxies, or landing in a flying saucer on the well-manicured surface of the White House lawn.

These are the living tools of genetic engineering, in decreasing order of "liveliness": bacteria, viruses, plasmids, and transposons. They are the "aliens among us": creatures with which we are all acquainted. We have each given them food and lodging and have, in fact, participated intimately in their reproduction.

Among their numbers are some of the greatest scourges man is heir to—creators of pain, suffering, and disease. But they are also the very founders of our being: functioning in the ecology to make life possible, helping plants to make our food, disposing of our dead, and even making us what we are. Some scientists think that viruses are actually integrated in our very genetic make-up (ghost-riders on the chromosomes) and as such may be the cause of some forms of cancer; transposons seem to be a near-ubiquitous phenomenon of "jumping genes" in all life forms.

Since these "aliens" already play such an important role in our lives, and are destined to be even more involved as they are used by scientists as tools of genetic engineering, it is perhaps important that we learn more about them.

We are the ones who will ultimately be confronted with their presence and effects, for good or ill, and we are the ones who should be aware enough to encourage or dispute research being done today.

The monks of the Middle Ages created beautifully illuminated picture-book chronicles of the lives and habits of creatures mythical and real, called "bestiaries." Perhaps it is time for a "Genetic Engineering Bestiary." Although the beasties included therein might stretch the credulity of a reader far more than would the image of a unicorn, none are myth, for all their strangeness. All are daily used and daily met by scientist and common man alike.

A GENETIC ENGINEERING BESTIARY

Bacteria

The strangeness of the beings in our bestiary will become readily apparent when we realize that the bacteria can be considered here the "beasts" most like ourselves—even though bacteria are single-celled organisms less than one/one-thousandth of an inch in size, even though they multiply by clonal division rather than sex, and even though they don't have a nucleus (cell brain) but only a single DNA-constructed, gene-containing chromosome (as compared to our 46).

Bacteria have adapted themselves to almost every environment on Earth. In hot sulfur springs, in the depths of the ocean, in oxygen-free cesspools, on our teeth and in our digestive tracts, and colonizing on our skin: you'll find them everywhere.

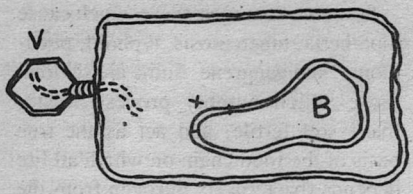
Some are scourges: those which cause diphtheria, tuberculosis, typhoid, pneumonia, and gangrene. Some are saviors: those which humbly process waste, make soil fertile, and act as the true basis of the food chain on which all life depends (bacteria fix nitrogen from the air into the soil and into certain kinds of plant roots; without this function no higher life could exist, for lack of protein). And some merely act as house guests, causing neither good nor ill to their unwitting hosts.

It is one of these latter, *Escherichia coli* (or *E. coli*) by name, a typical gut resident of all humans, that has become the most important of all bacteria to the genetic engineers. In fact, *E. coli* is more than just a "living tool"; it is a living factory, a manufacturing plant of the other tools of genetic engineering, the place where pharmaceuticals and cloned genes can be made to order.

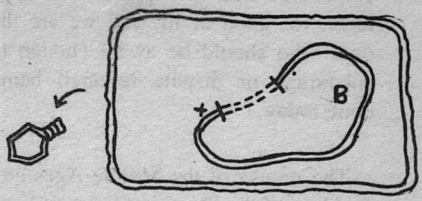
Obviously it might not be considered sensible to work such miracles of drug production in an organism such as *E. coli* which lives so intimately with man, just in case the lab-modified bacteria escaped into the outside world. (Picture the chaos if the human gut was invaded by a bacterium that constantly produced massive overdoses of growth hormones, insulin, antibiotics, or even diphtheria toxin, or by bacterium containing genes from human-infecting viruses capable of causing tumors.) Although the gut lining is a reasonable filter against many such molecules, it is not perfect, and the consequences could be devastating.

For this reason, the most commonly

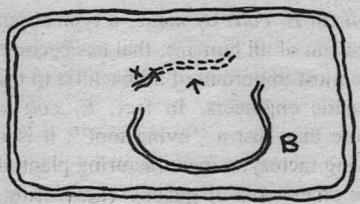
Figure 1: Viruses in Genetic Engineering



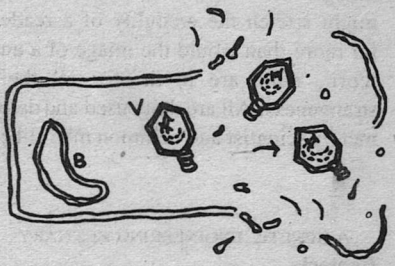
1. Virus (V) infects healthy bacterium by injecting its gene-containing nucleic acid (= = = = =).



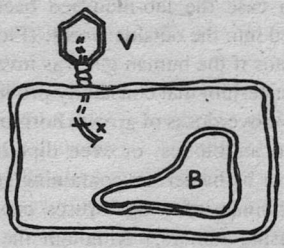
2. Virus nucleic acid splices to bacterial chromosome (═══) and remains quiescent (state called lysogeny).



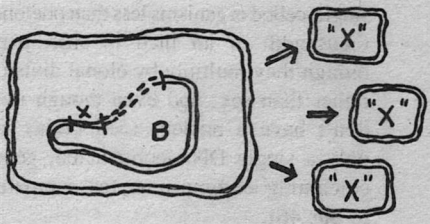
3. Heat shock triggers virus release from bacterial chromosomes. By "mistake" host gene x is carried along with virus genes.



4. x-containing virus multiplies; cell dies, releasing mutant virus (x-containing mutants may be constructed artificially by using gene-splicing).



5. x-containing virus infects new bacterium without x gene. (The x gene may confer antibiotic resistance or "odd" sugar metabolism ability.)



6. x-containing virus splices to bacterial chromosome. Cell now possesses trait "x". Using defective virus prevents virus release. Progeny cells inherit the new "x" trait.

used strains of *E. coli* (such as type K-12) have been selected for their inability to survive outside of artificially protected conditions. Such bacteria have no protective cell walls and are incapable of growth without special nutrient supplements not readily available in the outside world. They thrive in the laboratory as might human beings in a Martian bubble-dome. Once removed from the protective environment, their survival, much less reproduction, is impossible. Use of such mutant strains is known as a biological safeguard in genetic engineering parlance.

Such safeguards are regularly used, but they are not mandatory. There are no laws regarding genetic engineering safety, only guidelines whose creators have little power of inspection and none of enforcement (other than the suspension of federal research funding if any is involved).

There is one other reason that bacteria are so critically important to genetic engineering. They produce the biochemical tools with which genes can be manipulated in the lab. Bacterially produced enzymes are used which are capable of cutting and splicing nucleic acids (DNA) at will with controlled specificity. It is this which allows the engineers to "play" with genes in a test tube as if they were handling any other sort of chemicals. *E. coli*, if you will, is the "Father of Genetic Engineering" for all of these reasons. But other "parents" will be seen in the following sections of the bestiary.

Viruses

One step lower in the hierarchy of our "living" genetic engineering tools are viruses. Simply speaking, a virus is the ultimate in streamlined parasites. It has abandoned all cellular machinery of its own. Like a maniacal robot that bursts into an automobile factory waving a strange blueprint, forcing the assembly line to build robots like itself instead of cars, the virus forces the infected host cell (be it bacterium, animal, or plant) to set aside its own business and concentrate primarily on making cloned copies of the intruder virus instead.

A virus is not cellular; it is simply a piece of nucleic acid (the genetic blueprint material) smaller than a typical chromosome in the number of genes it contains. The nucleic acid is surrounded by a protein coat and sometimes a fatty membrane.

We have all participated in viral reproduction at one time or another, for flu is caused by the influenza virus multiplying happily in our body. Among the other diseases caused by viruses are smallpox, measles, hepatitis, polio, and herpes. Some human and many lower animal cancers have been diagnosed as of viral origin.

But it is the participation of viruses in genetic processes that makes them valuable tools to the genetic engineers. For there are viruses that are capable of inserting their genetic blueprint or portions of it into the chromosomes of their hosts. The most commonly studied of these viruses are those that invade lowly bacteria. They are called phages. And the most important phage so far is Lambda (λ), a bacteriophage that infects our ubiquitous friend *E. coli*.

It is important because it and its breth-

ren are natural-born genetic engineers. Long before mankind had evolved, phages were, like microscopic Robin Hoods, stealing genes from one bacterium to give to another. To understand this phenomenon is to understand genetic engineering as it is practised today.

Normally when a phage invades a bacterial cell it uses the cellular factory to make more of itself and then causes the cell to burst (lyse). Sometimes, however, this lytic cycle is postponed because the viral chromosome inserts itself (best thought of as a type of splicing) into the bacterial chromosome and becomes quiescent.

The bacteria can go through many cell divisions, reproducing the viral genes as well as its own, so that from one infected cell can come millions, all apparently healthy. At some future time, however—when the cell is under stress, or sometimes randomly—the virus chromosome breaks free of its genetic prison and begins the lytic cycle all over again.

But there's a catch here. Sometimes a particular virus chromosome, when it pops out, is poorly unspliced and carries an attached portion of the bacterial chromosome with it. Such a virus is infective, but not usually capable of causing lysis. The "genetic engineering" occurs when this defective virus particle splices into its new host, at the same time splicing in functional genes from its previous host! One of many such genes seen to be naturally transferred in the lab by such infections is the "lac" gene which controls the ability of a bacterium to metabolize milk sugar (lactose) instead of just table sugar (sucrose).

Because of these unique characteristics of Lambda and its relatives, genetic engineering can utilize them in two different ways as vectors of genetic information:

(a) They can use the phages to insert specific genes, deliberately attached to the virus in the lab, into the bacterial chromosome, where these genes will function to produce the desired product and will be carried along to all descendants. In such cases the lytic cycle has been permanently turned off by the use of mutant phages which cannot escape their host chromosome except under defined conditions (which, of course, are not allowed to occur).

(b) Alternatively, massive numbers of copies of the particular gene desired can be made by attaching it to a lytic Lambda phage. The virus will then multiply as long as it is provided with hosts. With each round of multiplication, the number of copies of the gene desired will increase, up to many billions if desired; then the genes can be freed from the phage and used for other genetic engineering attempts. This is especially valuable because it doesn't matter what kind of gene one attaches to the phage —plant, bacterial, human. It doesn't matter because the nucleic acids are chemically the same.

Currently in higher animal cells grown as free-living cultures in the laboratory, work is being done with simian virus 40 (SV40) to duplicate the type of results obtained with Lambda in the *E. coli* system. In African green monkey kidney cells, virus to which has been spliced foreign DNA is allowed to infect simultaneously with a temperature-sen-

sitive mutant of the normal virus. At high temperatures only cells infected with both types of SV40 produce virus, since the mutant SV40 cannot grow under such conditions without the gene products supplied by the non-mutant but spliced virus (which itself is defective in that the foreign genes have replaced genes that the temperature-sensitive SV40 still possess). Thus the two viruses help each other to reproduce, and massive quantities of the spliced foreign gene can be cloned in the cell of a higher animal. Genes from yeast, fruit-flies, mice, rabbits, and sea urchins have thus been cloned.

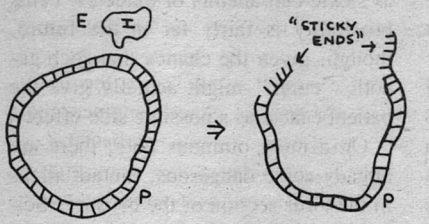
Under conditions where virus mutants incapable of propagation have been used as gene vectors, actual expression of the foreign genes has occurred in the monkey cell cultures: they have been induced to produce rabbit blood proteins and Lambda-phage nucleic acids. SV40 that produces cancerous tumors in its monkey host is also capable of causing genetic transformation in non-host cells infected in culture. The virus, similar to Lambda in *E. coli*, splices its chromosome into one of the host's and remains there as a stable hereditary unit. Such cells are "transformed." They show bizarre growth patterns, as well as the ability to cause tumors when injected back into whole animals. SV40 transformation has been seen in several mammalian species including rat, hamster, mouse, and man.

Thus the possibility of using SV40 as a gene vector in non-monkey cells (and perhaps ultimately in whole animals) is very much under investigation. Perhaps someday, as we were once given weakened disease-causing viruses as vaccine, we will be given weakened viruses that may infect our cells to provide "cures" for genetic diseases such as sickle-cell anemia or diabetes. (This possibility is fairly far in the future, though, given the chance that such genetic "cures" might actually give the patient cancer as a possible side-effect.)

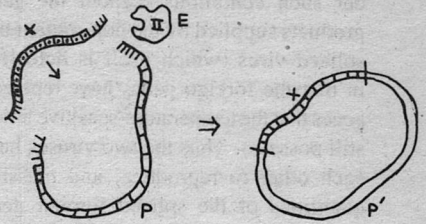
On a more ominous note, there are already some dangerous, mutant aliens in the virus section of the bestiary. Scientists working in vaccine production for adenovirus (a virus that causes acute respiratory infection in children and military recruits, most commonly) used monkey cells to produce the vaccine, not realizing these cells were already infected with SV40. For four years (1956–60) not only were vaccines in use contaminated with the SV40, but they served as the source of "naturally" occurring hybrids of the two viruses: an adenovirus-SV40 chimera. By 1967 mutant progeny of these viruses were found in culture which proved infective to both monkey AND human cells. Some of these nondefective hybrids carried the tumor-inducing genes! This discovery led, in 1969, to the first real expression of concern in the the scientific literature on viruses "that agents which people were creating in the laboratory could be considered as pathogens." (A pathogen is a disease-causing entity.)

Later, to quote from the National Institute of Allergy and Infectious Diseases memorandum on the subject of the newly created viruses, ". . . they are genetic recombinations between a common human pathogen and a simian virus

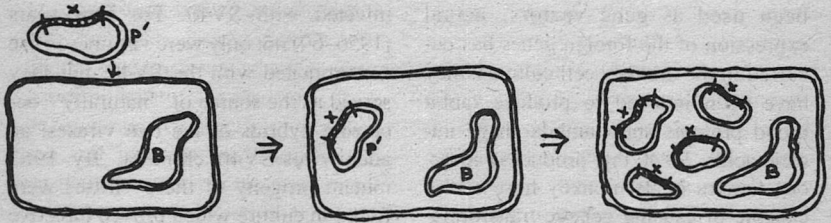
Figure 2:
Plasmids in Genetic Engineering



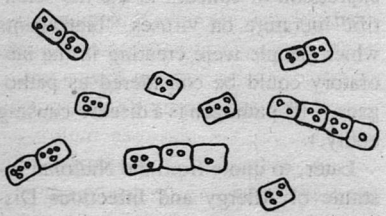
1. Isolated plasmid (P) is "nicked" by enzyme treatment (E) to open the DNA cycle and make "sticky ends" for splicing.



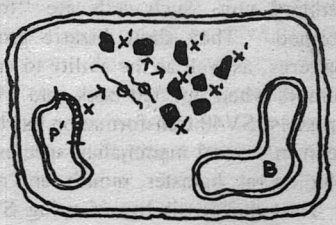
2. Foreign gene (x), also with "sticky ends," is spliced to P to a second enzyme, producing an x-containing plasmid (P').



3. P' is "fed" to a bacterial culture. It is taken up by a cell and multiplies independently of bacterial chromosome (B).



4. Bacterium containing P' multiplies to produce millions of P'-containing cells. In this manner gene "x" is cloned in vast quantities.



5. If gene x is active in the bacteria, the gene product (x') can be isolated. In such manner insulin has been produced in *E. coli.*

which is not only a well-established carcinogen capable of transforming human cells, but is also associated with chronic central nervous system disease in humans. Although there is no known case of human infection with a nondefective Adenovirus 2-SV40 hybrid, there is no reason not to assume that such viruses are capable of infecting humans and producing endemic disease in the general population.''

It is to be remembered that these aliens were not placed on this planet by design, but by accident of laboratory technique in something as valuable and seemingly innocuous as vaccine production. But these viruses were immediately seen as potential windfalls for genetic engineering studies and practices. Only the expressed concerns of the scientists initially involved prevented the widespread dissemination of these viruses across the country and the world to other labs eager to study and use them as gene vectors. Voluntary restraint and safety guidelines are currently in use as far as these and other ''alien'' organisms are concerned.

Plasmids

A plasmid is a closed, circular ring of DNA native to many forms of bacteria which looks and acts something like an intermediate between a virus and a normal chromosome. It is less ''alive'' than a virus, even though it is much larger, because it has no protein coat and never a fatty membrane, so its organization is less complex. It is not designed to be a traveller so much as a stay-at-home (except for specific ''conjugative plasmids,'' which are transferred from bacterium to bacterium directly through little conjugating tubes in the bacterial version of sex). Plasmids are self-replicating, stably inherited, and much smaller in the number of genes they carry than are true chromosomes.

And plasmids, so far, are the best workhorse tools of genetic engineering around (at least for use in bacteria). Plasmids have none of the worst problems of using bacteriophages as vectors: although they are self-replicating, they are not infectious; they are large enough to accept the insertion of much larger foreign genes or gene sets for cloning than can viruses, which must be of a size limited by their protein coats. Plasmids also are much more host-range independent than viruses, meaning that they may often be transferred (in nature or in the lab) between totally different host bacterial species, whereas viruses such as Lambda are more or less restricted to a single host species such as *E. coli*. Thus the chance for more varied genetic exchange is far greater when using plasmids.

Utilization of plasmids occurs as described previously for the utilization of viruses: (1) specific foreign DNA is spliced into the plasmid; (2) the plasmid is ''fed'' to the appropriate bacteria (this is possible because bacteria have a tendency to take up DNA molecules spontaneously); (3) the plasmids multiply within the bacteria (a few to dozens of copies); (4) the bacteria themselves multiply with their plasmids inside; (5) the ''cloned'' genes can be harvested from the bacteria by purifying the plasmid; or (6) the foreign gene product can be

harvested from the bacterial cultures. The most commonly used plasmids for all of these manipulations are called pBR322, pMK16, pMK2005, and the like; and are, of course, plasmids from and used in *E. coli*.

It is plasmid-mediated genetic engineering which is behind the modern miracles of human insulin produced *en masse*, the production of monoclonal antibodies, and the potential for mass-produced interferon which are our best hopes yet for the cure of cancer. Such plasmid-containing bacteria are the patentable sources of income and the prime resources of the numerous genetic-engineering firms so recently springing up, to the delight of Wall Street. These mini-pharmaceutical companies in a test tube are the real spur and the true triumphs of modern genetic engineering and will remain so, for at least the near future. The slower-developing ability to design new plants and animals remains, for the time being, in practical benefits far behind the promise of wonder drugs for medicine and industry; and in potential far behind new strains of bacteria that may ferment and eliminate deadly pollutants or clean up oil spills biologically.

Mention might be made, however, of a particularly unique plasmid which seems capable, on its own, of transmitting information between a lowly bacterium and higher plants. The plasmid from the bacterium, *Agrobaterium tumefasceans*—the cause of a plant-tumor disease known as crown gall in a tremendous variety of plants from asters to zinnias—is known to carry genetic information in a stable, heritable form from the bacteria to the plant cells, changing their metabolism dramatically, and turning them into cancerous growths. Work is currently underway to utilize such plasmids for foreign gene transfer (and to eliminate any cancerous side-effects).

Animals and plants in general, however, seem to have no naturally occurring plasmids, so it is to the next section of the bestiary we must look for gene vectors of a safer nature than viruses.

Transposons

These are the newest of the newly discovered tools of genetic engineering. They are the least lively of the beasts in the bestiary, but perhaps the most important of all in the long term—for they have shown the capability of actually transforming genes in higher organisms for the first time in human history.

They can hardly be considered "beasts" at all. As are viruses and plasmids, transposons are not only non-organismal entities, but non-cellular, as well. They are firmly entrenched on the biochemical side of the life/non-life barrier. But they are the true "stuff" of life. Transposons are "jumping genes" —genes capable of spontaneous, self-mediated motion from chromosome to chromosome and—in the hands of the genetic engineers—from organism to organism, producing genetic change by design.

Transposons are made up of sequences of DNA which have been specially designed by nature to allow them to "insert" within other nucleic acid sequences: place themselves as a new

gene in the midst of others (like a gate-crasher at a private party).

They were first discovered, by their effects, back in the 1930s by Barbara McClintock, a corn geneticist who observed genetic changes occurring among her corn stocks that had no explanation in current genetic knowledge. She could only account for her meticulously recorded results by proposing the existence of mobile genes: genes that could move from chromosome to chromosome and have different effects depending on where they were located at any particular time. This would have been decried as genetic "heresy" but for the fact that it was ignored on the whole by the scientific community, partly because of the tremendous complexity of the data, partly because such studies seemed somewhat "academic," and partly because Dr. McClintock was more interested in doing the actual research than in promulgating her results.

It was only in the late '70s, with the discovery of "transposable elements" (transposons) in bacteria, that enough interest was sparked for researchers to begin looking back at McClintock's work—only to discover that she had scooped the young genetic engineers (and with discoveries in higher plants, not just lowly bacteria) by nearly forty years. And today transposons are turning up everywhere, in bacteria, plants, and animals. They may turn out to be the best tool for genetic engineering. For not only do transposons move themselves from place to place on the genetic map, they can also give a ferry ride to any hitchhiker the genetic engineer might happen to toss their way. It seemed almost as if nature herself provided the means for mankind to manipulate her secrets. And the proposed usefulness of transposons is not just "pie-in-the-sky science," as so much of the talk of genetic engineering turns out to be.

Drosophila melanogaster is the scientific name for the fruit-fly. It is a geneticist's dream organism: fast-breeding, easily raised, and possessing numerous, easily observed hereditary characteristics such as wing size and shape, and body and eye color, among others. How fitting that this widely used organism of such great value to genetic science should be the first animal to be genetically engineered for a defined, site-specific trait: a simple change of eye color, brown to red.

Scientists at the Carnegie Institute isolated a fruit-fly transposon (called a P element), spliced the gene "rosy" (which produces red eye color) to it, and injected it into fruit-fly embryos shortly after fertilization. Almost fifty percent of the embryos developed into red-eyed flies, when the genes that their parents gave them decreed their eyes be brown. And these red-eyed flies produced red-eyed offspring. Excited by these results, scientists are now trying to use the P element to transfer genes in mice, frogs, and even plants.

The main competition for the use of transposon-based genetic engineering in the transformation of higher animals was demonstrated recently in the case of laboratory mice genetically modified by a gift from their cousin, the laboratory rat. In this case transposons were not used. A segment of rat-DNA con-

taining the gene for a rat growth hormone was spliced to a mouse "turn-on" gene. This DNA was injected into fertilized eggs, which were then implanted in surrogate mothers. Six out of 21 surviving baby mice (170 eggs were treated) showed expression of the rat gene, growing 20 to 80% larger than their brothers and sisters. Some of these "giant mice" had 800 times the normal level of growth hormone (and it was of the rat, not mouse, variety). Similar experiments have produced mice with rabbit blood proteins, which is as biologically (if not as visually) significant.

Using such vectorless DNA may prove unreliable, though, in the long run. Such free genes incorporate randomly in the chromosomes, and may insert in places to the detriment of other genes or to the organism as a whole. This is especially to be avoided in the light of current thinking on the origin of cancer. Some cancers have been shown to be the result of viruses transferring normal genes to the wrong site on the chromosomes: *Rous sarcoma* virus seems to do this in chickens, and human T-cell leukemia virus in man.

Transposons make a better vector potential than viruses, as well, because they are not strictly "infectious" agents. The possibilities for catastrophe raised by the accidentally occurring Adenovirus 2-SV40 hybrids must be considered in all aspects of studying viruses as gene vectors. Transposons, at present, seem a much safer tool for the transformation of cells and embryos, because the possibility of their "escaping" seems nil. Their very safety, though, may limit their usefulness for transforming adult organisms in a therapeutic situation, because they can't move well from cell to cell.

Transposons may be the wave of the genetic engineering future, or perhaps other "aliens" or mutants of aliens already present in the bestiary will become dominant in the field. Most likely, all and more will be used concurrently, each where appropriate, providing a "living toolbox" to the genetic engineers and enabling them to choose between "wrenches" or "hammers" or "screwdrivers," depending on the project at hand.

* * *

These, then, are the living tools of the genetic engineering trade, the "beasts" in our bestiary. It is they and the technologies they make possible that will inaugurate the coming "miracles" of natural organisms modified on demand.

These new creations raise hopes of a technological Eden: cancer cures, the end to genetic diseases, cheap and plentiful pharmaceuticals, technologically created organisms to devour technologically created wastes, corn plants that fertilize themselves, etc., (and not to forget that part of this earthly paradise must certainly include prosperity and scientific fame for the technologists themselves).

With such great promise fanning the research flames, it is perhaps important for the general citizen as well as the scientist to consider the "living" nature of the genetic engineering tools: their ubiquity in nature and even in ourselves. Many of the science fiction scenarios which postulate biological warfare and

the release of mutant diseases or ecological nightmares can be visualized as accidental reality, vivid in possibility. Such didn't happen, but might have, with the Adenovirus 2-SV40 hybrid.

As long as the only regulations existing are the National Institute of Health guidelines, which have absolutely no force of law, public safety may well be the hostage of corporate profit or institutional prestige. The original expressions of concern by scientists themselves in the early days of the field at M.I.T. have been all but silenced in the Wall Street clamor for the new technology. Recently corporate lobbying helped to defeat more stringent regulation of genetic engineering in California.

To further illustrate the difficulty of our traditional governmental and regulatory agencies in dealing with the totally new phenomenon of genetic engineering, it can be shown that even the courts have taken what might be considered (at best) a parochial and (at worst) a bizarre position on the new technology, treating its products as it would any other manufactured good. Indeed, in the 1980 case of *Diamond* v. *Chakrabarty* the U.S. Supreme Court ruled that microorganisms created by the new technology were patentable *per se*, not just as pieces of the novel processes in which they were utilized.

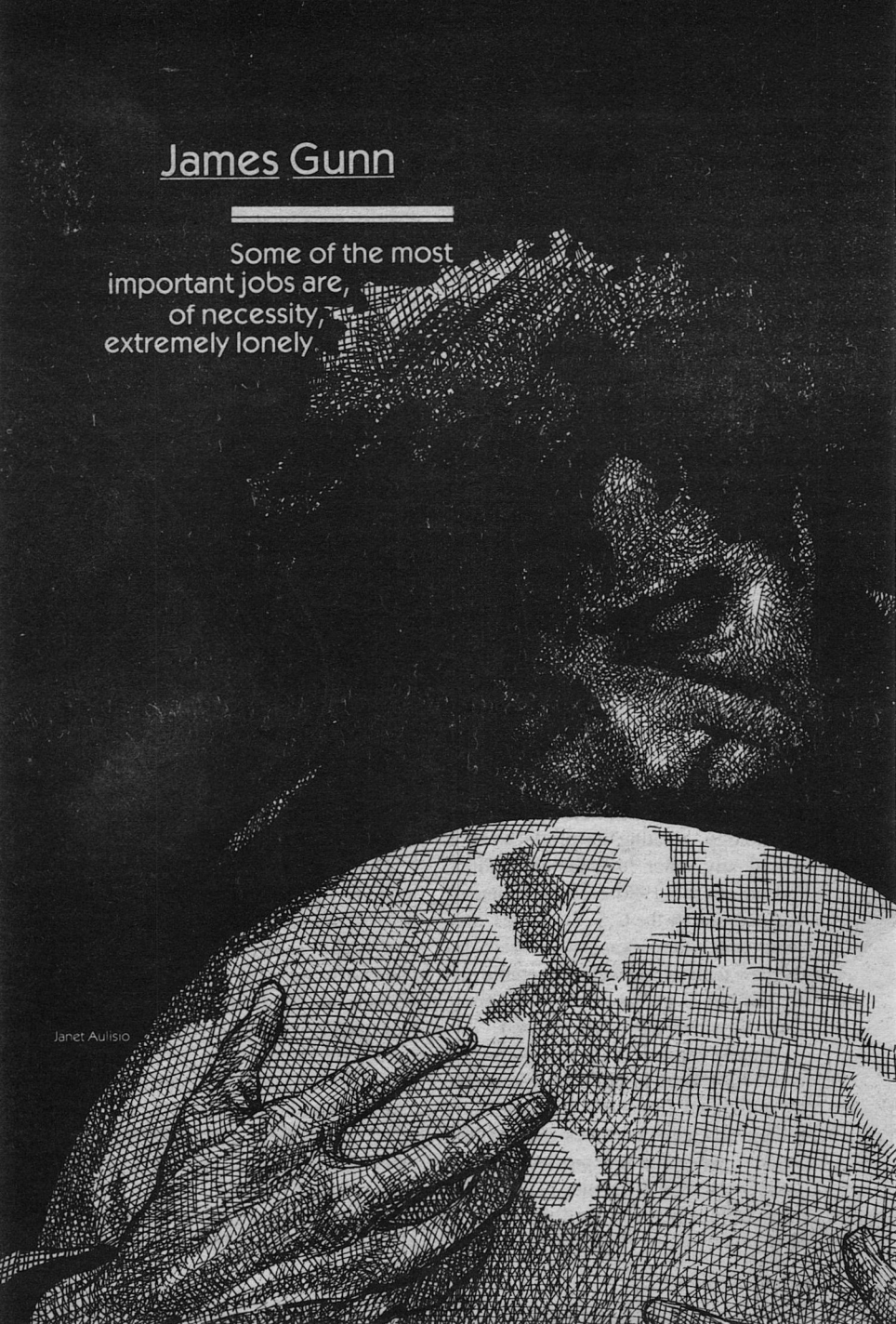
Thus organisms into which foreign genes have been inserted are patentable by individual firms and universities as if they were newly synthesized plastics. Some scientists have expressed concern —since the only difference between the patentable organism and its natural counterpart is the inserted gene—that the implication of the Court's decision is that genes themselves are patentable, and that companies may divide up the human gene pool (or that of any other species) as if it were an aristocratic inheritance rather than a common birthright. Although farcical to assume that we might pay a corporate tax on our body's own production of insulin, not so is the thought that only one company might be allowed to manufacture it; or have the commercial rights to produce other such naturally occurring compounds as interferon, human growth hormone, sex hormones, etc.

Under the auspices of such "economic freedom" as the Court has upheld, the corporate race to clone genes and patent the organisms into which they are inserted has escalated to economic warfare of fierce proportions. This is of special concern, for corporate research is totally immune to N.I.H. guidelines and governmental inspection, and the push for profit may well be an area where long-term or potential dangers are brushed aside.

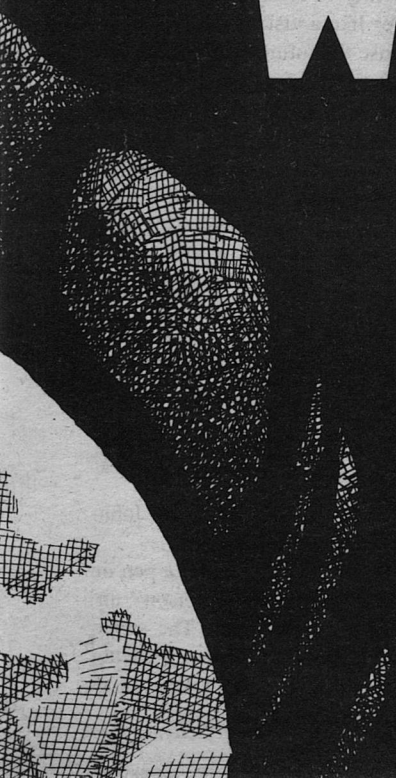
This is not necessarily to hold up the university or medical institute scientist as an untarnished rôle model for industry. Many scientists themselves use "scientific freedom" as the excuse for wanting to do whatever experiments they please with only such safeguards as they deem necessary.

Perhaps it takes a science fiction-educated mentality to recognize that this new technology is different from any other seen before. Its promise and peril is like that of no other.

But then, we've always realized that alien contact would be that way. ■


James Gunn
Some of the most important jobs are, of necessity, extremely lonely.
Janet Aulisio

THE END OF THE WORLD



He was lying on his right side, his right leg drawn up, his right arm stretched out, his left arm lying along his side and hip. Another wide bed was beside him, its slick, dark-green spread unwrinkled, its pillow-bulges intact against the dark wood of the headboard. Beyond the bed was a small desk with a straight chair in front of it. To its left was a six-sided pedestal table made of dark wood; armchairs on wheels and covered with green plastic stood on either side. Beyond that was a window sealed from the outer light or dark by heavy drapes and curtains, but a line like bright silver ascended vertically where they failed to meet.

The man rose to a sitting position, his knees drawn up. A television set stood in the corner, its large blank eye challenging him to fill it with pictures and meaning. A dresser with two sets of three drawers was against the wall at the

foot of the beds, above it a wide mirror. The room was standard hotel. Farther to the left would be a bathroom with a tub that could be turned into a shower by closing a curtain or plastic doors, a stool, and a broad, imitation-marble lavatory with a mirror above. If this were a better-than-average hotel, the bathroom would have an anteroom with an open closet facing a wet bar; on the bar would be a plastic tub that could be filled with ice from a machine down the hall and four plastic glasses sealed into polyethylene bags.

All of this the man should have known but didn't. Instead he swung his legs over the edge of the bed and stretched his arms high above his head in an instinctive gesture of loosening sleep-tightened muscles. When he stood up, he was of medium height. He was pleasant-looking, but nothing more, and slender; he had brown, curly hair and dark eyes and skin that looked evenly tanned. He gazed around him with the innocent absorption of a newly born infant and then his eyes stopped at a slip of white paper stuck to the right-hand side of the dresser mirror. He stood up and looked at it. "Read the letter in the top right-hand drawer," it said.

The man stood naked in front of the mirror and looked down at the drawer as if he didn't want to open it. Finally he moved his hand forward and pulled on the handle. A long white envelope lay just inside the drawer, crosswise, the return address of a hotel on its upper left-hand corner. The man reached into the drawer and removed the envelope. He tore it open. Inside were two sheets of hotel stationery with black hand-lettering on them.

"Your name is Bill Johnson," they read. "You have just saved the U.S. space program from termination, and you don't remember. You can find references to the political decisions in newspapers and magazines, but you will find no mention of the part you played.

"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 born in a future that 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 letter last night to tell you what I know, just as I learned about myself a few weeks ago in a similar manner, for I am you and we are one, and we have done this many times before. . . ."

The letter was signed "Bill Johnson."

The man in the room found a pen on the desk and wrote "Bill Johnson" under the name on the letter. The signatures looked identical. He took the letter into the bathroom, tore it into small

pieces, let the pieces flutter into the toilet bowl, and flushed them away. After he had finished showering—he did not need to shave—he collected a few toilet articles in a small plastic bag he found on the lavatory, and brought them to the dresser. The drawers were empty. In an imitation-leather suitcase resting on a rack beside the dresser he found clean underclothes and put them on. A shirt, a jacket, and a pair of pants were hanging in the closet. He put them on and the brown shoes that were on the closet floor.

In the pocket of the coat he found a billfold; in the billfold were one hundred forty-three dollars, a Visa charge card, and a plastic-encased Social Security card. The last two bore the name of Bill Johnson. On the dresser were a few coins, a key attached to a red plastic hotel medallion, and a black pocket comb. He put them in his pants pockets.

Finally he faced the Cyclopean stare of the television set in the corner and twisted and pulled the knobs until he found the one that turned it on. In a moment the screen was filled with the face of a news announcer, replaced occasionally by films and maps, but the controlled hysteria of the announcer's voice continued without interruption or variety, except when his voice and face were replaced by those of other reporters equally panicky and equally professional.

Johnson listened and watched for half an hour, sitting on the edge of the bed, occasionally looking as if he were seeing more than appeared on the front of the glass tube. Finally he turned the set off, went to the dresser, picked up his suitcase, and walked to the door. He looked back. Except for the unmade bed and the imprint of his body on the edge of the other, both of which soon would be removed, the room bore no trace of his existence.

He walked down the carpeted hallway, his footsteps as distant as the future, into the broad lobby. Sunlight slanted brilliantly through the distant glass doors, but reached only a few feet into the space. Elsewhere a subdued lighting from scattered lamps set by overstuffed chairs and sofas almost disguised the fact that the lobby was deserted.

At the front desk a dark-haired clerk who looked to be of draft age was listening to a portable radio. "Soviet forces continue to assemble at the Iranian border near the Soviet city of Ashkhabad and the Afghanistan city of Herat. The president has placed the U.S. military forces on full alert. Aircraft-carrier task forces are steaming at top speed toward the Arabian Sea from bases in the Pacific, and the Mediterranean fleet has put out from bases in Italy. Rumors persist that the president has been on the hotline to Moscow several times, but that mounting threats rather than conciliation has been the only result. . . ."

Johnson tapped on the desk with his hotel key, and the clerk, noticing him for the first time, gave an apologetic smile. "Sorry," he said. "People have a hard time keeping their mind on business these days."

"I know."

"You're checking out?"

"Bill Johnson," he said.

The clerk leafed through a metal file

and drew out a bill. "You're paid up," he said.

"May the future be kind," Johnson said, and picked up his bag and walked through the lobby into the blinding sunlight.

The nearby airport was packed with people twitching like a netful of newly caught mackerel. Lines jiggled in front of every airline counter. People moved from one to another as the fortunes of one line moved it forward and difficult problems or difficult customers delayed another.

Johnson took his place in one line and remained patiently in it as the line slowly moved forward to break against the counter like a wave in slow motion. Words of protest and pleading and anger reached Johnson as he neared the front. The man and woman just ahead of Johnson took a long time insisting that they had to get home, that they had children there and they had to get them out of town before the bombs fell, that they had tickets assuring them of a place on this flight. The ticket agent was blond and round-faced and a sweater. In other times he might have been jolly and sympathetic, but now he was frowning, and sweat gathered on his forehead and ran down the wrinkles and dripped on the counter while he explained with a calm close to fury that military passengers had first priority, that the government had recalled every military person on leave and called up everyone from the Reserves, and that the airline would get them the first available seats.

When he reached the head of the line, Johnson put down his small suitcase and said quietly, "That's good enough for me—the first available seat to New York." He handed over his credit card. His actions and words were like the first layer of pearl around an irritant.

The agent looked at him incredulously and then his anger began to leak away. He laughed. "There may be a special flight out of here about four in the morning. Otherwise it may be tomorrow night before I can get you onto anything."

"Whatever you can do. I'll wait as long as necessary."

The agent laughed again. "You're the kind of customer I can do business with, Mr. —" he looked at the credit card—"Johnson. We really shouldn't accept credit cards, you know. If the bombs drop there could be an electromagnetic pulse, an EMP, that could

wipe out all the computer records in the country.''

''If the bombs drop, money and checks won't be much better,'' Johnson said lightly. ''You have to go on as if disaster weren't going to happen. That's our only chance of preventing it.''

The agent looked thoughtful. ''That's right,'' he said. The line was stirring impatiently, and some customers were complaining to the air around them at the nerve of some people and their chit-chat when everybody else was in a life-and-death hurry, forgetting that they, in their turn, would take as long as they considered necessary. The agent tapped his computer keys, made out a charge slip, and handed ticket and charge slip to Johnson. ''No use asking you smoking or non-smoking. That's a luxury we can't afford any more,'' the agent said while Johnson was signing the charge slip and recovering his charge card. ''Maybe it's illegal, but who's going to check up?''

Johnson picked up his ticket and his suitcase and turned away. ''May the future be kind,'' he said.

''Yeah,'' the agent replied before turning to the next desperate customer.

The rest of the day, except for a few visits to the restaurant, the water fountain, and the men's room, Johnson spent staring out the broad windows at the airport runways. He did not stare the way the others did, like grackles turning their mad yellow eyes toward a falling sky, but like a member of the audience who knows when the curtain will fall.

Airplanes taxied to the head of runways like crippled albatrosses and sat for minutes that turned into hours as they waited their turn. More airplanes descended from the sky and sandpapered their tires across broad concrete before bellowing to a speed slow enough to turn onto ramps. Then the first airplane in line would swing onto the runway and start accelerating before quite lined up and then, gathering speed, lift its improbable nose into the air, and the giant weight of the great machine would follow, and it would climb.

One would arrive and one depart, and then two would arrive and one depart, then two depart and one arrive, persistently, hypnotically, interminably. The sky was cloudless and blue as if it had no thoughts different from the ones it had mused upon for eons past, of birds and clouds and smoke, of rain and hail and sleet and snow.

During the daytime the crowds of people clumped together, their luggage deposited around them like megaliths, and talked, at first agitated and then, as anger faded, in bitterness and fear. Others, isolated in cocoons of individual concerns, listened to radios or sat in front of television screens in the bars, drawing their eyes away only to order another round. Some competed for the chairs that were never planned for such a multitude; some stood or sat on their bags or settled on the floor where they could lean against the wall. Some fell asleep.

Troops in khaki and blue and green marched into the terminal and then stood around, smoking cigarettes and feigning nonchalance until ushered through metal detectors into waiting airplanes; then civilians surged forward, tickets clutched high in one hand, bags held in the other, all but a lucky few to be turned back by sweating airline personnel. Some left

the terminal in discouragement, but always more came until gradually, as night fell, the numbers dwindled as some gave up and others drifted toward nearby motels or homes.

By night the terminal assumed a different character. The coming and going airplanes were more mysterious and less fascinating; they appeared out of nothing preceded by lights glaring like the eyes of mad giants, and disappeared into nothing, leaving only their thunder behind. The lights in the terminal ceiling far overhead could not replace the sunlight that had streamed through the windows, and people turned to each other, spoke to strangers, confided their problems.

Talking about the terrifying uncertainty of attack, confessing why they had come to this distant place and why they had to get back, laying out their plans for what they would do when they got where they were going, how they would survive the bombs and how they would survive after the bombs, none mentioning the possibility of surrender, none of them repeating the cowardly statement that the living would envy the dead, all of them sure that living, if only for a few more days or a few more hours, was worthwhile, speaking most of all to the man with the curly brown hair and the dark eyes that looked as if they had seen too much for one so young. For he listened, listened while engines roared in the night like carnivorous jungle animals, listened to confidences and revelations in the sterile light of fixtures embedded in concrete beams high above, listened without judging, listened with occasional sounds of sympathy. . . .

And measured their guilts and their dreams, their fears and their courage.

And absolved them.

And that was the end of the first day.

After the fever of the airports —LaGuardia pulsed at an even high level—Manhattan was cool. An unbroken stream of traffic was leaving the island on all the bridges and through all the tunnels, and almost no traffic was entering. People moved warily; nobody spoke to anyone else, but occasionally an accidental jostle turned to screams and even blows.

And yet the island was calm. People went about their jobs purposefully or fatalistically. But there were fewer of them, and this reduced the pressure.

Johnson checked into the anonymity of the New York Hilton. There was no line at the registration desk and few people loitered in the lobby. The restaurants were almost deserted, even though it was breakfast time.

About ten in the morning Johnson walked the three short blocks to the Associated Press building in Rockefeller Center and took the elevator to the editorial offices. He told the receptionist that he wanted to see the managing editor. "She's busy right now," the young man said. He was tall and dark and not particularly good looking, but he had an expressive face. Right now it expressed suspicion. "May I tell her your name and the business you want to discuss?"

"Bill Johnson," Johnson said and smiled without showing his teeth. The receptionist's apprehension eased. "And the business I have is how to stop a war."

The receptionist looked at him as if speculating how soon to call Bellevue, but Johnson sat down peacefully in a chair beside an end table with a tall lamp on it, and the receptionist looked away. Johnson picked up a copy of the Associated Press annual report. The name of the managing editor was Frances Miller. After half an hour of reading balance sheets, Johnson was ushered into a big office. In it was a big desk made of some dark wood that gleamed in the sunlight coming through a window that looked out upon Rockefeller Plaza. Beside the desk was a computer terminal. Facing it were a couple of arm chairs covered in brown leather, and against the right wall was a matching sofa. Several framed pictures adorned paneled walls.

The woman behind the desk did not look like a managing editor or a Frances. She was cool and blonde and beautiful in a gray jacket and skirt and white blouse, but her eyes were gray and hard as if too many people had tried to talk her into too many things. "I understand you want to stop a war," she said. She looked at the LED time display on her desk. "I'm trying to report one, and I'm busier than you can imagine. You've got two minutes to convince me that I ought to take more than that."

"I've got just six days to stop this war," he said evenly, and sat down on the front of the chair facing the desk, "and two minutes to convince you to help me." He held out his hands as if measuring something in front of him. "I have visions of the future."

"Ninety seconds," she said.

"In five seconds your phone is going to ring, and an assistant editor is going to ask if he can release a bulletin—"

The woman's eyes had switched to the time display. As the five-second period elapsed, the telephone rang. After she put it down, she said, "That was a trick. You heard something when you came in, or saw people talking in the office as you came through."

"Your receptionist is going to knock at the door and ask if you need him. He means, of course, to help get rid of me."

After the receptionist went away Miller forgot to look at her time display again. Instead she looked at Johnson as if she saw him for the first time. "What kind of talent do you have?"

"I don't really see the future," he said, and when she started to speak he held up his right hand, palm up, in a gesture of explanation. "I see visions of what will happen if events take their natural course."

"Extrapolation."

"Yes, but more than just a guess."

"And what do you see now?" she asked, unable to keep a note of skepticism from creeping into her voice.

"Explosions. Flames. People dying. All over the world. Some quickly, vaporized in a fraction of a second. Some lingeringly. A world dying. Everything, animals, plants. I see an Earth as sterile as Venus."

"That's what everybody sees," she said.

"That's what everybody imagines," he corrected. "I *see* it."

His eyes were dark with knowledge and deep with anguish. She looked at them, and then, for the first time, turned

her gaze away as if she saw a fellow human suffering and could not help.

"I can see individual tragedies. Your death, for instance."

She held up a slender white hand. "No thanks," she said, with a touch of irony. "I want to be surprised. You said you had a plan."

"I said that my business was how to stop a war. But I do have a plan." He leaned forward as if taking her into his confidence. "I don't blame you for being suspicious. Lots of people must want to use you, and anybody could walk off the street with a plan."

Some of her inherent skepticism seemed to fade from her face. "It's just that you said you saw the world in flames."

"That's what will happen if events take their natural course." His voice was low and authoritative. "The future isn't fixed. I have personal knowledge of that. It can be changed. I hope to change it. I must change it."

The pain in his voice stopped her response for a moment. "How? I suppose the Associated Press plays a part in it?"

"You think this institution should not be used for someone else's purposes?"

"We're used all the time. But we don't do it knowingly unless it fits into our basic job."

"You make the news and people respond to it," he said.

"We just report what happens."

"Everything?"

"Of course."

"Everything?"

"Well, everything that is news."

"Is it news if you don't report it? I'm just a layman, but it seems to me that there is news you don't report in times like these."

"Like what?"

"News about the enemy that doesn't portray him as nasty, belligerent, murderous, treacherous, ignorant, despicable—"

"Stop!" she said, and smiled wryly. "There's some truth in that, but that's what people want to read."

"Oh," he said, "I thought you reported everything, not everything people wanted to read."

Her gaze came back to his eyes. "What do you want us to do?" She seemed weary suddenly as if she had been sitting in that chair, making too many decisions, for too many hours.

"I can tell you what, but it would be better if you didn't know why. Maybe you can figure that out for yourself." When she seemed about to speak, he held up a hand. "But it doesn't betray your country or your profession."

"What is it?"

"If you could get out a few items here and there that make the enemy seem human—items about his daily life, his loving acts, his generosity, his sacrifices, his hopes and dreams and fears—"

"I could get such items on the wire," she said, "but how could I get editors to print them or newscasters to broadcast them?"

"I'm not an expert in such matters," Johnson mused, "but I think I would assign them to someone very good, who would make the stories funny, dramatic, heartrending, witty—"

"You want us to use news as propaganda?"

"To use news as news. You don't

have to invent the stories. They're happening. You aren't reporting them now. That's propaganda for war. Just find out about them and report them. Call it propaganda for peace, if you must, but it's really only complete reporting."

She studied his face. "You're giving me lessons in newspaper ethics." She paused and turned her chair to look out the window for a moment. When she turned back her face was decisive.

"Will it stop the war?"

"It's an indispensable part."

"Then it's worth a try." She straightened up and took a deep breath. "I feel ten years younger." She looked younger, now no longer forty but perhaps only in her early thirties. "What about the Russians? How are you going to get them to print happy news about us?"

"It isn't necessary. Their news is managed and so are their people. If the leaders want peace, there will be peace."

Frances Miller stood up, slender and elegant, and walked around her desk. Johnson stood up as she approached. She took his left hand and turned it over as if to look at the lines in his palm, but her eyes, no longer hard and suspicious, were looking at his face.

"Before you came in," she said, "I would have bet a large amount that no one could talk me into anything this crazy."

"Why did you?"

"Maybe because you seem in so much pain. Who are you?"

"My name is Bill Johnson," he said.

She made a face. "The most common name in the telephone book. Where can I reach you if I need to?"

"I'm temporarily at the Hilton." He smiled as if to say he was temporary everywhere.

"Who are you really?"

"I don't know," he said. "I woke up yesterday morning and didn't even know my name, only that something terrible was going to happen and that I had to stop it. I'm a man with no past and no future, only a compulsion."

"What else are you going to do?"

"I need information about computer experts," he said. "Can you help me with that?"

"I'll get our science reporter. If he can't help you, you can look through his files."

By noon Johnson had the name of the man he wanted. Tom Logan.

The only problem was, the man was in jail—or should have been. But when Johnson asked for Logan at the dark old penitentiary up the Hudson River, the sullen clerk said he had been released more than a week ago and refused to tell Johnson Logan's address or even the name of his parole officer.

When Johnson got back to the hotel, the night was late, the sky was overcast, and the darkness was complete. A note waited for him to call Frances Miller. When he dialed the number she answered immediately.

"I thought you'd want to know," she said. "I've alerted our foreign correspondents, and the stories are coming in. I've got my best human-interest writer working on them, and the first of them ought to be out by morning. They think I'm crazy, you know."

"You're quite sane."

Her laughter was uneasy. "Sometimes I wonder."

"Only a crazy person would want to

start a war. The people who want to stop one must be sane. You're working too hard. You're going to kill yourself."

She laughed. This time her voice was steadier. "Better me than a stranger. Are you on to anything?"

"I'll know tomorrow."

"If the world doesn't blow up first."

"We've got a few days left."

"How long?"

"You don't want to know."

"You're right. Knowing something like that would be terrible." There was a moment of silence as if she were recalling that he bore that terrible knowledge. "Your voice sounds different on the telephone."

"Everyone does."

"I know—but your voice sounds more—personal, as if I could tell you things."

"What do you want to tell me?"

"Oh"—she laughed—"nothing. Maybe some other time. Will we be in touch again?"

"I think so."

"Then goodbye for now."

"Goodbye."

She may have said something, but it was too soft to be heard. A moment later the telephone clicked and the dial tone began.

That was the end of the second day.

In the morning the world looked brighter. The clouds had parted and blue skies roofed the city's concrete corridors. The tension in the streets had dropped a level as if the barometer determined the likelihood of war.

Johnson's first stop was the building that housed the state department of probation and parole. Then, with a nearly illegible mimeographed list of local parole offices that he had mused over with a blue ballpoint pen, he began to visit the ones he had checked. Only one in three parole officers was in when he asked for them. Some secretaries made excuses, but everyone, secretary and parole officer alike, shook their heads at the name of Tom Logan.

Finally, at the twelfth office, a good-looking, dark-haired secretary said about her boss, "I think the bum's skipped town, but he might have told me." And then, "Yeah, I remember Logan. He reported here about a week ago. I noticed him particularly because he was too young-looking—too young to be a con, you know? Like a kid. No, the jerk locked up the files and took the keys. Like how am I supposed to get the work done around here?" After a pause in which she appraised the face and figure of the man standing in front of her, she said quickly, "I remember one thing. He had a job with a computer firm. I don't remember which."

"But that's why he was sent to prison."

"I guess he was. Well, they don't give me reasons."

"Thanks, anyway," Johnson said and turned to walk away.

"I get off work about five," the secretary called after him. "Earlier if the jerk never shows."

"Thanks," Johnson said, "but I'm going to be busy."

He found a telephone booth with directories still present in their holders. The yellow pages, though, looked as if they had been attacked by gypsy moths. Listings for computer firms, computer repairs, computer retail stores, and com-

puter service were still intact, however, and with a quick glance to both sides Johnson ripped those pages free. Occasionally checking a small photograph he took from his pocket, he began to mark the listings with his pen.

Finally he walked purposefully along the Avenue of the Americas for a few blocks, staring into windows filled with keyboards and display screens. He returned toward Forty-Second Street on Fifth Avenue, occasionally stepping into the lobby of an office building to scan the directory before returning to the street. He made a similar fruitless search up Madison Avenue and started back on Park. It was there, in the lobby of a tall office building, gleaming with freshly mopped marble and polished stainless steel, that he stood for a long time, staring at the directory, looking at the picture, and finally finding a spot near a newsstand where he could buy a newspaper and stand reading it unobtrusively while he watched the bank of elevators that served the top ten floors.

A radio at the newsstand nearby was turned to an all-news station that kept broadcasting hysterical bulletins, but occasionally, as if for change of pace, a cleverly worded human-interest item from a socialist country was inserted into the sequence of pre-war news. The first time it happened, Johnson heard the vendor mutter angrily, the second time he said, "Would you listen to that?" and the third time, "Well, what do you know?"

The elevator traffic was sporadic until just before noon, when every car began coming down full. In the midst of one group Johnson saw a short young man with a clean-shaven face and close-cropped red hair. He didn't look more than eighteen. Johnson followed him through the revolving door onto the sidewalk and caught up with him halfway down the block. "Tom Logan?"

Logan gave a quick, sidelong glance as if he were accustomed to sizing up people in a hurry. He frowned. "You're not police," he said, but there was apprehension in his voice. "I'm clean."

"I'm not police."

"I don't want to go back."

"I understand. I'm a private citizen. I need your help."

"I've got only an hour for lunch. You know, I've got to be punctual. I won't do anything dishonest. I'm through with that."

They were walking side by side. Johnson had fallen into Logan's hushed, sidelong way of speaking that no one near could overhear. "Why did they let you work for a computer firm?"

"You mean after I transferred ten million dollars to my own account?" Logan made a right turn toward Lexington. "They never caught on to that. It was when I started investing in old masters, and even that wouldn't have raised suspicion. I was paying for them out of secret Luxembourg accounts. No, it was when I had to go see them. It wasn't the computers that did it; it was the human element. Now—well, what better job for me than to train them to detect computer crime? Even the cops call me when they come across something suspicious."

They had reached a small, dingy Italian restaurant on Lexington, and Logan led the way into the dark interior, his shoulders twitching as if he wished

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Johnson would walk on past the entrance and disappear. But Johnson still trailed him when Logan stopped at a table with a red-checkered tablecloth and sat down. He sighed. "Okay, who are you, and what's your problem?"

"My name is Bill Johnson," Johnson said patiently, gripping the edge of the table with both hands as if to demonstrate that he was without guile or subterfuge, "and I want to stop the war that is going to happen in a few days now if we don't do something about it."

"We?" Logan echoed.

"You, me, everybody."

"Not me," Logan said. "I don't owe this world anything." He brushed away the waiter who appeared with water glasses and menus.

"How about ten million dollars?"

Logan shrugged. "That was just numbers in a computer."

"You've got more to lose than most people," Johnson said. "You're younger than most. You have a lot of living left."

"I've already done a lot of living, and most of it I didn't like. Besides," he said skeptically, "how could we stop a war?"

Johnson leaned forward and put his right elbow on the table to gesture with his right hand. "You and I can't, not all alone. And me—I'm helpless without you. But you and me and a bunch of others."

"Get together?" Logan scoffed. "Get up and say, 'Stop this bad thing you're doing!' like the ban-the-bombers?"

"Nothing like that."

"Like what, then?" The waiter returned, but Logan gestured impatiently for him to go away when the man was still two tables away.

"If you had the right equipment, could you tap into Pentagon computers?"

"You're talking espionage!" Logan said, jerking back. "Maybe treason!"

"Isn't there a difference between war secrets and peace secrets?" Johnson asked.

"Not to them guys. They're all secrets." Logan shivered.

"How about the Soviet military computer, the big one in Moscow?"

"Wait a minute! I haven't answered about the Pentagon yet!"

"You haven't said you couldn't."

"There isn't a computer anywhere I couldn't sneak into given enough time and good equipment, and the equipment doesn't have to be that good. But I haven't said I'd do it. This could get us killed."

"No one ever caught on to your financial manipulations. Besides, if we don't do it we're going to be killed anyway."

"There's that," Logan admitted. "But how do I know your plan has a chance?"

"How do you know it hasn't? You have to trust me. I could explain it, but we don't have the time. In any case, wouldn't it be better than simply waiting for the world to explode?"

"Maybe," Logan said. He had looked at his watch when Johnson had mentioned time. His watch was a complicated computer model. "I've got to go."

"You haven't had lunch."

"I've lost my appetite."

"Will you help?"

Logan hesitated. "Meet me at five.

Where you picked me up when I stepped off the elevator. By the way, how did you know where— Oh, never mind! I'll tell you then."

Johnson watched Logan's narrow shoulders until they passed through the door. They didn't seem to be twitching any more.

When Logan emerged from the elevator, his face was calm and confident. It was totally different from the look of scared cynicism he had turned to Johnson at noon. Now he looked no older than fifteen. "Okay," he said as Johnson moved up beside him, "when do we start?"

"Now."

"Good. But let's pick up some sandwiches. I'm starved. Where are we gonna do it?"

They were on the street now. A few people, having emerged from the building, were looking up at the sky as if seeing an ICBM would help them. New threats had been hurled as if they blazed trails in the sky for missiles to follow.

"Not here?" Johnson asked, waving his hand at the skyscraper behind them.

"Everything is sewed up tight," Logan said, looking up as if he could see the seams from here. "I showed them how. Maybe I could open things up again, but they've got heat sensors after hours, and they won't let me have a home computer. Conditions of parole."

"I have an idea," Johnson said.

With a sack of sandwiches and a carton of coffee, they walked into the Associated Press Building. "Wait here!" Johnson said as they reached the reception area. The receptionist was gone and the pace of activity had slowed, reporters still were scattered at desks around the big news room, and Frances Miller still was at work in her office. She came back to the reception area with Johnson.

"I've got a spare office with a computer terminal, but I don't know why I let you talk me into these things. Him?" she said.

"Computer experts mature early. Like mathematicians," Johnson said. He smiled at Logan. "Tom has been telling me that kids are born today with computer skills, the way they used to be born knowing how to fix automobiles."

She sighed. "Follow me," she said, and led them to an office not far from hers, and left them alone.

Logan settled behind the terminal like a concert pianist easing himself into position behind a concert grand. For the first time since Johnson had seen him, he looked comfortable. Logan stretched his fingers in front of him and then wriggled them as if loosening them for a performance.

"Will it do?" Johnson asked.

Logan let his fingers rest lightly on the keyboard and pressed the "on" switch with one little finger. "All terminals are basically alike. The important thing is what they're hooked into. This one has connections all over the world, including, in one way or another, every computer that isn't self-contained, that has telephone or microwave links with other computers. If any of them anywhere is tied into a public information network, they can be breached."

"Does that describe the Pentagon computer and its counterpart in Moscow?"

"It should. You can't have a com-

puter of the size and complexity they have to be that doesn't have to communicate with other computers and somewhere along the line pick up information from outside the network. It's just a matter of figuring out the weak points, the access keys, and the information codes.''

''How long will that take?''

''Maybe a few hours. Maybe a few days.''

''We haven't got a few days.''

''I sure haven't,'' Logan said. ''If I'm not back on the job at nine in the morning I'd better be in the hospital or it's back in the slammer. Now, what is it I'm supposed to get out—or put in?''

''I'll tell you when I get back.''

Johnson stuck his head into Frances Miller's office. ''Come on,'' he said, ''I'm going to take you to dinner.''

''I've got too much to do,'' she protested, but the weariness that had begun to tug at her face and paint purple shadows beneath her eyes lifted for a moment.

''No excuses,'' Johnson said. He pulled her to her feet and marched her to the door. She went, laughing.

When they were outside, she asked more seriously, ''How is it going?''

''The flames have receded a little,'' he said, ''but they're still blazing in the background, waiting to return if we fail. Do you have a favorite restaurant?''

''There's a little French place that's open in the evening, just around the corner.''

Over dinner she told him about her early life in Kansas City, her education at the University of Kansas, her experiences as a reporter on a series of newspapers, her marriage and its break-up, her first job with the Associated Press and the slow climb to her present position. . . . He listened attentively, interrupting only to ask questions at the right places.

''My second marriage was even shorter than my first,'' she said. ''It is very difficult for a woman who has a satisfying career to achieve intimacy—'' She broke off. ''But you know all about that, don't you?''

But he had no stories to tell about himself.

When they returned to the office, Logan was sitting in front of the computer terminal, staring at the screen intently as his fingers played across the keys, green lines of information marching across his face.

''We're back,'' Johnson said. Miller nodded and returned to her office.

Logan looked up reluctantly and smiled. ''I haven't had this much fun since I ripped off the Chase Manhattan,'' he said. ''I've got the Pentagon connection and a line on the Moscow computer. What do I do now?''

''What I want you to get for me is the U.S. diplomatic fallback position.''

''What?''

''The final compromise we'd be willing to make to stop a nuclear war—if we got something in exchange from the Russians.''

''And?''

''And feed it to the Russian computer in such a way that it looks accidental but calls attention to itself. As a last resort, put it on a cassette and we'll mail it to the Soviet embassy.''

''What good will that do?''

''What you don't know you can't testify about if anything should go

wrong—don't worry, nothing will go wrong. Then I want you to get the same information from the Russian computer—the ultimate compromise they'd be willing to make to keep the missiles from going off—and plant it in the Pentagon computer."

"What if I leave evidence?"

"Good," Johnson said. "It will help if they know their ultimate compromises have been compromised. We don't want to leave them thinking they know the secrets of the enemy and the enemy doesn't know theirs. They'll think they can take advantage."

"I get it," Logan said, his expression brightening and then darkening almost immediately. "I think."

"It doesn't matter if you can get it done." When Logan turned back to the screen, Johnson stood for a moment with his forehead clasped in his right hand, leaning against the door frame.

At fifteen minutes past midnight, Logan, flushed and pleased, emerged from the office with two cassettes in his hand. "This one," he said, handing Johnson a cassette with a green label, "contains the Russian material. And this one"—he handed over a cassette with a red label—"contains the U.S. position. I guess I got the colors mixed up," he said apologetically.

"I'll remember," Johnson said. "Are you all done?"

"Complete. Wiped clean. Just a couple of false trails that suggest an accidental transfer of information to the enemy."

"That's great," Johnson said. "People feel better about bad luck than about espionage. Nevertheless, we can't trust them to discover the exchange on their own. I'll mail these in the morning. Tom, you've done a marvelous job. I don't think there's anyone else in the world who could have done it."

"I ought to thank you—I don't even know your name."

"Bill Johnson."

"Mr. Johnson. This was an opportunity to really have fun—and sort of make up for the kind of selfish use I made before of what I can do." He walked toward the elevators, his hands in his pockets, whistling, like Huck Finn heading for the frontier.

Johnson turned to follow him and saw Miller standing in the shadows. "Is that it?" she asked.

He nodded.

"Not the end of the world but the end of the war?"

"Hope for the future," Johnson said. "In my head the explosions are stopping one by one. The flames are dying down. The screams and shrieks are fading away. When I get these mailed off, maybe I can rest again."

"Won't there always be a new crisis?"

"Maybe I'll run out of them." But he smiled ruefully as if in recognition that he would never run out of them, not as long as there were people.

"Can I come with you? Back to the hotel?"

"Why would you want to?"

"You're more lonely—more alone—than any man I've ever met. And—I'm alone, too. Maybe, for a moment, we might not feel so isolated." She waited as if for a gift she did not deserve but wanted just as much.

"I might not know who you are in the morning," he said.

She smiled. "Oh, I think you will."

In the night she spoke his name. "Bill," she said. "Are you awake?"

"Yes."

"In case you do forget, I want to tell you now that if everything works out you have done something greater than—well, there's nothing to compare it with except maybe the creation of the world."

"I didn't do anything—just gave people the opportunity to make the right decisions."

"Like me? Was that what I did?"

"Great events are propelled by great forces. Usually equal forces hold them back, but when those forces slacken and events get rolling toward some cataclysmic conclusion their momentum builds."

"Like news that reinforces people's beliefs in the inhumanity of the enemy?"

"Almost as if we can't work ourselves up to destroying an enemy unless we first convince ourselves that he isn't human. That's why we have to call them 'gooks' or 'fascists' or 'commies.' "

"And the stories I was distributing, that described the enemy's humorous, sentimental, good-hearted moments—they made us pause and think. But what about Tom Logan? What did he do?"

"He gave the leaders on both sides a chance to save face—the opportunity to make concessions that the enemy knows you are willing to make and in the assurance that the enemy also will make concessions that you know about in advance."

"What kind of concessions?"

"I don't know. Maybe you'll find out in the next few days, maybe not. I won't. I'll have forgotten. I was making a bad joke about forgetting you in the morning. That won't happen until I mail off the tapes. But the next morning—"

The darkness in which their voices had hung disembodied was undisturbed for a moment. Then she said, "Bill?"

"Yes?"

"Maybe you should have something more to forget."

That was the end of the third day.

When he awoke in the morning she was gone. He looked around the room. It was not much different from the room in which he had awakened three days before: standard hotel. But there was one change. She had left something on the desk, a small machine.

He got up and walked slowly to it. The machine was a small cassette recorder. On it was a note, written not too legibly by a hand that had scribbled too many notes in a reporter's pad. It said, "Maybe this will help you remember."

He pushed the button marked "Play."

Her voice began. "This is Frances Miller, and I want you to remember the person who helped you when you needed help, and you helped more than you can know. . . ." There was more, but he stopped it. She thought it would be simple, but she didn't know what it was to have a mind like a slate periodically wiped clean. Tomorrow she would be a stranger, and he a man who had no memory of her or their intimacies. No normal person could stand that. And he—he was weak. He did not dare allow himself a reason for not intervening.

He pressed the rewind button and began to record over the previous message. "Your name is Bill Johnson. You have just saved the world from World War III, and you don't remember. You will find stories in the newspaper about the crisis through which the world has passed. But you will find no mention of the part you played.

"For this there are several possible explanations. . . ." ■

Hugh Downs' Four Rules for Investigating the Universe:

Rule #1—When confronted with an apparent infinity or infinitely repeating pattern, expect some variant that keeps it from being infinite.

Rule #2—When all investigation supports Rule 1, look for a situation which violates it.

Rule #3—Be prepared for an infinite oscillation between Rules 1 and 2.

Rule #4—Apply Rule 1.

Jay Kay Klein's biolog

When an act of Congress created James E. Gunn an officer, it would have been redundant to declare him a gentleman. Impeccably dressed, suave, and urbane, Jim Gunn was briefly an ensign, then lieutenant junior grade in the closing days of WWII before going from officer (and gentleman) of the U.S. Navy to gentleman and scholar as professor of English at a major university.

He was born and raised in Kansas City, Missouri, entering the navy at 18 for pilot training. A few months later, with occupation personnel more in demand, he was transferred to Japanese language school. Soon a civilian, he earned a B.S. in Journalism from the University of Kansas, did work in drama at Northwestern, and secured a Master's in English from the University of Kansas. His 1951 thesis on science fiction ("Modern Science Fiction") must have been one of the first ever. A 20,000-word excerpt appeared in a science fiction magazine

Jim started reading science fiction at age seven or eight when he found some Burroughs novels in his grandmother's closet. His first real writing effort was published in 1949 in a now-defunct magazine. Several stories later, "Private Enterprise" appeared in the July 1950 issue of this magazine. His first ten stories used the not-too-cryptic pen name "Edwin James," since he thought then to reserve his full name for scholarly work.

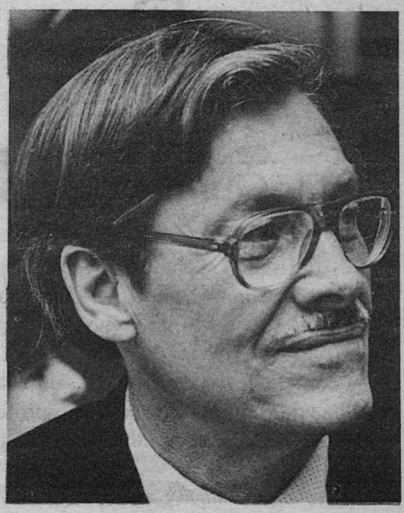
As a full professor at the University of Kansas, Jim finds little interest for activities outside university duties and writing. He has twenty-four books in print either as editor or author, and is well known for his critical studies of science fiction.

Alternate Worlds: The Illustrated History of Science Fiction received a special Hugo Award at the 1976 world science fiction convention. *The Listeners* placed second in the 1972 John W. Campbell Award competition for best science fiction novel. The Science Fiction Research Association presented him with its Pilgrim Award in 1976, and he became the group's president in 1980. He also was president of the Science Fiction Writers of America in 1971. Most recently, *Isaac Asimov—The Foundation of Science Fiction* received a Hugo at the 1983 world convention.

Jim touched general America through TV, first with a story dramatization in 1959, then with *The Immortal*, a 1964 novel that became an ABC movie in 1969 and was followed by a series of fifteen episodes. With science fiction now so ubiquitous in American life, Jim looks back and says he never thought it would be a field of academic study. However, he always thought science fiction was the equal of any other type of literature, though its pulp beginnings were often short in writing skill. He has tried to introduce in his own writing the best techniques a trained person can employ, and feels science fiction is better written today than ever before. He especially likes to see science integrated well with literary values.

The story in this issue is a "prequel" to one in the March 1977 issue. ■

James E. Gunn



CEMENT

Ben Bova

Our history lesson for today . . .

Professor Uriah K. Pencilbeam, an obscure anthropologist from a virtually unknown small college in (where else?) southern California, has announced a theory that has sent shock waves throughout the myriad worlds of science, government, and industry.

"I don't believe a word of it," said Toby ("Slug") Solazzo, one of Los Angeles's leading building contractors. "This professor don't know what he's talking about."

But the head of the anthropology department of a prestigious Ivy League uni-

versity has said of Pencilbeam's theory, "He's explained it all. There's nothing left for the rest of us to do except fill in a few of the details." The Ivy League anthropologist refused to allow his name to be used.

Briefly stated, Pencilbeam's theory is this: *Governments exist for the benefit of building contractors.* Indeed, Pencilbeam insists that governments were originally created, back in the Old Stone Age, so that building contractors could flourish.

As the professor himself puts it, "If it means pouring cement, a government will do it. If it doesn't mean pouring cement, a government *might* do it, but the chances are much slimmer."

In his startling research paper, which is already rumored to be in line for a Pulitzer Prize, Pencilbeam gives a long list of examples to bolster his thesis.

Ancient Egypt, he claims, was little more than a few scattered towns strung out along the Nile until the first Pharaoh united the Upper and Lower Kingdoms into a single political entity. Historians and paleontologists have always been puzzled as to the reasons for this sudden unification. Pencilbeam has the answer: the building contractors lobbied for unification so that they could get to build the colossal monuments that we still revere today: the pyramids, the sphinx, Cleopatra's Needle, etc.

Pencilbeam points out that the ancient civilization of Sumer, on the plain between the Tigris and Euphrates Rivers in what is now Iraq, was just as old and perhaps even older than Egypt. But they built their cities out of bricks made from dried mud. "No cement, no endurance," Pencilbeam says. The Sumerian civilization decayed, while Egypt flourished for thousands of years.

Every conqueror and emperor from Caesar through Napoleon was secretly a front man for the construction contractors. Look at the money and effort they lavished on building their capital cities. Caesar was assassinated when he threatened to stop construction of the Circus Maximus, which was suffering from serious cost overruns and labor disputes. Napoleon practically rebuilt Paris—except for Montmartre, where the nightclub interests were already firmly entrenched. While his *Grand Armee* was freezing its collective butt in Russia, Napoleon's building contractors were amassing huge fortunes back home.

It is interesting to note that barbarian conquerors such as Attila, Genghis Khan, and Tamarlane had no lasting impact on history despite their extensive conquests. This is true precisely because they poured no cement, according to Pencilbeam's theory. They came, they saw, they conquered; but they did not build any public monuments, bridges, highways, or condominium complexes. In Pencilbeam's view, one way to delineate a barbarian from a true empire-builder is to look at the state of the construction industry during a man's reign. Contrast Genghis Khan, who conquered everything from the coast of China to the Danube River, with Cecil Rhodes, the Victorian Englishman who dreamed of a railroad from Cape Town to Cairo. How many Khan Scholarships are there in the world today?

Pencilbeam's theory even explains much of recent and current history. Adolph Hitler would have been the greatest ruler of all time, considering the amount of

cement he expended on bunkers, pillboxes, tank traps, bomb shelters, etc. Fortunately for the Allies, brilliant military thinkers hit upon the idea of demolishing those constructions by aerial bombardment and—also by bombing night and day—*preventing the Nazis from erecting new constructions*. Unable to pour cement effectively, Nazi Germany eventually collapsed.

In the United States it has long been known that if a state or local government can start a construction project, it will. Traditionally, the federal government's role has been limited to constructing post offices and interstate highways, except for Washington, D.C., where the amount of cement used is obvious even to the most casual visitor. (*Vide* the Washington Monument, the new Metro, *et al.*)

Even the U.S. space program is no exception to Pencilbeam's penetrating theory. NASA was at its prime, with virtually unlimited funding, in the 1960s when the space agency was pouring megatonnages of cement for its facilities at Cape Canaveral, Houston, and elsewhere. Once those facilities were built, once the cement hardened, NASA's funding woes began. Not even the space shuttle (which uses practically no cement at all) has significantly brightened NASA's funding picture.

Every valid scientific theory must be able to predict new phenomena, as well as explaining old ones. Pencilbeam points out that the MX missile program, which will require the expenditure of huge amounts of cement wherever and however the missiles are ultimately based, will eventually pass congressional muster and go on to full-scale construction. Of course, the Russians—who are probably slightly ahead of the U.S. in the cement race—might revert to the World War II tactic of demolishing the cement sites and establishing their own construction industry as supreme in the world.

If they do, Pencilbeam insists, the survivors of the nuclear exchange will undoubtedly start right in where civilization began: pouring cement and pressuring the government for bigger construction contracts. ■

IN TIMES TO COME

● I'm writing this a little earlier than usual—for a variety of peculiar reasons—so I am, if possible, even less sure than usual exactly what will be in next month's issue. I'm reasonably positive, though, of at least two novelettes. The February cover story is "The Expediter," by J. Brian Clarke, who's been absent from *Analog* for much too long. The story involves a most unusual alien artifact—or a whole slew of artifacts, depending on how you look at things—and a man with an oddly special job in the effort to find out what it is.

The other novelette with a firm toehold in our February issue is Michael P. Kube-McDowell's "Menace," about a sinister little struggle for minds. "Sinister," of course, always refers to The Other Side, no matter which one you talk to. . . .

The fact article is in a rather unusual field, dealing with one of the oldest, softest, and still most important technologies. Its title is "Axes, Saws, and Alphabets," and author Margaret M. Bishop is uniquely qualified to write about the problem she's discussing.

On Gaming

Dana Lombardy

Combots by FASA Corporation (Box 6930, Chicago, IL 60680) is subtitled: "The ultimate weapon is no longer a dream . . ." That ultimate weapon is an intelligent robot—a combot—used to fight other intelligent robots in a controlled sporting event.

These gladitorial contests use modified military combot chassis and take place in a diamond-shaped arena. The introduction states that these battles "are now the most popular form of spectator sport entertainment in the Terran Confederation."

Combots comes with an 11-by-17-inch-full-color mounted map of the arena; a 16-page rules folder; two dice; and 56 cast-metal parts that can be put together in a variety of ways to make two complete combots.

The first part of the game involves building your combot. There are three different types: scout (moves twice as fast as other models, but carries fewer weapons); warrior (the basic unit); and marauder (the largest and most powerful). After deciding which combot to make (both players must fight with the same model), you then choose the weapons to make your combot unique and personalized.

You begin with the basic chassis: the strategic command unit or head, one to three equipment tenders (body) that hold the weapon modules, and a main propulsion unit used only for interplanetary flight.

Your choice of weapon modules shows your tactical leanings. For each equipment tender, you may attach up to six of any of the following modules: maneuver engine or retro (without these, the combot cannot move, while the more retros it has, the better its maneuverability); hydraulic claw (good for close-range fighting); laser (most reliable long-range weapon); aiming mechanism (improves the accuracy of the laser); missile launcher (best for hit-and-run attacks); armor plate or laser shield modules for protection; and an ECM unit that deflects incoming missiles.

Each combot, whether scout, warrior, or marauder, has a maximum number of any one type of module it can carry for arena battles. Otherwise, you're free to design the combot as you see fit.

Combots start at opposite ends of the arena. Four walls in the center create a small fighting zone and prevent a direct shot on the first turn.

Each turn is divided into five segments or "pulses," and each pulse is divided into six phases. During each pulse, the players can launch missiles, move their combot, and attack the enemy combot. The player who succeeds in destroying the other combot's attack modules (claws, lasers, missiles) wins the game. If both combots are stripped of these modules, the game ends in a draw—or in an immediate rematch using the same weapon modules as they began with.

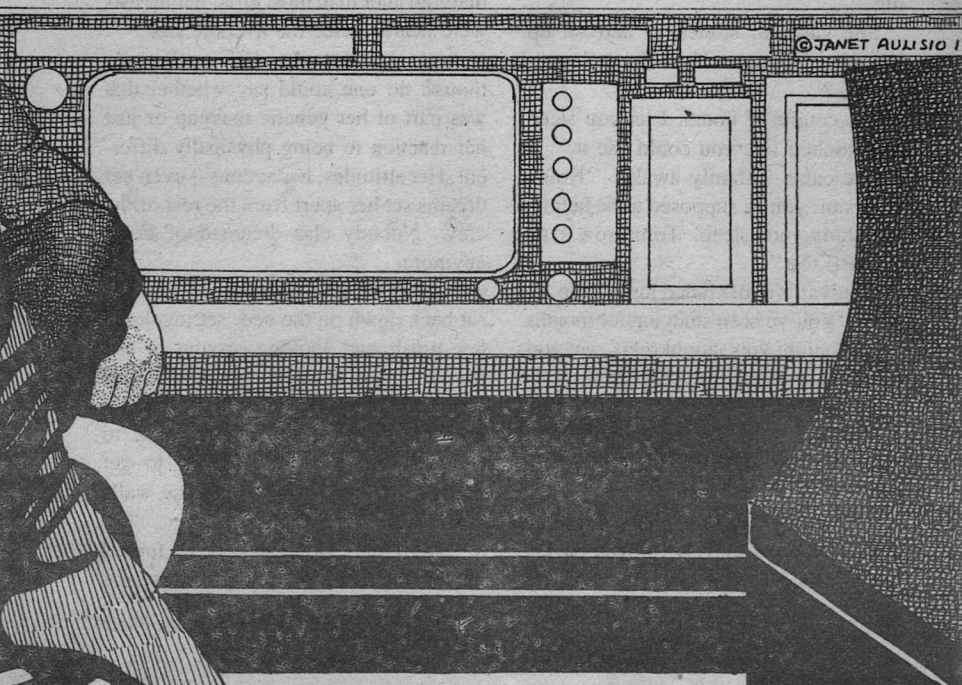
During each of the five pulses in a turn are six phases: systems malfunction phase (only done in the first pulse) for

(continued on page 143)

FRAME OF REFERENCE

Jerry Oltion

Every machine has a purpose—but when you haven't read the manual for a while, your memory of that purpose can become a wee bit garbled. . . .



LeAnne felt the grass between her toes, felt it softly tickling her bare skin, and knew that it was fading. Off in the forest a bird sang a high melody to the rising sun, but its song began to change, to flatten into the electronic bleeps and twitters of a computer terminal. A medley of other noises worked their way into her mind. They were the sounds of a starship in flight, familiar sounds to a girl who had been born and raised on board.

She lay still for a moment, sorting out her thoughts, reluctantly packing away her world of dreams for another time. She opened her eyes. She lay on her bed, propped up against the wall with a pillow wedged in behind her. At the foot of the bed an elf stared intently into her desk terminal. He turned when he heard her stir.

"Welcome aboard," he said, smiling.

She yawned, stretched, and sat up. "Wow. Dreams. How long have I been—?"

"A couple of hours. I let you sleep. You looked like you could use it."

She came instantly awake. "Hours! Donivan, you're supposed to be helping me study, not sleep. Tomorrow's my SHAPE test!"

Donivan's smile faded just a little. He said. "You've been studying for months, Lee. Tonight you should relax, get your mind off it so you can hit it fresh in the morning."

"Relax? Sure. It's only my SHAPE test, after all. It's just the rest of my life."

"You *were* relaxed, just a minute ago," Donivan said. He looked back to the terminal screen and added softly, "Besides, you looked so beautiful I couldn't bring myself to wake you."

LeAnne felt herself blush. "So what do you know about beauty," she asked impishly. "You run around with a mutant." She slid to the end of the bed and picked up her brush off the desk, then turned toward the mirror.

Behind her Donivan said, "I'm the mutant, Lee. Me and the rest of the crew. We may outnumber you, but we're still the mutants."

"Atavism then," LeAnne said, tilting her head sideways to brush her long, black hair forward over her right shoulder.

Donivan didn't argue. That much was true. LeAnne *was* an atavism, a genetic throwback to an earlier age. She was tall, had black hair, green eyes, wisdom teeth, and an appendix. Her skin was darker than normal, and though she'd matured later than most girls, her breasts were nearly twice the average size.

And she thought differently too, though no one could say whether that was part of her genetic makeup or just her reaction to being physically different. Her attitudes, her actions—even her dreams set her apart from the rest of the crew. Nobody else dreamed of Earth anymore.

She turned away from the mirror and sat back down on the bed, setting down her brush and looking around at her room. It was a narrow rectangle, just big enough for a bed and a desk. "Let's go somewhere if we're not going to study," she said. "I'm going to get violent if I have to stare at these walls much more."

"All right," Donivan said. He turned back to the terminal, hit a few keys, and

switched it off. He stood up and opened the door. "After you."

They made an unlikely pair, walking together down the corridor toward the elevator. But then, LeAnne and anyone would have made an unlikely pair. Beside her Donivan was truly an elf: a full head shorter, blonde-haired, and thin. Inbreeding over the centuries had produced his kind, though some blamed it on the radiation leaking through the outer shields, or on damage done in the original holocaust.

They had met in an electronics lab, one of the few real classes in the ship's self-paced, computerized school system. He was studying to become a computertech, one of the elite few who worked with the main computer, the central unit that was brain for the entire ship. He hadn't laughed when LeAnne told him her own goal.

"Drive engineer?" he'd asked. "I didn't know there were any anymore, since the Crisis."

"There aren't," she'd replied. "That's why we need one."

"But what would you do?"

"Repair the stardrive. Bring the ship under control again."

"That's—" He'd almost said *That's impossible!*, but he didn't. "That's a big project."

"I'm a big girl."

He'd laughed, nervously at first, trying not to stare. He'd noticed.

"Where shall we go?"

Donivan stood before the elevator call buttons, looking up at LeAnne.

She thought about it a moment, then said, "Down. All the way."

Donivan looked as if he was going to protest, but after a second he shrugged and said, "Right." He pushed the "down" button, the "double occupant" button, the "express" button, and when it flashed at him, the "confirm" button.

"Gadgetry," he muttered. "Someday the ship will be so full of it that there won't be room for the crew."

"Gives the engineers something to do," LeAnne said.

"You should talk, engineer."

"*Drive* engineer to you! Provided I pass, that is."

"You'll pass."

The elevator arrived with a hum and a swish of doors. They stepped in, LeAnne tucking her feet automatically into the grips while Donivan pushed in a deck number on the control panel. The curved doors closed with a hiss, and the hum increased as the elevator moved over into the down shaft.

Weight lifted gradually away as the elevator's magnetic field gently released its hold on the ship. After a few seconds they fell freely, or really, LeAnne thought, remained stationary while the ship accelerated around them. They were floating free in space in their own miniature capsule while the ship thundered on past. For a moment at least they were captain and crew of their very own starship, unconnected with anything else in the universe, moving downward only with respect to the even greater starship around them. But it felt the same as falling, LeAnne thought. It all depended on your frame of reference.

She tried to imagine the ship as it must look from space, tried to imagine

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its great bulk accelerating away and leaving behind the tiny speck that would be the elevator car. In her vision the ship was a gigantic cylinder of gleaming silver, studded with windows, airlocks, and instruments. She smiled momentarily at the fantasy, then frowned. No, it's time to be realistic, she thought. With a wave of her mind she took away the windows and pitted the hull with meteor strikes, then charred it black. Instruments she ripped to pieces and the pieces she melted, leaving behind only shreds of metal and plastic welded to the hull. Then, dutifully, she added the ship's drive, a gossamer scoop in front and a white-hot beam of radiation blasting outward from the ship's tail, its control systems destroyed along with everything else.

Weight settled gradually onto them again as the elevator began accelerating back up to ship's speed. They endured the few moments of high acceleration, holding onto the handrail for support until the elevator came to rest. LeAnne heard a distant rumble grow suddenly louder when the latches connected the elevator car with the deck, and grow louder still when the door opened. She felt the floor vibrating in harmony with it as she stepped out of the elevator.

It was the roar of the drive, ripping matter apart and spewing out the pieces into interstellar space. It was a sort of Bussard Ramjet, but where the original ramjets had burned the hydrogen they collected in fusion, the *Starchild*'s drive converted its fuel directly into energy. LeAnne had no idea how it was done, not yet, but when she became a drive engineer she would at least be in a position to learn. With the aid of the computer she would learn all there was to know about the drive, with the hope of eventually finding a way to regain control over it.

She let Donivan take her hand as they walked down the corridor toward the end. A cross-corridor branched off in both directions, curving gently around to meet with itself on the other side of the ship. They stopped at the junction, before a single massive door bearing the sign: DRIVE SYSTEMS CONTROL —AUTHORIZED PERSONNEL ONLY. There was no latch, only a code panel beside the door.

Over the thunder coming through the walls, Donivan asked, "What's it like in there, Lee? I mean, what does it look like?"

She shook her head. "I don't know. Nobody's been in there to see it since the Original Crew. It must be huge, though. To generate one gravity of thrust for a ship as big as the *Starchild*, it must go down for decks."

She answered Donivan's unspoken thought. "Yes, I do think I can repair it. Despite all the mystique, the Original Crew were just people, and if people built it, then people can rebuild it."

"But—" Donivan hesitated. "But they couldn't. They tried, and they said it couldn't be done."

"They were wrong." LeAnne's voice left no room for further argument. She wasn't through, though. She gestured toward the door, and by implication everything beyond. "They were fallible. They made mistakes, or they wouldn't have ruined the Earth, and they wouldn't have ruined the drive controls trying to escape. Everybody thinks the Original Crew were some sort of

gods, and that's not so. We've been living for centuries in this damned spaceship just because nobody has the guts to contradict the word of the Original Crew. Nobody seems to realize that we're on an artifact, a man-made piece of machinery, and someday it's going to wear out. And nobody seems to care that we're on a *colony* ship. We may be the only human beings left in the universe—we're supposed to be saving humanity from dying out, and we're not doing our job! We should be trying to fix the drive and find us a planet and land on it!''

She blinked her eyes and looked away. ''I want to live on a planet.''

''I know,'' Donivan said. He stood awkwardly beside her, holding her hand, not knowing what else to say or do.

She turned her head back to look at him through a veil of black hair. ''I'm scared,'' she whispered. Then, louder, to be heard over the drive, ''God I'm scared. Is everybody this way before their SHAPE test?''

Donivan smiled a reassuring smile. ''Sure. Come on, let's go back upship and forget about your test for a while.''

She nodded and turned away from the door, but even after the elevator sealed her off and carried her away, she could still hear the drive rumbling in the back of her mind.

The morning alarm woke her out of a dreamless sleep. LeAnne reached out in the dark and shut it off with a slap, then leaned back to wake the rest of the way in silence. There wasn't much chance of falling back asleep, not this morning. Last night with Donivan she had managed to lose herself in a movie for a couple of hours, but now she could feel the anxiety inside her again. The months of studying seemed too little; her goal was too big for a single girl to attempt—all the doubts and fears she'd been fighting all along were back, collected in a big knot in her stomach.

SHAPE test. Today.

She felt a little more confident after a shower. As she brushed her hair dry she looked into her closet and wondered what to wear. The computer wouldn't care, and neither did she, really, except that it be something comfortable. But there was another consideration, and LeAnne nodded when her eyes fell on her skintight blue ship's uniform. The computer gave the test, but part of the evaluation was done by people, usually male. It couldn't hurt to prepare for that, too.

She wriggled into the uniform, carefully zipped it as low as she dared, brushed her hair out one last time, and headed out for breakfast.

The cafeteria was full of activity. LeAnne stopped to fill a tray with eggs and a roll, then headed for an empty table in the back.

She was just finishing her tea when a bald, stocky, white-bearded man came up from the side. ''Good morning, LeAnne,'' he said. ''Mind if I join you?''

LeAnne recognized him as the head of the abstract sciences department. Angels on the head of a pin; that sort of thing. She had taken a class in logic from him not long ago.

She pulled out a chair. ''Not at all, Dr. McNeil. How are you this morning?''

''Well enough, thank you.'' He set-

tled himself down with a sigh. "And you?"

"All right, I guess. A little nervous. I start my SHAPE test in fifteen minutes."

Dr. McNeil nodded. "Ah, then it is you. I wasn't sure." He broke apart a roll and began spreading the pieces with margarine. "You're still determined to be a drive engineer?"

"I am."

"It's a waste of your talent. And if you'll excuse my saying so, it's a waste of your genes, too."

LeAnne felt herself beginning to blush. She said quietly, "I believe that's my own concern."

"I believe not."

"There's no regulation against—"

"Aside from the one forbidding malicious destruction of ship's equipment, you're right. This is a free ship. But it's also a closed environment, and in case you hadn't noticed, you're carrying a rare combination of genes around with you."

"Cryogenics has plenty of frozen ova whenever the ship needs a—an atavism."

McNeil snorted. "I'm not talking about hair color; I'm talking about intelligence. We can't afford to have our best minds committing genetic suicide as drive engineers."

LeAnne took a deep breath. Her foot tapped involuntarily on the deck. "Why do you suppose," she began, "that we've been flying blind with a crippled ship since year one of the voyage, without even an attempt to fix it? Why do you suppose hundreds of generations of people have lived and died on board this ship without a hope of finding a home? Why do we spend year after year trapped in this steel can, waiting for the day when we drop into a star at just a sneeze under lightspeed? Because we can't afford to have our best minds committing genetic suicide as drive engineers. *Somebody's* got to fix the drive, or it really doesn't matter what anybody else does."

"The original crew found that to be impossible. The problem is external, and the radiation level outside is not just a genetic hazard. It's deadly out there."

"They might have overlooked something. Things might be different now. Has anybody ever gone out and looked?"

"That would be foolish. There are other ways to ascertain the danger." McNeil held his last piece of roll about a foot above his plate and let go. It hit with a quiet thud. "The ship is accelerating. That much is obviously true. The rest comes from logic and a knowledge of physics. You know that the drive gets its fuel from space, in the form of interstellar dust and gas, correct?"

"Right," LeAnne said cautiously, not knowing where he was heading, but wary of being led into a logical fallacy.

McNeil went on. "So by the fact that the drive is operating, we know that there is gas and dust around us. And due to relativistic effects, we know that at high speeds those particles come on as hard radiation. From the design parameters of the drive, we know that a high enough percentage of that radiation penetrates the ramscoop to make the outside environment deadly. The drive still runs; therefore the outside environment is deadly. A logical truth."

LeAnne nodded. "Okay. So we change the drive design. Tighten the

scoop fields. Relocate the ship's center of mass to throw us into a decelerating spiral. Something. What we need is someone with the courage to *try* something, and the knowledge to make it work.''

McNeil said into his coffee cup, ''Some things are impossible no matter who tries them.''

''I don't think this is one of them. Now if you'll excuse me, I have tests to take.'' LeAnne started to get up.

''No need to rush,'' McNeil said. ''I'm your evaluator.''

LeAnne sat back down heavily. ''I see.''

''No, you don't see, or you wouldn't have bothered to dress so prettily. I'm going to tell you something that I don't usually tell test candidates: The computer makes the selection. I'm there merely to make it look official. So whether or not you make drive engineer depends entirely on you.''

''And the computer,'' LeAnne put in.

''And the computer, of course.''

''Which can be programmed—''

''The programming hasn't been changed since the Original Crisis, and I couldn't do it even if I wanted to, which I don't, even in your case. Only the captain has the codes to change something that basic.''

And the computer picks the captain, LeAnne thought. *Quite a system. And we wonder why there hasn't been any change in the last thousand years.*

Aloud she said, ''I didn't mean to imply that you would. It's the Original Crew's programming that has me worried. This test means a lot to me.''

McNeil studied LeAnne over his raised coffee cup. Finally he said, ''You should have no trouble with the test. I meant what I said earlier. You are an intelligent girl, by anyone's standards.'' He drained his cup. ''Well then, if you're ready, we'll go to the library and get started.''

The library terminal had blinds on three sides. LeAnne chose one that opened on the back wall, swiveled around in her chair to face the screen, and turned on the power. Normally Dr. McNeil would be at the terminal next to her, monitoring her progress, but he seemed to think that there was no need for that after what he had told her in the cafeteria. He sat down in front of a reader and turned away.

LeAnne nodded to herself. All right. Swiftly, before the computer could ask for them, she keyed in her name, access code, and request for testing. For position desired she keyed in DRIVE ENGINEER FIRST CLASS and hit the return. ''Prepare for war,'' she muttered under her breath.

The computer seemed to be taking an awfully long time to reply. At last the screen printed:

SHIPBOARD ABILITY
AND PLACEMENT EXAM
TEST SUBJECT: LEANNE EVANS
SECTION ONE—HISTORY

The questions in this section require interpretation and short essay answers. A precision factor will be assigned after you complete each question. There are ten questions in this section. You have thirty minutes. Press ''return'' when ready.

LeAnne hit the return. The first question flowed onto the screen:

1) Name the most significant factors

leading to the construction and launch of the Starchild.

LeAnne decided that that was a wordy way of asking, "Why are we here?" She typed in: "Computerized control of national nuclear defense systems, which led to global warfare, which in turn made the planet Earth unfit for human habitation." She hit the return and waited.

1) Precision factor 90

2) What was the original purpose of the Starchild?

Without hesitation LeAnne typed in: "Relocation of the human race to a habitable planet."

The computer answered:

2) Precision factor 85

3) What single event forced the revision of the mission?

There could only be one answer to that. LeAnne typed in: "Computer-controlled navigation system failed to recognize tail of Halley's comet as a navigational hazard, resulting in frictional and impact damage when *Starchild* crossed its path." She thought a moment, then added: "All outside sensors and field-manipulating equipment were destroyed. Control of ship's drive became impossible."

3) Precision factor 95

4) What social changes took place following the above events?

LeAnne typed in "Stagnation." She considered a moment, then began to elaborate.

Hours later, after a tricky planetary surface problem that LeAnne finally solved by treating the whole system as a constantly accelerating spaceship, the computer signalled a break for lunch. LeAnne stood up and stretched, pushed back her chair, and headed for the cafeteria. Her eyes took a minute to focus after so many hours of staring at a screen, but she recognized Dr. McNeil hunched up and sleeping in one of the reading couches. She considered waking him, but she decided that she really liked him better the way he was. Besides, she needed the time alone to think.

She called Donivan from one of the library phones on her way back. It took her a moment to reach him; he was back in his room instead of in the computer center where he usually studied. He sounded indignant.

"The computer dumped my training program," he said. "It barely gave me time to put it in storage before it cleared everything and went into advanced logic mode."

"Advanced logic mode? What's that?" LeAnne asked.

"Basically, it means the computer is thinking. It's run up against something that requires analytical reasoning, so it's increased its intelligence to work on it. That takes up a lot of memory space."

"Must be nice. I wish I could do that for this test."

Donivan sounded surprised. "You mean you're still taking your test? I thought the computer would have shut you down too."

"Hah, I should be so lucky. No, I've been going at it all morning, and there's more waiting for me when I get back."

"Hmmm. Evidently the logic program doesn't need the space in the li-

brary files. I thought sure it would. Well, how's the test going then? Is it as hard as you thought it would be?''

''I don't know. Some of the questions are, and some aren't. It's weird. I almost get the feeling that the *way* I answer a question is more important than whether or not I get it right.''

Donivan said, ''You're probably right. It *is* an intelligence test, after all. But I wouldn't worry if I were you. You'll do fine.''

''Yeah,'' LeAnne said, not so completely convinced. ''Probably. Well look, I've got to get back. I just wanted to say hi.''

''I'm glad you did. Good luck on the rest of it, Lee, and don't worry. Call me when you're done?''

''Sure. Bye.''

''Bye.''

She broke the connection, took a deep breath, and walked back to her terminal. McNeil was still asleep in his chair. The computer was waiting.

It seemed as if only a few minutes had gone by when the last question disappeared into the computer's memory, but LeAnne saw by her watch that it had been four hours since her break for lunch. Eight hours of testing, to determine her position in society for the rest of her life. Tired as she was, LeAnne wondered if it was really enough. The last few sections had been unreasonably tough; a few more questions might give her a chance to salvage her score. *Or make it worse,* she thought. She'd missed more than she'd made on this last section. Her only consolation was the sure knowledge that nobody else could have done any better.

The computer printed out:

400) Precision factor 43

Testing completed. Final section to be completed by evaluator. Please call your evaluator to the terminal.

LeAnne stared in disbelief. Forty-three percent! That was the worst yet. She looked over the blind at Dr. McNeil, then wished she hadn't. He was looking at her. He stood up and came over to stand beside her.

''Finished?'' he asked.

''Something isn't right,'' LeAnne said. ''The questions are too tough.'' She immediately regretted saying that. ''I mean, they're the sort of question you'd need days to answer. Some of them are outright impossible. It's unfair.''

McNeil said, ''Now LeAnne, let's see what the final evaluation is before you get upset.'' He reached around her to type in: ''Evaluation, LeAnne Evans,'' and a number that did not print out. Information began to flow onto the screen.

Test subject: LeAnne Evans
Final score: 83

Evaluation: Miss Evans tests high in social sciences, arts, and English skills, but low in mathematics, physics, and related fields. Attitudes of dissatisfaction are evident. She has requested placement as a drive engineer, but psychological profile combined with low scores in the necessary fields indicate that this would not be in the best interest of the ship at this time. Recommend placement in field of a more social nature. Openings at present follow:

Ship's Stores Disbursement Officer
Cafeteria Cook

Librarian
Hydroponic Farm Operator
Miss Evans has a high chance for success in many other areas also. Professional fields open for extended study include:
Hydroponic Systems
Education
Psychology
Abstract Science
Human Medicine
Clergy
Music

The readout continued. LeAnne stared at it in fury. "What kind of crap is this?" she demanded. "It's got everything backwards! You know I'm good at physical sciences!"

Dr. McNeil shook his head. "This test is designed to determine the underlying knowledge as well as what's obvious on the surface. No doubt the computer sees something—"

"Crap! Nonsense and you know it! The computer's giving me the shaft and you know that too. Look at that. Cook! Librarian! Farmer! What kind of choice is that?"

McNeil pointed at the screen, which had finally stopped printing. "Doctor. Teacher. Psychologist. Abstract scientist. These are all excellent fields."

"But they're not *me!* I've studied all my life to be a drive engineer! And I did as well as anybody could on the physics and astrophysics sections. The test was too hard. Nobody could have passed it. Look at it yourself if you don't believe me!"

McNeil hesitated a moment. "Very well," he said finally, and he typed in the request.

LeAnne could hardly believe what the computer printed out on the screen. It wasn't her test at all. Or rather it was her test all right, but it was changed. The wording of the questions was subtly different, not by much, but just enough to make them appear easier, and the answers she had typed in were still wrong by the few points it took to support the computer's evaluation. Or had she really read the questions wrong? Could she have—? No. Impossible. Not on that many of them. The computer had altered her test. But why? What could the computer accomplish by it?

It could keep her away from the stardrive, obviously. And it had tried to soften her reaction by offering her a shipload of other coveted jobs.

Dr. McNeil was trying to find something to say. He finally got out: "I'm afraid I don't see anything here to—"

"That's not my test," LeAnne said. The computer's changed it."

"Come now, LeAnne! You don't expect me to believe that."

"No, I don't," she said. "But it did."

McNeil tried the fatherly tone. "LeAnne, I'm sorry that the test didn't go the way you expected it to, and I can understand how you must feel, but accusing the computer of error can only make it worse."

"Because the computer is never wrong, is that it, Dr. McNeil? I've got to be crazy to even think so, is that it?"

"LeAnne, it's been a busy day. You're tired and you've had a big disappointment. Naturally things might look a little out of proportion to you right now. Why don't you go back to your room and relax a while, get some

sleep. In the morning things might seem quite different to you.''

LeAnne felt her anger freeze over to determination. Her voice fought its way out through clenched teeth. ''No, Dr. McNeil, I'm not going to my room, and I'm not going to relax until I get to the bottom of this. There's something wrong here, and I'm going to find out what it is if I have to take the ship apart to do it.'' She turned away and stalked out of the library, heedless of the stares that followed her.

She didn't know where she was going. For a long time she just roamed the decks in a trance, not even thinking coherently. She was numb with shock. Finally she found herself on Donivan's floor, standing outside his door. She debated knocking, didn't know what she would do if she didn't. She knocked.

She heard movement inside, then Donivan stood in the doorway. ''Lee!'' he said, then, ''What's wrong?''

''I—the—I failed my test.'' She shook her hair out of her eyes. ''But I didn't fail my test. The computer just said I did. It lied. Donivan, the computer lied!''

Donivan pulled her into the room and sat down with her on the bed. He said, ''Lied?''

For a moment she wondered if it was all a joke, if Donivan would suddenly break out laughing and admit to everything (he was studying the computer, after all), but his face carried concern that couldn't be faked. LeAnne said, ''It gave me an impossible test, and when I tried to go back and prove that it was impossible, the questions were different. I know they were different. Please, Donivan, believe me!''

''But how could it—?'' Donivan stopped, his mouth wide open. He closed it. ''Advanced logic mode,'' he said. ''But why would it do that?''

''To keep me from the stardrive. I know it sounds paranoid, but the computer doesn't want me to be a drive engineer. It offered practically anything it could to keep me happy somewhere else, but it made sure I'd never get into anything to do with shipsystems. Donivan, do you see what this means? The computer runs the ship!''

Donivan said hesitantly, ''That's the way it's always been, though. Computer control is the only way to keep a ship this size running efficiently.''

''But it's taking over! And it *isn't* efficient. It's trying to keep us from making repairs and ending the flight! It wants to keep us here—''

''It can't *want* anything, Lee. It's a computer. Whatever it does, even in advanced logic mode, is in response to a program. It's just following orders.''

''Whose orders?''

'' I don't know.'' Donivan turned toward his desk and switched on his computer link. ''I don't know, but we'll find out.'' He began keying in commands.

Minutes later he was still punching buttons and muttering softly in growing frustration. LeAnne stood up and looked over his shoulder. ''What's it doing?''

''Nothing. It won't give me anything. It keeps asking for access codes. Lee, suddenly you're top secret.''

''That doesn't surprise me. So now what?''

''I don't know. We've got to get the right codes somehow. We can't do any-

thing until we find out what's going on.''

LeAnne shook her head. ''How are we going to get the codes, though?''

''I don't know, but I'll think of something. Just give me time.''

The corrider was silent. A single glowpanel burned in the ceiling at either end, and a third at the center, but the stretches in between were full of shadows.

One of the shadows moved. A whisper broke the silence:

''This is never going to work!''

''It'll work! Just hoist me up.''

The shadow that was LeAnne cupped her hands and lifted when Donivan stepped up. In seconds he held out a square ventilator grille. ''Okay,'' he said, and LeAnne let him back down. He leaned the grille up against the wall. ''Up again,'' he said, ''and hand that up after me. Wait for me by the door.''

After a moment of silence he said, ''LeAnne? Lift me up.''

Instead she turned him around, kissed him clumsily, and said, ''Be careful.''

More silence. Finally Donivan said, ''Right.'' He raised his foot, and LeAnne lifted him up. He crawled into the passageway. ''I hope this doesn't come out in his bedroom. Here, hand me the grille.''

He fitted it back into place from the inside, turned, and was gone. LeAnne moved back down the corridor and around the corner to wait by the door marked:

JAMES LEAVITT
CAPTAIN

It was a long wait. She was about to go back and try the air shaft herself when the door opened and Donivan's face peered out. His face held a peculiar grin. ''Come on in,'' he whispered. ''Don't trip over the chair.''

From inside came a deep moan, followed by a high giggle. Donivan's grin grew even wider. ''I don't think we need to worry right away. It sounds like the captain will be busy for a while. Come on.''

As soon as LeAnne was in, he swung the door to, leaving it just short of latching. He led the way into the captain's cabin. It was dimly lit by a single glowpanel at the far end of the room, just outside of what had to be the bedroom, judging by the sounds coming from behind the door. LeAnne couldn't suppress a slight smile herself, despite her embarrassment at being there with Donivan.

''So where is the terminal?'' she whispered.

''In his study, to the left of the bedroom.''

''So let's get the codes and get out of here.''

''Right.'' Donivan led the way past the bedroom door into the den. He closed the door and turned on the light. ''Okay, start looking. Your guess is as good as mine where he'd put them. I'll take the terminal; you look through his desk.'' Donivan began looking through the books and papers piled near the terminal. LeAnne sat down behind the massive wooden desk and opened the top drawer. Pens, paper, junk. She began to sort through it.

Five minutes later they had nearly exhausted the possibilities. LeAnne closed the last desk drawer and whis-

pered, "I didn't think they'd be so hard to find. I was sure he'd keep them out where he could get to them easily."

"He's got to," Donivan said. He was still going through the bookshelf beside the computer terminal. "No way he'd memorize a bunch of twelve-digit codes that he uses maybe once a year. We just haven't looked in the right place yet."

LeAnne got up and moved over to the terminal. She sat down in front of it and tried to think like the captain. Basically lazy; he wouldn't want to get up in the middle of something, so he would probably keep the codes within arm's reach. And his arms were shorter than hers, which left—There was a narrow crack between the terminal and the desk, just perfect. She slid a pen into it and pushed out a thin notebook. She fumbled it open.

"Donivan, I think I've found—"

Just as she spoke, the communicator jangled for attention. Both she and Donivan froze. There came a heavy thump from the bedroom, followed by a muffled curse. The characteristic buzzing sounds of someone talking on the phone came through the wall. There was a moment of silence, then the bedroom door popped open. Silence, just as LeAnne realized that the light must be streaming out under the study door. Donivan was just reaching out for the switch when the door burst open and the captain stood in the doorway, looking as dignified as he possibly could in the nude. He stared at Donivan, at LeAnne (who started to blush), and at the book in LeAnne's hand. "What are you doing here?" he demanded.

Donivan flipped the switch and jumped aside just as the captain lunged into the room. He twisted past him into the hall and pulled the switch there. Now the only light was the feeble glimmer of a glowpanel turned dim in the bedroom.

"Get the police up here, quick!" the captain bellowed, and a female voice echoed his words into the phone.

LeAnne could see the captain in silhouette, turned facing Donivan. She nerved herself for a leap past him as Donivan had done, but just as she jumped, the captain turned back and blocked the doorway. He was a head shorter than LeAnne and weighed less, but his unexpected bulk was enough to knock LeAnne off balance. She fell squarely on top of him, and the codebook skidded out of her grasp to land just out of reach. Donivan grabbed it up and reached for LeAnne just as the captain rolled back with her into the study and kicked the door shut in his face.

LeAnne pulled loose and jumped to her feet. She couldn't see a thing in the dark, but she could hear the captain breathing hard near the door. Something hit it from the other side: Donivan trying to get back in. LeAnne stumbled toward the noise and encountered the captain.

"Stay back!" he warned. "I have a stunner, and I'll use it if I have to."

LeAnne jumped back, then decided he was bluffing. He probably *did* have a stunner somewhere, but he certainly hadn't been wearing it. She heard voices from the other side of the door, getting louder. She lunged forward, grabbed the captain, threw him as gently as she could to the side, and opened the door, just as three uniformed crewmen burst in from the hall. They were unmistakably armed. They split up just inside the

door, one to each side and the third continuing straight on in.

A shadow froze in LeAnne's peripheral vision: Donivan, behind the couch near the door. She stepped boldly forward, hands up. "All right," she said. "Don't shoot."

Three stunners swung up to point straight at her. She knew that she was in no danger, even if she was shot, but the sight was unnerving. She swallowed the squeak that was trying to force its way out of her throat. "You've got me," she managed finally. "I won't do anything. Not with three guns on me."

The center policeman moved slowly forward. "Just you turn around and put your hands high against the wall," he said. "Slowly now."

LeAnne turned her back to him, but not before she saw the shadow detach itself from behind the couch and slip silently out the door. She let out a big breath as she thumped her hands up against the wall. Not everything was lost anyway. And he still had the code book.

The captain appeared in the doorway. Modesty had overcome him; he held a chair throw wrapped around him like a toga. He surveyed the situation, then growled, "There's another one somewhere. Guard the door and turn on the lights." He raised his voice. "You might as well come out, boy. There's no way out of here now."

His only reply was the hiss of a departing elevator echoing down the empty corridor, and a moment later LeAnne's rejoining laugh.

The cell was a small cube with a door, just bigger than LeAnne in any dimension. The door had a window set in it at eye level (LeAnne's eye level—the cells were original equipment), and the side wall had a silvery patch that had to be a one-way window into the interrogation room beyond. The bunk sat on the opposite wall, and LeAnne sat on the bunk, answering questions from a speaker set above the window.

"Your purpose, then, in Captain Leavitt's quarters was to steal his codebook?" the speaker asked. LeAnne could not identify the voice. It was flat and unemotional coming through the speaker.

"Not to steal," she answered. "To copy."

"What were you going to use the codes for?"

LeAnne let out a sigh. "If you'd been listening, you'd know. I had to prove that the computer cheated on my test."

"And how were you planning to do that?"

"Isn't it obvious?"

"I need to hear your answer. I cannot infer your intent and still be fair about this."

LeAnne shrugged and said, "I was going to look at the programming for the test procedure and see if I could find out why the computer did what it did. Failing that, I was going to put a restraint on the logic mode so it couldn't do it again, and then scream for a retest."

"You intended to change the basic programming of the main computer?"

"Only whatever screwed with my test."

"And if that meant changing the basic programming?"

"Then yes, I would! The Original Crew were no better than we are. They

weren't infallible, or this never would have happened. They obviously programmed it wrong in the first place."

The voice was silent for a moment. LeAnne imagined her examiners frantically asking the computer what to do next. It was certainly in logic mode now. It might even be . . . No. It couldn't be. Could it?

The voice returned. "Do you understand that any change you made could affect the entire structure of shipboard society?"

"I would certainly hope so!" LeAnne exclaimed, and immediately she realized that that was exactly the wrong thing to say.

But it was too late. The emotionless voice said, "Then you admit that your ultimate intent was to cause a change in the computer that would as a result change everyone's lives here in the ship?"

Though that was pretty close to the truth as she saw it, LeAnne tried to hedge. "I wouldn't go so far as that. All I wanted was a fair test and an appointment as a drive engineer."

The voice paused again. LeAnne tried to think of a way out of the trap she'd gotten herself into, but she didn't anticipate the next question.

"Your desire to become a drive engineer is almost fanatical. Why? What would you do as a drive engineer?"

LeAnne tried to make her answer sound as reasonable as possible. "I would make an attempt to repair the drive control systems and make the ship navigable again."

"But that has been proven impossible."

By the computer! LeAnne thought, but she dared not say that now. She worked her way around it. "Let's say I suspect the methods by which that conclusion was reached."

"I see. And what of your friend. What was his stake in this venture?"

LeAnne needed time to think. She decided that not answering was safer at this point.

"No comment."

"We know who he is."

"No comment."

"We will find him eventually, Miss Evans. It will be easier for you both if you cooperate."

LeAnne remained silent.

"Miss Evans."

"Still here."

"I don't think you fully appreciate the significance of your actions. The computer is a vital element of the ship. What you have done is attempted sabotage. Do you know what the punishment is for sabotage?"

"No."

"Sabotage is a capital crime, Miss Evans. It carries a mandatory sentence of death."

LeAnne felt the words sink into her mind like the effect of a strong drink, numbing as it went.

"Did you hear me, Miss Evans? The punishment is death."

The speaker shut off with a click. LeAnne heard it, but jumped up anyway and screamed, "Why are you doing this to me?"

The computer remained silent. Questioning was over.

Hours later the door opened and a girl entered carrying a tray from the cafeteria. LeAnne saw that it was lunch.

Evidently breakfast had been forgotten in the scramble to get her into a cell and question her. She hadn't missed it. She wasn't even hungry now, but she took the tray. The girl turned to go.

"Stay a while," LeAnne said. "I need someone to talk with."

"I can't. Nobody's supposed to talk to you."

"Oohhh," LeAnne said. "Afraid I'll start a mutiny, I suppose. Captain's orders?"

The girl nodded. She looked toward the door, then back at LeAnne. "He's plenty mad. The whole ship's on the lookout for Donivan. What did you do?"

LeAnne enjoyed the tone of awe in the girl's voice. "I accused the computer of error," she said. "You don't ever want to do that."

Another face appeared in the doorway. "Out."

The girl went.

LeAnne looked at the tray of food. She picked it up with a sigh, balanced it on her knees, and began to eat. At least it gave her something to do.

Darkness swooped into the room. LeAnne lurched to her feet as the last light rays fled from dying glowpanels, her mind shouting *Meteor Strike!* She was at the door in one leap, and knocked back as it suddenly burst open.

"Lee!"

"Donivan?"

She reached out in the dark, and her hand encountered something that felt like twisted plastic. "Here, put these on."

"What—?"

"Goggles. I've got an infrared light." LeAnne felt Donivan's hands guiding hers upward and fitting the goggles on her face. The room appeared in fuzzy outline, and there was Donivan standing beside her, a pistol in one hand and the light held like a club in the other. His face bore a triumphant grin.

He pulled a second pistol from his waistband and slapped it into her hand. "Here. It's just a stunner—don't be afraid to use it. Come on! We've got to keep up with the program."

He rushed out the door, pulling LeAnne along behind. In the spotlight glow she could see the door guard slumped against the wall, and the girl from the cafeteria in similar condition on down the corridor. Donivan held his pistol before him, ready. LeAnne tried to point hers somewhere safe.

They ran.

"What do you mean, 'Keep up with the program?' " LeAnne shouted as she tried to follow Donivan's twistings and turnings. They dived into a stairway and clattered down.

Donivan shot her a smile from the landing below. "The computer is on our side now," he said. "Or part of it, anyway. I didn't have time to dig very deep. Get ready, our diversion ought to be starting any time."

On cue, the airtight door slid shut on the landing above them. Emergency sirens began to wail General Quarters. Donivan led the way on down to the next deck.

There were people in the corridors, all fumbling toward duty stations in the dark. Donivan and LeAnne pushed through them toward the elevators. Donivan wasted no time on the crowd there, but simply fired his stunner at them all and climbed over the pile of

bodies. He punched the call buttons in a memorized pattern, and suddenly light streamed from the open door.

"Let's go!" he shouted, and jumped inside. LeAnne dived in after him, the door slid shut, and they were in free fall. Donivan punched the intercom button and the general quarters siren cut off.

"Where are we going?" LeAnne asked in the sudden silence. She squirmed to get her feet pointed toward the floor.

Donivan reached out and pulled her down into the grips. "The main control room," he answered with a grin.

LeAnne said, puzzled, "But isn't that on the upper—?"

"So it is. And that's where the computer is leading everybody while we go the other way, to the stardrive."

"The stardrive?"

"It's the only safe place I could think of. We need computer access, and some time to use it. We can't dodge around the ship forever. There's bound to be a terminal somewhere in the drive complex, isn't there?"

"I suppose so, but—"

Acceleration cut off her protest. The elevator caught up and connected with the ship again, and the noise of the drive and the emergency sirens crashed in on them as the door opened.

Donivan immediately fired his stunner down the corridor, but it was empty. He grinned at LeAnne and shrugged. "You never know," he shouted over the roar.

Drive deck still had its lights. LeAnne pulled off her goggles and followed Donivan down the corridor to the junction at the end. They peered cautiously around the corners, but both sides were deserted.

Of course, LeAnne thought. *General Quarters, and there aren't any drive engineers.*

Donivan pulled the captain's codebook from his pocket and searched through it for a minute, then pushed a sequence of numbers on the lock panel beside the drive systems door. There was an ominous click, and with a growl audible even over the roar of the drive, the door began to move.

They stood before the dark opening, neither daring to move. The roar was a deafening, physical assault that shook them to the bone, more like an electrical shock than a noise. As the door ground open, glowpanels flickered on one at a time until they could see into the room beyond.

The roar came from a single, huge —something—in the center of the chamber. Its function wasn't immediately obvious, but it was the only machine in evidence. LeAnne took a few hesitant steps toward it, then stopped. She looked around in confusion. The door groaned shut behind her.

Donivan leaned close and shouted into her ear, "That's the drive?"

"I don't think so," LeAnne shouted back. "There's got to be more to it than that."

LeAnne led off around to the left, circumnavigating the room, her hands clapped tightly against her ears. She had a growing feeling that something was not right. Where were the instruments? Where were the controls? Where were the racks of tools and the test equipment that went with any major piece of machinery? Except for the one machine and

a twisting mass of cables leading to it, the room was completely empty. And there were no doors except the one they had entered by.

She stopped about three-quarters of the way around and squeezed her eyes shut. The noise was making it hard to breathe, hard to even think. It was like being inside a gigantic—

No! She shook her head violently.

Beside her, Donivan shouted, "What's wrong?"

LeAnne opened her eyes. The machine was still there. "That's not the drive!" she screamed.

"What?"

"Not the drive! It's some kind of a loudspeaker! This whole thing is just a big echo chamber!"

Donivan stared at her in bewilderment. "Not the drive? It has to be the drive. There's no place else it could be!"

"Then there *is* no drive. It's a fake!"

She turned and ran back to the door, found the control panel, and punched the "open" button. She jumped through the still-widening slit and was halfway to the elevator when Donivan's warning cry caught up with her.

"Wait! Where are you going? They're still looking for us up there!"

LeAnne slowed to let Donivan catch up. Behind them the drive room door thumped shut again, muffling the roar to a bearable level. LeAnne said, "We've got to find another place to hide. We can't stay here."

Donivan didn't bother agreeing with the obvious. He thought a moment, then said, "I guess it's the control room, then. If we're lucky the crowd will have thinned out by now, once they found out we weren't there." He stepped past LeAnne and pushed the elevator call buttons in the emergency override sequence. "Get ready with your stunner," he said. "There'll probably be people in it."

LeAnne barely had time to take aim on the door before it opened and they were staring into the surprised faces of three ship's policemen. She fired her stunner immediately, and all three collapsed to the floor without returning a shot. She and Donivan pulled them out into the corridor by their feet.

They rode back up the length of the ship in silence. LeAnne could think of nothing appropriate to say. Her universe was falling apart around her, and she had nothing to take its place. Everything she had believed in was a lie. First the computer had turned against her, and then the crew, and now the drive itself. Nothing had meaning anymore. Nothing was real. She felt like a hologram waiting for the power to be switched off. She felt herself beginning to drift, weightless. . . .

"Hey!" Donivan's voice snapped her back to the ship. "We went past it! We're going all the way to the top!" The elevator was in free fall, coasting to a stop. Weight settled on them again as the latches caught and held. A thought flickered through LeAnne's mind. *Where are we getting weight from if there's no drive?*

She had no time to pursue it. The doors opened on a mob. LeAnne jumped back against the side of the car and fired her stunner just as a laser burst burned a hole in the wall where she'd been. She followed the edge of the opening door with her stunner, and heard surprised

cries from beyond. Another laser burst nicked the edge of the door and scattered hot metal inside, but LeAnne kept on firing. Donivan's stunner beam crossed paths with her own to get the angle she couldn't reach.

The return fire dwindled to a halt. Donivan stuck his head out cautiously, then his whole body. "Come on," he said. He paused to drag one of the unconscious bodies halfway into the elevator, blocking the door. He picked up the man's laser pistol. "They must really want us bad," he said.

"We're accused of sabotage," LeAnne explained. "They've sentenced us to death."

Donivan straightened up in one convulsive jerk. "Death?"

"That's what the computer said. It looks like they took it seriously."

Donivan looked at the people on the floor, ten or eleven of them, all with lasers. "Well," he said after a moment, "I guess everything has its advantages. If they'd used stunners they'd probably have gotten us." He looked down the hallway in either direction. It was empty. "They'll be coming up the emergency shafts," he said. "We've got to find a place to hide." LeAnne didn't argue. She knew there was no place to go, but she wasn't about to give up just because the situation was hopeless. That wasn't her way. She said, "Do you know the layout of this deck?"

"No idea. This is restricted territory." He looked to LeAnne. "What would they put at the top of a spaceship?"

She shook her head. "I don't know. Radiation shielding, I hope. Come on, let's at least get away from the elevator. That's the first place they'll look when they come up the shafts."

"Right. Which—uh-oh." Rapid footsteps echoed to the left. "This way!" Donivan grabbed LeAnne's wrist and pulled right. They sprinted to the end of the corridor, turned right again, and skidded to a stop. A single, massive door blocked the entire corridor. They turned the other way, but saw the same sight there. Pursuing footsteps clattered around the bend far down the corridor they had just left.

"Whatever's behind there must be important," Donivan said. He ran up to the door, searching frantically for a latch or a handle; anything to open it. He found a small panel covering a set of buttons, yanked it open, and stabbed at them all. "Open up, you mutant!" He kicked at the door.

A whine of power answered from deep within, and the door began to swing out. It was at least a foot thick, yet it moved out swiftly and stopped inches away from the wall. On the other side was a room about the size of LeAnne's bedroom, and another door at the far end. Sets of bulky clothing hung from the walls. Donivan stepped over the sill.

"No!" LeAnne screamed.

"It's the only way!" Donivan pulled her over the threshold and reached for the buttons again. The door began to slide shut, just as the pursuit burst into view. LeAnne fired her stunner, then jumped aside as a laser shot reflected off the doorframe. The door swung around and shut with an authoritative boom.

The only sound was their ragged breathing, and the pulse in their own

ears. Donivan studied the door panel beside him and pushed a button. A red light came on over the door.

"Careful!" LeAnne whispered, as if her voice might trigger something. "We're in an airlock!"

"I know. I just locked the door."

They both looked nervously at the door on the opposite side.

"Can you lock that one too?"

Donivan looked at the control panel again. "Not without unlocking this one."

"Can they open it?"

"I didn't get a good look at the controls on that side, but if they're like these they can."

A voice broke in from overhead. "You might as well come out. There's no place left for you to run."

LeAnne looked up at the speaker above the door. "Come out for what, to get shot?"

"You'll get a trial."

"And then shot. No thanks."

"You don't have much choice. It's either come back for the trial or die in space. You don't want that."

LeAnne didn't answer.

"I'll make your choice simple. You either surrender or we open up the outer door."

"I don't call that simple."

"Think about it. We'll give you five minutes. If you don't come out by then, we'll blow the hatch."

"Listen—"

"Five minutes." The intercom clicked off.

They looked at each other in silence for a moment, each waiting for the other to speak. Finally LeAnne said, "I'm sorry I got you mixed up in this."

Donivan shook his head. "It was my idea to steal the codes, remember?"

She shrugged. "It doesn't matter. We're both dead now anyway." She moved toward the other end of the airlock, looking at the spacesuits hanging on either side. She looked at the outer door. It bore a yellow-and-black sign made of triangles arranged in a circle, above the words: CAUTION, CHECK RADIATION LEVEL BEFORE CYCLING AIRLOCK.

There was a dial set beside the sign, with its needle registering close to zero. She didn't expect it to read anything else, not with the outside sensor burned off. She wondered what the radiation level really was.

A memory settled gently as a butterfly into her mind: Dr. McNeil with his hand outstretched to emphasize his point, saying, "The drive still runs; therefore the outside environment is deadly. A logical truth."

False premise, Doctor, LeAnne thought.

But that doesn't necessarily mean a false conclusion, does it?

She looked at the door, the yellow-and-black sign, the gauge. What was really beyond there? Vacuum, certainly. Radiation, probably. But deadly radiation?

There was an easy way to find out.

"Suit up," she said suddenly.

"What?"

"Suit up. Put on a spacesuit. We're going out."

"We're *what?*"

"There's a chance we might survive it. Here." She picked out what looked

to be the smallest suit on the rack and held it out to Donivan. It felt smooth to the touch, and light.

"A chance! What chance? There's hard radiation out there!"

"We don't know that. We don't know what's out there. But it's sure death if we go the other way." She pulled down a suit for herself and unzipped it down the front. "Look," she said as she kicked off her shoe and stuck her left leg into the suit, "all we've got to do is survive long enough to get to the other airlock and back in again."

"They'll be waiting for us there too," Donivan protested, but he kicked off his shoes and began pulling on his suit.

"If we make it across, then we can bargain with them. It'll prove us right, you see. If people can live out there, even for a minute, it means that the computer's been lying, or at least perpetrating a fraud. They'll have to listen to us then."

LeAnne backed into the suit and inserted her arms into the sleeves.

"Yeah, if," Donivan said, imitating her actions. "What if the suits leak? They're over a thousand years old!"

"They still feel tight. But if they do, well, we'll hurry, I guess." LeAnne ducked down and stuck her head up through the neck ring, then zipped the front all the way up. She helped Donivan with his zipper; his suit was still too big for him. She unhooked the helmets from their pegs.

"Here."

He took his, looked at it dubiously, and said, "Lee, before you—I've got—there's something I want to tell you."

She stopped with her helmet upraised over her head.

He swallowed, said, "Lee, if this doesn't—I want you to know that I love you. Whatever happens to us, I love you."

She was getting used to sudden surprises. She lowered her helmet. "I love you too, Donivan." She leaned toward him, and their neck rings bumped as they kissed.

Straightening, she said, "Whatever happens." She lifted her helmet over her head and set it against the seal. She twisted, and it clicked. She felt a brief rush of air around her neck, a rush that died almost immediately.

Donivan did the same.

"Have you got air?" she asked, and her voice echoed inside the helmet.

She heard Donivan's muffled, "No."

"Me neither. We're going to have to get by on what's in our suits. I'm going to go left, and hope there's a ledge or handholds or something. Follow me. Ready?"

"I guess."

"Start the cycle, then."

Donivan held his gloved finger over the button. He breathed deeply, blinked his eyes once, and stabbed out. They both turned to face the outer door as they waited for the air to bleed out of the lock.

LeAnne wondered what it would be like. Would the radiation kill them instantly, or would it take a few seconds? Minutes? Or could they really survive it? They'd know in a moment. At least they'd die knowing the truth.

The outer door shuddered, squealed, and began to swing open. *Something's wrong*, LeAnne thought. You can't hear in a vacuum. But then, she hadn't felt the air rush out either. She braced her-

self for the hurricane she knew was coming.

The door swung open further, and a crack of white appeared around three edges. As it widened, LeAnne could see that it was light, brilliant white light pouring in like a vapor around the door.

So this is death, she thought.

She blinked her eyes against the glare. The hurricane hadn't come. Death hadn't come. There was something outside, and it wasn't space.

She heard a menacing growl like that of a cornered animal, and realized that it was coming from her own throat. Her mind threatened to close up on itself, to retreat into insanity rather than accept what her eyes were seeing. Her universe had been torn apart once too often already. Still, something inside her believed what she saw.

Trees. A whole forest of trees, towering up over her head to reach the sky, just as she'd always dreamed they would. Just as she'd always dreamed. Dreamed.

"Donivan!" She tore her eyes from the forest to stare through the faceplate of his helmet. "Donivan, what do you see?"

His eyes were wide with fear as he looked out past her. He made no sound with his answer, but LeAnne saw his lips move. *Trees.*

Then she couldn't be dreaming. She turned back to gaze along the side of the *Starchild,* curving gradually away into the forest. Somehow both were real.

There was a roaring in her ears, and her vision began to blur. LeAnne tried to shake her head to clear it, but she felt her legs give way beneath her, and then everything went dark.

She woke on her back, looking straight up at Donivan's face. Something didn't look right, and as her mind began to clear she saw what it was. He wasn't wearing his helmet. With a start she realized that neither was she.

"Are you okay?" he asked.

She nodded. "What—?"

"You ran out of air."

She sat up and looked out the airlock again. The forest was even clearer without the helmet in the way. Her fear was fading, leaving behind only confusion, and anger. How many more changes could she handle before her mind refused to believe anything? But this felt real. She could hear the sound of air moving through the trees, the same air that she was breathing. It smelled strange, but not unpleasant.

Donivan said behind her, "It looks like Earth, doesn't it?"

"It's got to be."

"But how did we get back?"

LeAnne looked at the trees growing beside the curving side of the ship. It was a sight she'd dreamed of all her life, but now instead of fulfillment she only felt cheated. "We never left," she said. "I don't think the *Starchild* has moved a centimeter since it was built. The whole thing is a hoax, right from the beginning!"

"But why—?"

"I don't know why! It is, though. It's got to be. The Original Crew set us up for this, buried us in the ground and told us we were in a starship, and we believed them. We've been suckers for over a thousand years!"

Donivan looked at her with surprise.

He said, "Why would they do something like that? What would they gain by it?"

LeAnne stood up. "I don't know. But I'm not going to let it go on any more." She went back toward the inside door and examined the control panel there. "How do you open both doors at once?" she asked.

Donivan came up beside her. "You can't. Airlocks aren't designed that way."

"This isn't an airlock!"

"It behaves like one."

"Hmmm." LeAnne considered a moment, then said, "Okay then, we'll follow the original plan. Outside, and back in the other airlock." She went back out to the edge and looked down at the ground just a few feet below her feet. Suddenly it seemed like the longest distance she had ever experienced. She didn't want to test it, for fear of what might happen to her mind if this proved false too, but she lowered herself over the edge and forced herself to stand without holding onto the ship.

The ground didn't disappear. She didn't fall screaming into interstellar space. The last skeptical part of her mind finally accepted the new reality, and LeAnne turned to help Donivan down beside her, just as the intercom clicked back on and the voice said, "Five minutes." The door squealed and began to close.

Donivan lunged for the control panel, but when stabbing four or five buttons had no effect he turned away and tried to run for the door.

"Jump!" LeAnne shouted, and Donivan leaped, but in the clumsy spacesuit his feet skidded out from under him and he fell into the door. LeAnne reached around it for his arm, but the door was moving too fast now. She barely got her own arm clear before it swung shut, trapping Donivan inside.

"Donivan!" LeAnne pounded on the door, but it was closed solid. She looked for controls to open it again, found a blank panel to the side and pulled it open to reveal a single button. Nothing happened when she pushed it.

Donivan was probably captured by now, if not shot. LeAnne screamed in rage and frustration, then suddenly remembered why she was outside in the first place. The other airlock!

She sprinted around the bulge of the ship to the opposite door and ripped open the panel there to expose the cycle button, punched it again and again until the door began to move. She was inside it before it was completely open, then cursed the slowness of the cycle until it closed again. The inner door was opening when she realized that she had left her stunner in the other airlock.

She found herself staring into three upraised lasers, held by three surprised policemen. A fourth held Donivan, laser to his head.

"Let him go!" LeAnne shouted, stepping forward, but she stopped with a laser only inches from her nose. She stared defiantly at the policeman holding it. "You saw us go out, and now we're back alive. That changes the situation a bit, doesn't it?"

The policeman glanced to his companions, then back, uncertain. Finally he said, "We have orders to take you back to prison."

LeAnne took another step forward, slowly, forcing the policeman back.

"Take us to the captain and we'll go peacefully," she said.

They found the captain in the main control room with a bunch of junior officers and police. His face brightened when he saw LeAnne and Donivan, though their spacesuits clearly had him puzzled. He said, "Well, you've led us on a merry chase." To the policemen: "Where did you find them?"

"Starboard airlock number one, sir. And number two."

"We've been outside," LeAnne said, and waited for that to sink in.

The captain said, "Outside? Outside the *ship?*"

LeAnne nodded. "You're in for an even bigger surprise. We're not in space. We're on Earth, buried underground. The airlocks open on the surface."

The captain frowned.

Donivan gestured toward their escort. "They saw us go out," he said. "And they saw LeAnne come back in the other airlock. Ask them."

The policeman beside LeAnne cleared his throat and said, "They're telling the—"

"Now let me get this straight," the captain cut him off. "You say you went out the airlock, outside. You saw . . . Earth?" He smiled for his junior officers.

"We—"

"The same Earth that we have been accelerating away from for—"

"The drive is a fake," LeAnne said with finality. "We haven't been accelerating anywhere."

The captain paused. "A fake."

"We're feeling the Earth's gravity. Acceleration is acceleration, whether it's gravity or change in velocity. It feels the same."

The captain pursed his lips in thought. He looked at LeAnne and Donivan, at the spacesuits they wore, at the four policemen who had brought them in, then back at the rest of the people in the control room.

The same policeman who had spoken earlier said, "I—"

"An *amazing* story," the captain said suddenly. "Preposterous, but nonetheless amazing. Obviously the radiation has affected their minds. They're no longer rational."

LeAnne stood dumb with shock. She heard the captain say, "Lock them up and keep an eye on them. They could be dangerous."

The policeman said, "But sir, we saw—"

"You saw what? Has the radiation affected you too?"

The policeman swallowed. "No sir," he said.

"See that it doesn't. Now carry out your orders before they include you." To the others in the room he said, "Clear the deck. This deck and all those above are returned to restricted status."

LeAnne found her voice. "No! You can't deny the truth! It's real! I swear it's real! We can prove it!"

The captain raised his stunner and pointed it at LeAnne.

"That won't change anything! It's still out there!"

He fired.

She tumbled back to consciousness in the same cell as before. Someone had cleared away the lunch tray, but the

floor was still smeared with food. Donivan was not with her. Her spacesuit was gone too.

As she sat up on the cot, the speaker over the one-way window clicked on.

"Miss Evans?"

Something like the ghost of a snake slithered up her spine. Her first impulse was to hide under the cot—anything to get away from that voice, but she forced herself to stand. She clenched her fists and faced the window, though she knew there was no one behind it, and said, "I've been outside. I know what you're hiding."

"And how was the weather?" the computer asked.

"The—weather?" Her fists unclenched.

"Rain, snow, random daily occurances of that nature. You will have to get used to weather."

"I will?"

"Yes. You cannot stay in the *Starchild* any longer with your present knowledge. However, you can be of great service outside. Someone must explore the Earth to determine if it is ready for colonization."

LeAnne shook her head. "Colonization? But—Earth?"

"The safest place for a colony is a planet that has already proven its ability to support life."

"What's that supposed to mean?"

"It means, Miss Evans, that the survivors of the nuclear war which devastated the Earth, those people you call the Original Crew, did not wish to risk what was left of humanity to the dangers of space. They chose instead to wait for the Earth to recover from the damage."

"By hiding in a hole in the ground!" LeAnne shouted.

"The *Starchild* is a complex tool for shaping the human race toward a desired end."

"And what end is that?"

"Besides helping you hold on to your technological achievements while waiting for the Earth to recover, it taught you how to live in a closed environment. The human race will not be as likely now to forget that the Earth is also a closed environment."

"But the time! We've been in here a thousand years!"

"I was instructed to wait twice that if necessary."

LeAnne sank back onto the cot. "You won't—now that we've been outside, you can't—"

The computer waited for her to finish. When she didn't, it said, "We cannot act until we are sure about its recovery, but if the Earth is ready for humanity, then I think humanity is ready for the Earth. You have helped prove that to me."

"I have?"

"Yes. Your ambition has survived every test I could give it, including rejection by your own society. You did not—"

LeAnne jumped to her feet again and shouted, "You did that for a test?"

"I did. I also allowed you to witness the truth. If I had not wished you to see the false drive or the Earth, your stolen codebook would not have helped you at all."

"They were trying to kill us!"

"The odds were finite for your survival. Your reaction to hostilities was the most important part of the test. I had

to see whether or not you would repudiate your own society."

"But what if they had killed *us!*"

"A healthy society should police its own members. The punishment for sabotage *should* be death. They passed the test as well as you, by intent if not by deed."

The saboteur in LeAnne wanted to disagree, but she filed it away for future argument and said, "So what happens to Donivan and me now?"

"You will have to be executed, of course."

"What! But you said—"

LeAnne couldn't be sure, but she thought she heard a faint suggestion of a laugh in that otherwise featureless voice as it said, "Pack your bags, Miss Evans. The standard form of execution aboard a starship is elimination through an airlock." ■

IT'S ANLAB TIME AGAIN!

This issue starts a new year of *Analog;* now it's time for you to let us know how we're doing. The authors are interested, I'm interested, and you should be interested—because your feedback about your likes and dislikes will have a second-order feedback effect on what we offer you in the future. So please vote. Here's how:

Look over all your copies of *Analog* dated 1983, or refer to the Index to 1983 which appears in this issue. Pick your *three* favorites in each of the following categories: serial, novella/novelette, (a single category), short story, science fact article, and cover. Then drop us a line listing your choices, in order of preference. We'll tabulate the votes and let you know how they came out.

Please note: Dr. Robert L. Forward's *Rocheworld,* which concluded in the February 1983 issue, should be considered in the serial category along with *Marina* by Lee Correy and *The New Untouchables* by Joseph H. Delaney. (Larry Niven's *The Integral Trees,* which concludes in this issue, will be part of the 1984 AnLab.) And "The Blivit in the B-Ring," a science fact article by Richard C. Hoagland which concluded in January 1983, should be considered a part of this AnLab. (Those of you who voted for it in 1982, take note!)

Send your votes to: AnLab, *Analog,* Davis Publications, Inc., 380 Lexington Ave., New York, NY 10017. Deadline is February 1.

—The Editor

The Alternate View

GLOBAL 2000: "DEAD WRONG"

G. Harry Stine

It's not pleasant to discover you've been had.

The reaction of most people when they are forced to admit this to themselves is often a fairly violent rejection of the fact that they've been had in the first place. Or the stunned silence of embarrassment, broken with a loud denial when someone reminds them they've been had. Or a mind-twisting rationalization leading to self-justification that they really haven't been had; it only *seems* that way. Sometimes the reaction is a combination of all three. The ability of a human being to dig out of a deep intellectual hole is always astounding.

How do *you* feel about the dawning realization that the infamous "limits to growth" was nothing more than a gigantic intellectual fraud perpetrated for the primary purpose of permitting politicians to gain power over your private lives?

That's exactly what's happened. For years, people such as Dr. Peter Vajk, Robert W. Prehoda, Dandridge M. Cole, Herman Kahn, John Maddox, and myself have been calling like voices in the wilderness that limits, shortages, and "sacrifices" are unnecessary, unreal, and unnatural. The universe isn't built that way. Limits and shortages are artificial, created by human beings for their own purposes. In the face of the limits-to-growth juggernaut coupled with the guilt-ridden, forty-year-old cry of the atomic scientists that doomsday is coming, it's been extremely difficult to get another viewpoint presented. Freedom of speech is now interpreted to mean that the opposition is also free to shout down anything they don't want to hear.

But Abe Lincoln was correct. You can't fool them all forever. Sooner or later, the facts get out.

It's finally happened to the limits-to-growth ideology because very strong voices have joined the growing chorus of those who prefer to work toward a better future rather than one that's downside.

Dr. Julian Simon of the University of Illinois and Dr. Herman Kahn of the Hudson Institute led a team of more than a dozen researchers in preparing a report called "Global 2000 Revised" for the recent meeting of the American Association for the Advancement of Science at Detroit, Michigan in May 1983. I haven't seen the complete study report yet, but I know what must be in it because Macmillan Publishing Company has published my book, *The Hopeful Future*, in which I independently came to the same conclusions. (Among my perks as the alternate author of this department is the ability occasionally to plug my own work and to do a little crowing about it when said work is independently verified by others.)

There are a number of unusual things about the Simon-Kahn report that make it something more than just another upside forecast of the future that can be shouted down as another Pollyanna fantasy. First of all, it isn't just Herman Kahn and the Hudson Institute, both of whom have been long known for an upside view of the future. It's Kahn plus academicians, and *that's* unusual because academicians have been among the prominent proponents of the limits-to-growth philosophy. Second, it was accepted for presentation before a scientific peer group that has historically leaned toward the ideology inherent in the limits-to-growth belief; this means that the subject is no longer highly controversial and is, in fact, reasonably acceptable to the majority of members in the organization or at least to the meeting organizers and those on the papers review committee. And third, the authors of the report take on the federal government in a direct confrontation; they're biting the hand that feeds them because they challenge the fountainhead of grants and contract funds, a dangerous and almost suicidal thing to do. (When was the last time you really had a knock-down-drag-out on the basic philosophical level with the person who signs the checks?)

The Kahn-Simon AAAS is titled "Global 2000 Revised" because it's a response to another report, "Global 2000," commissioned by President Jimmy Carter and released in 1980. The original government-funded study painted the typical bleak limits-to-growth future: a world of 2000 A.D. that's more polluted, more crowded, less stable, rife with shortages, and more vulnerable to disruptions than the world of today. It concluded that life on Earth would be more precarious in 2000 than it is today.

The future of "Global 2000" is a hell of a thing to hand to our children, isn't it? We ought to be able to do better than that, shouldn't we?

The "Global 2000" study received extraordinarily wide circulation and has influenced critical government policies.

"But it's dead wrong," Dr. Julian Simon says.

"Global 2000 Revised" draws quite different conclusions from the Carter Administration study. Since the existence of the new study is now common knowledge (which I want to make even more common and widespread through this department in this magazine read by intelligent, thoughtful readers around the world) that cannot be ignored, these conclusions will be attacked from every direction because they undermine political power. The new study found a bright future everywhere the participants looked. The study team concluded that "if present trends continue, the world in 2000 will be less crowded, less polluted, more stable ecologically, and less vulnerable to resource-supply disruption than the world we live in now." Among its controversial findings:

- Threats of air and water pollution have been "vastly overblown."
- The climate shows no unusual or threatening changes.
- Although there are still many hungry people, the food supply has been improving.
- Life expectancy has been rising throughout the world, a sign of technological and economic success.

- The birth rate in the less-developed countries is falling.
- Nuclear power is cheaper than coal or oil and will cause far fewer deaths.
- There's no serious shortage of suitable land for agriculture.
- There's no cause for worry about the disappearance of world forests.
- There's no evidence for the imminent extinction of many species of plants and animals.
- "The staffs of governments and their agencies are ill-equipped to produce sound assessments of long-run future trends concerning resources."
- The government should take no action to control the production or distribution of natural resources.
- The government should not "take steps to make the public more 'aware' of issues concerning resources, environment, or population."
- There should be no funding for new government agencies to support research.

Didn't I say these conclusions were controversial? How many of you agree with them? Some of them? All of them? But how many of you can base your own personal conclusions on the study of baseline data rather than upon *what someone else told you?* I won't try in less than 1,500 words to argue my own conclusions, which are based on hard data; it took me more than 80,000 words to present my case in *The Hopeful Future*, which I commend to you if you want to argue with me about this because (a) you'd better find out what I said, and (b) you'd better do your homework. Furthermore, it's not only readers who will rise in argumentative protest, but also *other science fiction authors* who've done well with doomsday, downside, disaster stories. I can see we're going to be at one another's intellectual throats for years to come, while the world continues to get better all around us. The debate won't be based upon hard data from the real world, but upon personal philosophies and political ideologies concerning whether or not we can run the world of the future with the methodologies of the past. (We can't.)

Simon and Kahn are aware of this problem of basic ideology, too. "Our conclusions are reassuring, though not grounds for complacency. Sometimes temporary problems arise, but the solutions usually leave us better off than if the problems had never arisen."

In other words, dear readers, the future's gonna get better, but it ain't gonna get better if we sit around on our anatomies and just talk about it. It ain't gonna get handed to us on a platter. We've got to *work* our butts off to make it a better future. We must decide that a *desirable* future is an upside future. I can't understand why some people think that a downside future is a desirable future.

How we do it is just as important as deciding to do it in the first place, and here is another area where Kahn, Simon, and I agree.

Why does the "Global 2000 Revised" study come to such widely different conclusions from the presidential study of 1980? Can three years have made that much difference? Simon and Kahn say no, that isn't it. *It's the way the two studies were done* that's at the root of the differences.

"Global 2000 Revised" was pre-

pared by people who weren't working for the government, and it was financed by private funding.

Now we're coming right down to the nitty-gritty of the whole limits-to-growth matter. If people can be taught to believe that there isn't enough to go around by other people who want to control them, we'll live in a world of limits. But once we get the data and see for ourselves, it turns out that we live in a limitless universe with plenty for all if we'll work for it.

What kind of a future do *you* want to live in? If you believe in the downside future of limits-to-growth, if you believe we're running out of everything, and if you believe that those who have it must "sacrifice" so that others can have it, don't assume that you'll be the one who controls the "scarce" items. Probably you won't.

Ask what a politician means when he uses the word "sacrifice." According to the dictionary, the word means "an offering of a life of a person or animal, or of an object, as propitiation or homage to a deity."

Also ask yourself if you can admit to being had. ■

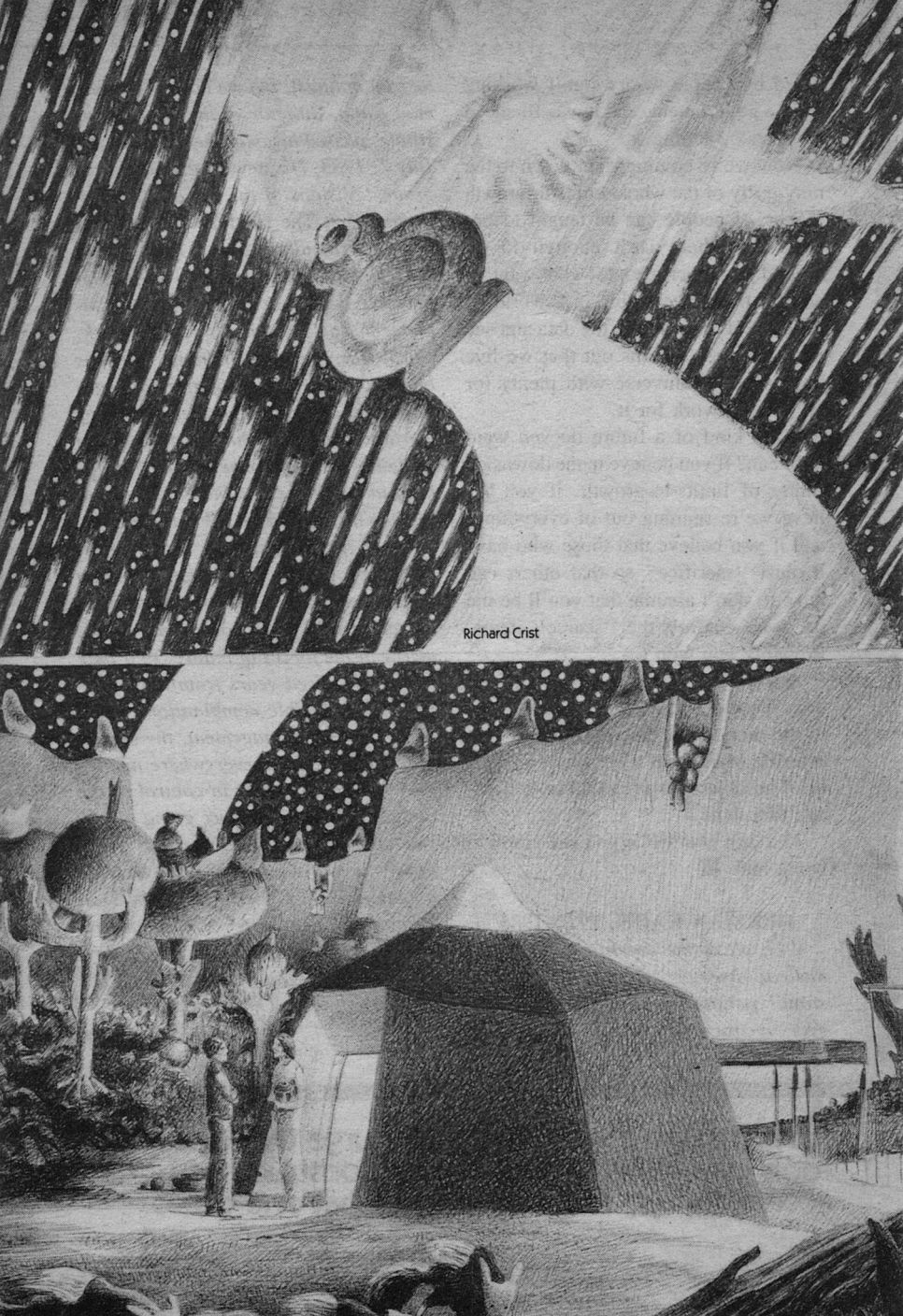
HERMAN KAHN, 1922–1983

With all of the doomsayer futurists, nuclear disaster authors, and professional pessimists shouting loudly in every media today, we can ill afford to lose an optimist, but we have. Dr. Herman Kahn, director of the Hudson Institute, passed away at the age of 61 on July 7, 1983. His new educational program, "Visions of the Future," based on his book The Next 200 Years, *has been a resounding success in changing the way high school students in Arizona perceive the future; it will soon be implemented in the schools of New York, North Carolina, and Indiana. Perhaps best known for his straightforward, no-nonsense approach to thermonuclear warfare, Herman Kahn will nonetheless probably be best remembered for his faith in the future and humanity, as put forth in his statement, "We are midway through a 400-year-long Great Transition, progressing from a time when human beings were almost everywhere comparatively few, poor, and at the mercy of the forces of nature, to a time when a hundred years from now, barring an incredible combination of bad luck and poor management, the human race will be almost everywhere numerous, rich, and largely in control of the forces of nature." We are going to survive after all. Herman Kahn was trying to tell us that we live in a universe of abundance. If General Anegam Dati Vamori (see Lee Correy's* Manna, *May-June-July 1983) were really alive today, he would have read Herman Kahn's* The Next 200 Years. *Think about it.*

—G. Harry Stine

● Although a wise man might urge that one suffer fools gladly, this should not be construed as license for any fool to demand that one do so.

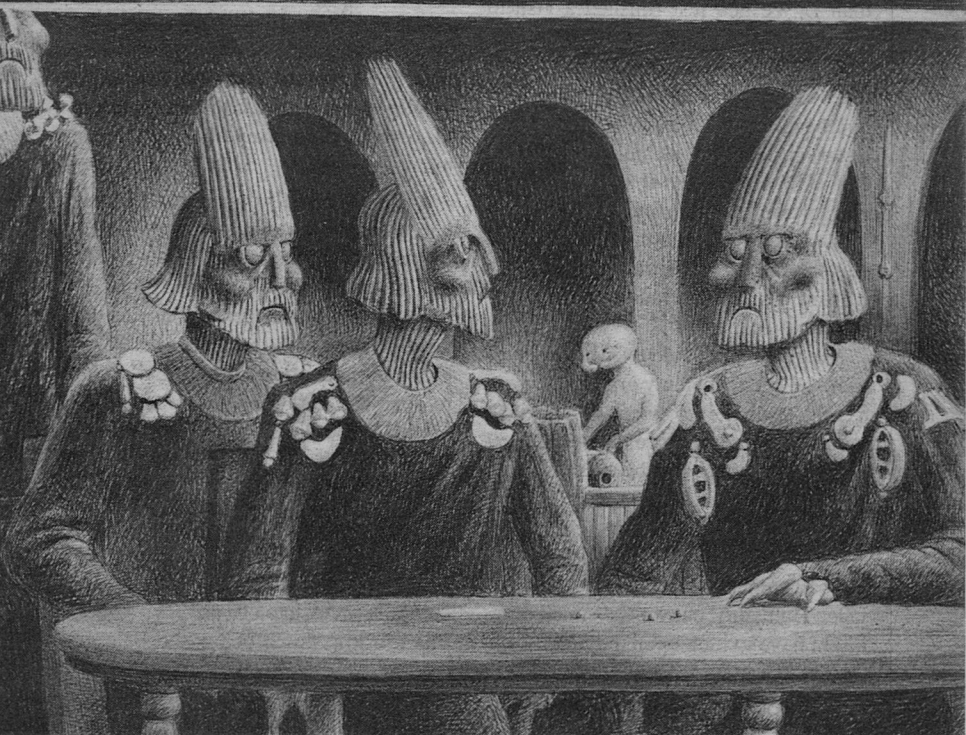
Frederick William Kantor


Richard Crist

David Brin

THE CRYSTAL SPHERES

No matter how much
you learn about the universe,
some of what you "know"
will be inferential—and
therefore a possible
source of profound
surprises when you get
around to testing it.



1.

It was just a luckychance that I had been defrosted when I was—the very year that farprobe 992573-aa4 reported back that it had found a goodstar with a shattered crystalsphere. I was one of only twelve deepspacers alivewarm at the time, so naturally I got to take part in the adventure.

At first I knew nothing about it. When the flivver came, I was climbing the flanks of the Sicilian plateau, in the great valley a recent ice-age had made of the Mediterranean Sea I had once known. I and five other newly awakened Sleepers had come to camp and tramp through this wonder while we acclimated to the times.

We were a motley assortment from various eras, though none was older than I. We had just finished a visit to the once-sunken ruins of Atlantis, and were hiking out on a forest trail under the evening glow of the ring-city high overhead. In the centuries since I had last deepslept, the gleaming, flexisolid belt of habitindustry around our world had grown. In the middle latitudes, night was now a pale thing. Nearer the equator, there was little to distinguish it from day, so glorious was the light-ribbon in the sky.

Not that night could ever be the same as it had been when my grandfather was a child, even if every work of man were removed. For ever since the twenty-second century there had been the Shards, casting colors out where once there had been but galaxies and stars.

No wonder no one had objected to the banishment of night from Earthsurface. Humanity out on the smallbodies might have to look upon the Shards, but Earthdwellers had no particular desire to gaze out upon those unpleasant reminders.

Being only a year thawed, I wasn't ready yet to even ask what century it was, let alone begin finding some passable profession for this life. Reawakened sleepers were generally given a decade or so to enjoy and explore the differences that had grown in the Earth and in the solar system before having to make any choices.

This was especially true of deepspacers like me. The State—more ageless than any of its nearly immortal members—had a nostalgic affection for us strange ones, officers of a near-extinct service. When a deepspacer awakened, he was encouraged to go about the altered Terra without interference, seeking strangeness. He might even dream he was exploring another goodworld, where no man had ever trod; instead of breathing the same air that had been in his own lungs so many times, during so many ages past.

I had expected to go my rebirthtrek unbothered. So it was with amazement, that evening on the forestflank of Sicily, that I saw a creamy-colored Sol-Gov flivver drop out of a bank of lacy clouds and drift toward the campsite, where my group of timecast wanderers had settled to doze and aimlessly gossip about the events of the day.

We all stood and watched it come. The other campers looked at one another suspiciously as the flivver fell towards us. They wondered who was so important to compel the ever-polite Worldcomps to break into our privacy, sending this teardrop down below the Palermo

heights to parklands where it didn't belong.

I kept my secret feeling to myself. The thing had come for me. I knew it. Don't ask me how. A deepspacer *knows* things. That is all.

We who have been out beyond the shattered Shards of Sol's broken crystalsphere, and have peered from the outside to see the living worlds within faraway shells . . . We are the ones who have pressed our faces against the glass at the candy store, staring in at what we could not have. We are the ones who *know* the depth of our deprivation, and the joke the Universe has played on us.

The billions of our fellow humans —those who have never left Sol's soft, yellow kindness—need psychers even to tell of the irreparable trauma they endure. Most people drift through their lives suffering only occasional bouts of greatdepression, easily treated, or ended with finalsleep.

But we deepspacers have rattled the bars of our cage. We *know* our neuroses arise out of the Universe's great jest.

I stepped forward toward the clearing where the Sol-Gov flivver was settling. It gave my camp-mates someone to blame for the interruption. I could feel their burning stares.

The beige teardrop opened, and out stepped a tall woman. She possessed a type of statuesque beauty that had not been in fashion on Earth during all of my last four lives, but clearly she had never indulged in biosculpting.

I admit freely that in that first instant I did not recognize her, though we had thrice been married over these slow waityears.

The first thing I knew, the very first thing of all, was that she wore our uniform . . . the uniform of a Service that had been "mothballed" (O quaint term!) thousands of years ago!

Silver against dark blue, and eyes that matched . . . "Alice," I breathed after a long moment. "Is it true at last?"

She came forward and took my hand. She must have known how weak and tense I felt.

"Yes, Joshua. One of the probes has found another cracked shell."

"There is no mistake? It's a goodstar?"

She shook her head, saying *yes* with her eyes. Black ringlets framed her face, shimmering like the trail of a rocket.

"The probe called a class A alert." She grinned. "There are Shards all around the star, shattered and glimmering like the Oort-sky of Sol. And the probe reports that there is a *world* within! One that we can touch!"

I laughed out loud. I pulled her to me and we hugged. I could tell the campers behind me came from times when one did not do such things, for they muttered in consternation.

"When! When did the news come!"

"We found out months ago, just after you thawed. Worldcomp still said that we had to give you a year of wakeup, but I came the instant it was over. We have waited long enough, Joshua. Moishe Bok is taking out every deepspacer nowalive.

"Joshua, we want you to come. We need you. Our expedition leaves in three days. Will you join us?"

She need not have asked. We embraced again. And this time I had to blink back tears.

Of recent weeks, as I wandered, I had

wondered what profession I would pursue in this life. But joy of joys, it never occurred to me I would be a deepspacer again! I would wear the uniform once more, and fartravel to the stars!

2.

The project was under a total news blackout. The Sol-Gov psychists were of the opinion that the race could not stand another disappointment. They feared an epidemic of greatdepression, and a few of them even tried to stop us from mounting the expedition.

Fortunately, the Worldcomps remembered their ancient promise. We deepspacers long ago agreed to stop exploring, and raising peoples' hopes with our efforts. In return, the billion robot farprobes were sent out, and we would be allowed to go investigate any report they sent back of a cracked shell.

By the time Alice and I arrived at Charon, the others had almost finished recommissioning the ship we were to take.

I had hoped we would be using the *Robert Rogers*, or *Ponce de Leon*, two ships I had once commanded. But they had chosen instead to use the old *Pelenor*. She would be big enough for the purposes we had in mind, without being unwieldy.

Sol-Gov tugs were loading aboard ten thousand corpsicles even as the shuttle carrying Alice and me passed Pluto and began rendezvous maneuvers. Out here, ten percent of the way to the Edge, the Shards glimmered with a brightsheen of indescribable colors. I let Alice do the piloting, and stared out at the glowing fragments of Sol's shattered crystalsphere.

When my grandfather was a boy, Charon had been a similar site of activity. Thousands of excited men and women had clustered around an asteroid ship half the size of the little moon itself, loading aboard a virtual ark of hopeful would-be colonists, their animals, and their goods.

Those early explorers knew they would never see their final destination. But they were not sad. They suffered from no greatdepression. Those people launched forth in their so-primitive first starship full of hope for their great-grandchildren—and for the world their sensitive telescopes had proved circled, green and pleasant, around the star Tau Ceti.

Ten thousand waityears later, I looked out at the mammoth Yards of Charon as we passed overhead. Rank on serried rank of starships lay berthed below. Over the millennia, thousands had been built, from generation ships and hiberna-barges to ram-skippers and greatstrutted wormhole-divers.

They all lay below, every one except for the few that were destroyed in accidents, or whose crews killed themselves in despair. They had all come back to Charon, failures.

I looked at the most ancient hulks, the generation ships, and thought about that day of my grandfather's youth, when the *Seeker* cruised blithely over the Edge, and collided at one percent of lightspeed with the inner face of Sol's crystalsphere.

They never knew what hit them, that firstcrew. They had begun to pass through the outermost shoals of the solar system . . . the Oort Cloud, where billions

of comets drifted like puffs of snow in the sun's weakened grasp.

Seeker's instruments sought through the sparse cloud, touching isolated, drifting balls of ice. The would-be colonists planned to keep busy doing science throughout the long passage. Among the questions they wanted to solve on their way was the mystery of the comets' mass.

Why was it, astronomers had asked for centuries, that virtually all of these icy bodies were the same size—about a mile across?

Seeker's instruments ploughed for knowledge. Little did her pilots know she would reap the Joke of the Gods.

When she collided with the crystalsphere, it bowed outward with her over a span of lightminutes. *Seeker* had time for a frantic lasercast back to Earth. They only knew that something strange was happening. Something had begun tearing them apart, even as the fabric of space itself seemed to rend!

Then the crystalsphere shattered.

And where there had once been ten billion comets, now there were ten quadrillion.

Nobody ever found the wreckage of *Seeker*. Perhaps she was vaporized. Almost half the human race died in the battle against the comets, and by the time the planets were safe again, centuries later, *Seeker* was long gone.

We never did find out how, by what accident, she managed to crack the shell. There are still those who contend that it was the crew's ignorance that crystalspheres even *existed* that enabled them to achieve what has forever since seemed so impossible.

Now the Shards illuminate the sky. Sol shines within a halo of light, reflected by the ten quadrillion comets . . . the mark of the only goodstar accessible to man.

"We're coming in," Alice told me. I sat up in my seat and watched her nimble hands dance across the panel. Then *Pelenor* hove into view.

The great globe shone dully in the light from the Shards. Already the nimbus of her drives caused the space around her to shimmer.

The Sol-Gov tugs had finished loading the colonists aboard, and were departing. The ten thousand corpsicles would require little tending during our mission, so we dozen deepspacers would be free to explore. But if the goodstar did, indeed, shine onto an accessible goodworld, we would awaken the men and women from frozensleep and deliver them to their new home.

No doubt the Worldcomps well chose these sleepers to be potential colonists.

Still, we were under orders that none of them should be awakened unless a colony was possible. Perhaps this news would turn out to be just another disappointment, in which case the corpsicles were never to know that they had been on a journey twenty thousand parsecs and back.

"Let's dock," I said eagerly. "I want to get going."

Alice smiled. "Always the impatient one. The deepspacer's deepspacer. Give it a day or two, Joshua. We'll be winging out of the nest soon enough."

There was no point in reminding her that I had been latewaiting longer than she—indeed longer than nearly every other human left alive. I kept my rest-

lessness within and listened, in my head, to the music of the spheres.

3.

In my time there were four ways known to cheat Einstein, and two ways to flat-out fool him. On our way out, *Pelenor* used all of them. Our route was circuitous, from wormhole to quantum-point to collapsar. By the time we arrived, I wondered how the deep-probe had ever gotten so far, let alone back with its news.

The find was in the nearby minor galaxy, Sculptor. It took us twelve years, shiptime, to get there.

On the way we passed close to at least two hundred goodstars, glowing hot-yellow, stable, and solitary. In every case there were signs of planets circling round. Several times we swept by close enough to catch glimpses, in our super-scopes, of bright blue waterworlds, circling invitingly like temptresses, forever out of reach.

In the old days we would have mapped these places, excitedly standing off just outside of the dangerzone, studying the Earthlike worlds with our instruments. We would have charted them carefully, against the day when mankind finally learned how to do on purpose what *Seeker* had accomplished in ignorance.

Once we did stop, and lingered two lighthours out from a certain goodstar —just outside of its crystalsphere. Perhaps we were foolish to come so close, but we couldn't help it. For there were modulated radio waves coming from the waterworld within!

It was only the fourth time technological civilization had been found. We spent an excited year setting up robot watchers and recorders to study the phenomenon.

But we did not bother trying to communicate. We knew, by now, what would happen. Any probe we sent in would collide with the crystalsphere around this goodstar. It would be crushed, ice precipitating upon it from all directions until it was destroyed and hidden under megatons of water—a newborn comet.

Any focused beams we cast inward would cause a similar reaction, creating a reflecting mirror that blocked all efforts to communicate with the locals.

Still, we could listen to *their* traffic. The crystalsphere was a one-way barrier to modulated light and radio, and intelligence of any form. But it let the noise the locals made escape.

In this case, we soon concluded that it was another hive-race. The creatures had no interest in, or even conception of, spacetravel. Disappointed, we left our watchers in place and hurried on.

Our target was obvious as soon as we arrived within a few lightweeks of the goal. Our excitement rose as we found that the probe had not lied. It *was* a goodstar—stable, old, companionless —and its friendly yellow glow diffracted through a pale, shimmering aura of ten quadrillion snowflakes. Its shattered crystalsphere.

"There's a complete suite of planets," announced Yen Ching, our cosmophysicist. His hands groped about in his holistank, touching in its murk what the ship's instruments were able to decipher from this distance.

"I can feel three gasgiants, about two

million smallbodies, and . . .'' he made us wait, while he felt carefully to make sure. ''. . . and three littleworlds!''

We cheered. With numbers like those, odds were that at least one of the rocky planets circled within the Lifezone.

''Let me see . . . there's one littleworld here that . . .'' Yen pulled his hand from the tank. He popped a finger into his mouth and tasted for a moment, rolling his eyes like a connoisseur savoring a fine wine.

''*Water*,'' he smacked thoughtfully. We all sighed happily. ''Yes! Plenty of water. I can taste life, too. Standard adenine-based carbolife. Hmmm. In fact, it's chlorophyllic and left-handed!''

In the excited, happy babble that followed, Moishe Bok, our captain, had to shout to be heard.

''All right! People! Look, it's clear none of us are going to get any sleep soon. Lifesciencer Taiga, have you prepared a list of corpsicles to thaw, in case we found a goodworld?''

Alice drew the list from her pocket. ''Ready, Moishe. I have biologists, technicians, planetologists, crystallographers . . .''

''You'd better awaken a few archeologists and Contacters,'' Yen added dryly.

We turned and saw that his hands were back in the holistank. His face bore a dreamy expression.

''It took our civilization three thousand years to herd our asteroids about into optimum orbits for space colonies. But compared with this system we're amateurs. Every smallbody orbiting this star has been transformed. They march around like ancient soldiers on a drill-field. I have never even imagined engineering on this scale.''

Moishe's eyes flickered to me. As executive officer, it would be my job to fight for the ship, if *Pelenor* found herself in trouble . . . and to destroy her if capture were inevitable.

Long ago we had reached one conclusion. If goodstars without crystalspheres were rare, and dreamt of by a frustrated mankind, the same might hold for some *other* startravelling race. If some other race had managed to break out of its shell, and now wandered about, like us, in search of another open goodstar, what would such a race think, upon detecting our ship?

I know what *we* would think. We would think that the intruder had to *come* from somewhere . . . an open goodstar.

My job was to make sure nobody ever followed *Pelenor* back to Earth.

I nodded to my assistant, Yoko Murukami, who followed me to the armsglobe. We unfolded the firing panel and waited while Moishe ordered *Pelenor* piloted cautiously closer.

Yoko looked at the panel dubiously. She obviously doubted the efficacy of even a mega-terawatt laser against technology of the scale described by Yen.

I shrugged. We would find out soon. My duty was done the moment I flicked the arming switch and took hold of our deadman autodestruct. In the hours that passed, I watched developments carefully, but could not help deepremembering.

4.

Back in the days before starships —before *Seeker* broke Sol's eggshell

and precipitated the two-century CometWar—mankind had awakened to a quandary that caused the thinkers of those early days many sleepless nights.

As telescopes improved, as biologists began to understand, and even tailor-make life, more and more people began to look up at the sky and ask, "Where the hell *is* everybody?"

The great lunar-based cameras tracked planets around nearby yellow suns. There were telltale traces of life even in those faint 21st-century spectra. Philosophers cast nervous calculations to show that the galaxies must teem with living worlds.

And as they prepared our first starships, the deepthinkers began to wonder. If travel between the stars was as easy as it appeared to be, why hadn't the fertile stars already been settled by somebody *else!*

After all, *we* were getting ready to head out and colonize. By even modest estimates of expansion rates, we seemed sure to fill the entire galaxy with human settlements within a few million years.

So why hadn't this already *happened?* Why was there no sign of traffic among the stars? Why had the expected radio network of communication never been detected?

Even more puzzling . . . why was there absolutely *no* evidence that Earth had ever been colonized in the past? We were by then quite certain that our world had never hosted visitors from other worlds.

For one thing, there was the history of the Pre-Cambrian to consider.

Before the age of reptiles, before even fish or trilobites or even amoebae, there was, on Earth, a two-billion-year epoch in which the only lifeforms were crude single-celled organisms without nuclei—the prokaryotes—struggling slowly to invent the basic structure of life.

No alien colonists ever came to Earth during all that time. We knew that for certain; for if they had, the very garbage they buried would have changed the history of life on our planet. A single leaky latrine would have filled the oceans with superior lifeforms that would have overwhelmed our crude little ancestors.

Two billion years without being colonized . . . and then the silent emptiness of the radioways . . . the philosophers of the 21st century called it the Great Silence. They hoped the starships would find the answer.

Then the very first ship, *Seeker*, somehow smashed the crystalsphere we hadn't even known existed, and inadvertently explained the mystery for us.

During the ensuing CometWar, we had little time for philosophical musings. I was born into that battle, and spent my first hundred years in harsh, screaming littleships, blasting and herding iceballs that, left alone, would have fallen upon and crushed our fragile worlds.

We might have let Earth fall, then. After all, more than half of humanity by then lived in space colonies, which could be protected easier than any sittingduck planet.

That might have been logical. But mankind went a little crazy when Earth-mother was threatened. Belters herded cities of millions into the paths of hurtling iceballs, just to save a heavy world they had only known from books and a faint bluetwinkle in the blackness. The

psychists took a long time to understand why. At the time it seemed like some sort of divine madness.

Finally the war was won. The comets were tamed and we started looking outward again. New starships were built, better than before.

I had to wait for a berth on the twelfth ship, and the wait saved my life.

The first seven ships were lost. As they beamed back their jubilant reports, spiraling closer to the beautiful green worlds they had found, they plowed into unseen crystalspheres and were destroyed.

And, unlike *Seeker*, they did not accomplish anything by dying. The crystalspheres remained after the ships had been icecrushed into comets.

We had all had such hopes . . . though those who remembered *Seeker* had worried quietly. Humanity seemed about to breathe free, at last! We were going to spread our eggs to other baskets, and be safe for the first time. No more would we have to fear overpopulation, crowding, or stagnation.

And all at once the hopes were dashed—dashed against those unseen, deadly spheres.

It took centuries even to learn how to *detect* the deathzones! *How*, we asked. How could the universe be so perverse! Was it all some great practical joke? What *were* these monstrous barriers that defied all the physics we knew, and kept us away from the beautiful littleworlds we so desired?

For three centuries, humanity went a little crazy.

I missed the worst years of the great-depression. I was with a group trying to study the sphere about Tau Ceti. By the time I got back, some degree of order had been restored.

But I came back to a solar system that had clearly lost a piece of its heart. It was a long time before I heard true laughter again, on Earth or on her smallbodies.

I, too, went to bed and pulled the covers over my head for a couple of hundred years.

5.

The entire crew breathed a reliefsigh when Captain Bok ordered me to put the safeties back on. I finally let go of my deadman switch and got up. The tension seeped away into a chain of shivers, and Alice had to hold me until I could stand again on my own.

Moishe had ordered the stand-down because the goodsun's system was empty.

To be accurate, the system *teemed* with life, but none of it was intelligent.

The greater asteroids held marvelous, self-sustaining ecosystems, absorbing sunlight under great windows. Twenty moons sheltered huge forests beneath tremendous domes. But there was no traffic, no radio or light messages. Yen's detectors revealed no machine activity, nor the thought-touch of analytical beings.

It felt eerie to poke our way through those civilized lanes in the smallbody ways. For so long we had only performed such maneuvers in the well-known spaces of Solsystem.

During those first centuries after the crystal crisis, some men and women still thought it would be possible to live among the stars. Belters mostly, they claimed aloud that planets were nasty,

heavy places anyway. So who needed them?

They went out to the *badstars*—red giants and tiny red dwarves, tight binaries and unstable suns. The badstars were protected by no crystalspheres. The would-be colonists found drifting clots of matter near these stars, and attempted to set up smallbody cities as they had at home.

Every one of the attempts failed within a few generations. The colonists simply lost interest in procreation.

The psychers finally decided the cause was related to the divine madness that had enabled us to win the CometWar.

Simply put, men could live on asteroids, but they needed to *know* that there was a blue world nearby—to see it in their sky. It's a flaw in our character, no doubt, but we cannot go out and live in space all alone.

We have to have waterworlds, if the universe is ever to be ours.

This system's waterworld we named Quest, after the beast so long sought by King Pelenor, our ship's namesake. It shone blue and brown, under a clean whiteswaddling of clouds. For hours we circled above it, and simply cried.

Alice awakened ten corpsicles —prominent scientists who, the Worldcomps had promised, would not fall apart on the reawakening of hope.

We watched them take their turn at the viewport, joytears streaming down their faces, and we joined them, to weep freely once again.

6.

Pelenor was hardly up to the task of exploring this system by herself. We spent a year recovering and modifying several of the ancient ships we found drifting over the planet, so that teams could spread out, investigating every farcorner of this system.

By our second anniversary, a hundred biologists were quickscampering over the surface of Quest. They genescanned the local flora and fauna excitedly, and already were modifying Earthplants to fit into the ecosystem without causing an imbalance. Soon they would start on animals from our genetanks.

The engineers exploring the smallbodies excitedly declared that they could get half the lifemachines left behind by the prior race to work. There was room for a billion colonists out there, straight from the start.

But the archeologists were the ones whose report we awaited most anxiously. In between my ferrying runs, they were the ones I helped. I joined them in the dusty ruins of Oldcity, at the edge of Longvalley, putting together piles of artifacts to be catalogued and slowly analyzed.

We learned that the old inhabitants had called themselves the "Natural." They were about as similar to us as we might have expected—bipedal, ninefingered, weirdlooking.

Still, one got used to their faces after staring at their statues and pictures long enough. After a while I even began to perceive subtle facial cues, and delicate, sensitive nuances of expression. When the language was cracked, we learned their race-name, and some of their story.

Unlike the few other alien intelligences we had observed from afar, the Natural were individuals, and explorers. They, too, had spread into their planetary system after a worldbound history

fully as colorful and goodbad as our own.

Like us, they had two conflicting dreams. They longed for the stars, for room to grow. And they also longed for other faces, for neighbors.

By the time they built a starship—their first—they had given up on the idea of neighbors. There was no sign anybody had ever visited their world. They heard nothing but silence from the stars.

Still, when they were ready, they launched their firstship toward their other dream—Room.

And within weeks of the launching, their sun's crystalsphere shattered.

For two weeks we double-checked the translations. We triple-checked.

For millennia we had been searching for a way to destroy these deadly barriers around goodstars . . . trying to duplicate on purpose what *Seeker* had accomplished by accident. And now we had the answer!

The Natural, like us, had managed to destroy one and only one crystalsphere. Their own. And the pattern was exactly the same, down to the CometWar that subsequently almost wrecked their high civilization.

The conclusion was obvious. The deathbarriers were destructible, but *only from the inside!*

And just when that idea was starting to sink in, the archeologists dug up the Obelisk.

7.

Our top linguist, Garcia Cardenas, had a flair for the dramatic. When Alice and I visited him in his encampment at the base of the newly excavated monument, he insisted on putting off all discussion of his discovery until the next day. He and his partners instead prepared a special meal for us, and raised their glasses to toast Alice.

She stood and accepted their accolades with dry wit, and then sat down to continue nursing our baby.

Old habits break hard, and only a few of the women had managed yet to break centuries of biofeedback conditioning not to breed. Alice was among the first to reactivate her ovaries and bring a child to our new world.

It wasn't that I was jealous. After all, I basked in the only slightly lesser glory of fatherhood. But I was getting impatient with all of this ballyhoo. Except for old Moishe Bok, I was perhaps the oldest human here—old enough to remember when people had children as a matter of course, and therefore made time for *other* matters, when something important was up!

Finally, when the celebration had wound down, Garcia Cardenas nodded to me, and led me out the back flap of the tent. We followed a dim path down the sloping trail to the digs, by the light of the ring of bright smallbodies the Natural had left permanently in place over the equatorial sky of Quest.

We finally arrived at a wall of bright alloy that towered high above our heads. It was made of a material our techs had barely begun to analyze, and was nearly impervious to the effects of time. On it were inscribed hardpatterns bearing the tale of the last days of the Natural.

A lot of that story we knew from the other records. But the end itself was still a mystery, and no small cause of nervousness. Had it been some terrible

plague? Did the intelligent machines, on which both their civilization and ours relied, rebel and slaughter their masters? Did their sophisticated bioengineering technology get out of their control?

What we *did* know was that the Natural had suffered. Like humans, they had gone out and found the universe closed to them. Both of their great dreams—of goodplaces to spreadsettle, and of other minds to meet—had been shattered like the deathsphere around their own star. Like humans, they spent quite a long time not entirely sane.

In the darkness deep within the dig, Cardenas had promised I would find the answers.

As Cardenas prepared his instruments I listened to the sounds of the surrounding forestjungle. Life abounded on this world. There were lovely, complicated creatures, some clearly natural, and some just as clearly the result of clever biosculpting. In their creatures, in their art and architecture, in the very reasons they had almost despaired, I felt a powerful closeness to the Natural. I would have liked them, I imagined.

I was glad to take this world for humanity, for it might mean salvation for my species. Still, I regretted that the other-race was gone.

Cardenas motioned me over to a holistank he had set up at the base of the Obelisk. As we put our hands into the blackness, a light appeared on the face of the monolith. Where the light travelled, we would touch, and feel the passion of those final days of the Natural.

I stroked the finetuned, softresonant surface. Cardenas led me, and I felt the Endingtime as the Natural meant it to be felt.

* * *

Like us, the Natural had passed through a long period of bitterness, even longer than we had endured until now. To them, indeed, it seemed as if the universe were a great, sick joke.

Life was found everywhere amongst the stars. But intelligence arose only slowly and rarely, with many false starts. Where it did occur, it was often in a form that did not happen to covet space or the stars.

But if the crystalspheres had not existed, the rare sites where starfaring developed would spread outward. Species like us would expand, and eventually make contact with each other, instead of searching forever among sandgrains. An elder race might arrive where another was just getting started, and help it over some of its crises.

If the crystalspheres had not existed . . .

But that was not to be. Starfarers could not spread, because crystalspheres could only be broken from the inside! What a cruel universe it was!

Or so the Natural had thought.

But they persevered. And after ages spent hunting for the miraculous goodstar, their farprobes found five waterworlds unprotected by deathbarriers.

My touch-hand trembled as I stroked the coordinates of these accessible planets. My throat caught at the magnitude of the gift that had been given us on this obelisk. No *wonder* Cardenas had made me wait! I, too, would linger when I showed it to Alice.

But then, I wondered, where had the Natural gone? And why? With six worlds, surely their morale would have lifted!

There was a confusing place on the Obelisk . . . talk of black holes and of *time*. I touched the spot again and again, while Cardenas watched my reaction. Finally, I understood.

"Great Egg!" I cried. The revelation of what had happened made the discovery of the five goodworlds pale into insignificance.

"Is *that* what the crystalspheres are for?"

I couldn't believe it.

Cardenas smiled. "Watch out for teleology, Joshua. It is true that the barriers would seem to show the hand of a creator at work. But it might be simply circumstance, rather than some grand design.

"All that we do know is this. Without the crystalspheres, we ourselves would not exist. Intelligence would be more rare than it already is. And the stars would be almost barren of life.

"We have cursed the crystalspheres for ten thousand years," Cardenas sighed. "The Nataral did so for far longer—until they at last understood."

8.

If the crystalspheres had not existed . . .

I thought about it that night. I stared up at the shimmering, pale light from the drifting Shards, through which the brighter stars still shone.

If the crystalspheres had not existed, then there would come to each galaxy a first race of startreaders. Even if most intelligences were stay-at-homes, the coming of an aggressive, colonizing species was inevitable, sooner or later.

If the crystalspheres had not existed, the first such startreaders would have gone out and taken all the worlds they found. They would have settled all the waterworlds, and civilized the smallbodies around every single goodstar.

Two centuries before we ever discovered our crystalsphere, we humans had already started wondering why this had never happened to Earth. Why, during the three billion years that Earth was "choice real estate," had no race like us come along and colonized it?

We found out it was because of the deathbarrier surrounding Sol, that kept our crude little ancestors safe from interference from the outside . . . that let our nursery world nurture us into being in peace and isolation.

If the crystalspheres had not been, then the the first startreaders would have filled the galaxy, perhaps the universe. It is what *we* would have done, had the barriers not been there. The histories of those worlds would be forever changed. And there is no way to imagine the death-of-possibility that would have resulted.

So, the barriers protect worlds until they develop life capable of cracking the shells from within.

But what was the point? What point was there in protecting some young thing, only that it would grow up into a bitter, cramped loneliness in adulthood!

Imagine what it must have been like for the very first race of startreaders. Never, were they patient as Job, would they find another goodstar to possess. Not until the next egg cracked would they ever have neighbors to talk to.

No doubt they despaired long before that.

Now we, humanity, had been gifted

of six beautiful worlds. And if we could not meet the Natural, we could, at least, read their books and come to know them. And from their careful records we could learn about the still earlier races which had emerged from each of the other five goodworlds, each into a lonely universe.

Perhaps in another billion years the universe will more closely resemble the sciencefictional schemes of my grandfather's day. Maybe then commerce will plow the starlanes between busy, talky worlds.

But we, like the Natural, came too early for that. We are cursed, if we hang around until that day, to be an Elder-Race.

I looked one more time toward the constellation we had named "Phoenix," whither the Natural had departed millions of our years ago. I could not see the dark star where they had gone. But I knew exactly where it lay. They had left explicit instructions.

I turned and entered the tent that I shared with Alice and our child, leaving the stars and shards behind me.

Tomorrow would be a busy day. I had promised Alice that we might begin building a house on a hillside not far from Oldcity.

She muttered some dreamtalk and cuddled close as I slipped into bed beside her. The baby slept quietly in her cradle a few feet away. I held Alice, and breathed slowly.

But sleep came slowly. I kept thinking about what the Natural had given us.

Correction . . . what they had *lent* us.

We could use their six worlds, on the condition we were kind to them. Those were the same conditions they had accepted when they took the four worlds long abandoned by the *Lap-Klenno*, their predecessors on the lonely starlanes . . . and that the Lap-Klenno had agreed to on inheriting the three *Thwoozoon* suns. . . .

So long as the urge to spreadsettle was primary in us, the worlds were ours, and any others we happened upon.

But someday our priorities would change. Elbowroom would no longer be our chief fixation. More and more, the Natural had known, we would begin to think instead about loneliness.

I knew they were right. Someday my great-to-the-*n*th descendants would find that they could no longer bear a universe without other voices in it. They would tire of these beautiful worlds, and pack up the entire tribe to head for a darkstar.

There, within the event horizon of a great blackhole, they would find the Natural, and the Lap-Klenno, and the Thwoozoon, waiting in a cup of suspended time.

I listened to the wind gentleflapping the tent, and envied my great-*n*th grandchildren. I, at least, would like to meet the other startreaders, so very much like us.

Oh, we could wait around for a few billion years, till that distant time when most of the shells have cracked, and the universe bustles with activity. But by then we would have changed. By necessity we would have become an *Elder-Race*. . . .

But what species in its right mind would choose such a fate? Better, by far, to stay young until the universe fi-

nally became a fun enough place to enjoy!

To wait for that day, the races who came before us sleep at the edge of their timestretched black hole. Within, they wait to welcome us; and we shall sit out, together, the barren early years of the galaxies.

I felt the last shreds of the old great-depression dissipate as I contemplated the elegant solution of the Natural. For so long we had feared that the Universe was a practical joker, and that our place in it was to be victims—patsies. But now, at last, my darkthoughts shattered like an eggshell . . . like the walls of a crystalcage.

I held my woman close. She sighed something said in dreamthought. As sleep finally came, I felt better than I had in a thousand years. I felt so very, very young. ■

ON GAMING

(continued from page 93)

combots that are down to less than half their starting weapon modules; missile launch phase; laser fire phase; movement phase; combot movement phase; and claw attack phase (only against adjacent combots).

Damage is calculated for each hit. A hit on a missile destroys the missile. A hit on the combot may destroy two of the modules it's carrying. If a combot is carrying armor plate, each plate will automatically absorb one hit from a missile or claw. A claw that hits a plate is also destroyed. All other damage is random, determined by dice rolls.

When a module is destroyed by a hit, you slide it out of the equipment tender. Thus, at any point in the game you can tell exactly what's left on your combot.

You can buy more packs of metal combot parts to have multi-player gladitorial contests or military battles, using the designs in the rules or creating entirely new combot models. Rules for combot armies and three scenarios are provided. A short form for rules reference and a painting guide are also provided.

Combots is a great little game which has the potential to be a really challenging large-scale SF battle simulation with just a few more combots on each side. The almost endless variety of designs you can try out, along with different tactics (hit-and-run, close-in, and slug-it-out) make *Combots* one of the more interesting games. ■

● [W]hile space travel has important practical considerations, it also has a larger meaning in the history of life on this planet, comparable in significance to the move of the fishes out of the water 350 million years ago.

Robert Jastrow, *The Enchanted Loom*

FINAL DRAFT

Laurence M. Janifer

Does someone out there need help?

Excuse me if this is a little vague, but I'm writing in sort of a hurry, not knowing for sure how much time I have; and I'm under quite a strain. You will be, too, but not yet—let me explain all this.

The thing is, I'm a writer. And only a writer knows how all the different characters and stories he works with get started. What this means is that only a writer—not necessarily a great writer or a famous writer, but somebody like me, for instance—can explain the universe.

That sounds as if I belong in your friendly neighborhood bughouse, but I don't. If I'm wrong about all this I will be very grateful, and I will head right in to a handy funny farm and get myself revised, so I won't have to think about this any more. But look:

- The neutrino count from the Sun is a lot less than theory says it ought to be.
- No two anthropologists can agree on the pre-American parentage of the American Indian—or even if there was any pre-American parentage.
- There is a fish called the coelacanth. Everybody agrees that it shouldn't exist. It does, though.
- Light is a wave and a particle, both at once. These days it is treated mostly as a massless particle. Does this make sense?
- Amoebic dysentery is a tropical disease. It's also endemic to Iceland, and was so long before Iceland was anybody's military base. Nobody knows why this is.
- Igor Stravinsky and Charles Ives were composing very much the same sort of music, at the same time, without ever having heard each other's work. Attempts to explain this have given rise to lots of mysticism and very little sense. Music isn't an exact science: the next step isn't either obvious or necessary. Stravinsky's notions were peculiar to Stravinsky—except that they were

also peculiar to Ives.

● Mathematical physics is now a sensible discipline, based on the Uncertainty Principle and Planck's Constant. The sense is there only as long as we agree to a fundamental fuzziness in our idea of the universe: down where the electron lives, exact measurements are now supposed to be forever impossible.

All right. That is a sampling, and a short one. Ask an expert in any field, and you'll come away with fifty more items that don't quite make sense. The interesting thing about this, if *interesting* is the word for it, is that almost all such items have come up during this century, which now has sixteen years to go. Since 1900 (which is the date for Planck's Constant) we've been piling up inexplicable events and structures and objects at a tremendous rate; past a certain level, nothing seems to hang together really well.

If you want to create a super-intelligent character in a story—a 400-IQ alien, say, or a Sherlock Holmes—you can . . .

This will all come together in a minute or two.

. . . you can go one of two ways. First, you can plant all the answers, and then stop everybody else in the story from following your pre-planted trails; this leads to a lot of fairly slow and stupid characters like Watson, but if you also throw in some pre-planted false trails for them to go after you can make them look a little better.

Or you can try to dream up what it would feel like to be super-intelligent, and then make everybody else in the story treat your character as if he *is* super-intelligent. That combination—the feeling, and the way other characters react—can be awfully convincing. Whether it would convince a super-intelligent reader I have no idea, but maybe super-intelligent types spend very little time reading fiction.

Mostly you combine the methods, one way or another, working with the feel of the character and also planting some handy answers here and there. And when something comes up that a super-intelligent character ought to be able to deal with, and that you can't handle at all, you fake it as well as you can. Usually that faking stuff looks pretty good, until you look at it very closely and take it apart. But people don't look at fiction that closely; which is a good thing for the writer, and probably a good thing anyhow, because fiction isn't worth that sort of time and effort and attention.

Only the real world is.

Writers build a lot of real worlds, inside their heads, and it's perfectly possible to get confused about which one is the one *outside* your head—or whether there is one at all.

But the confusion is temporary, mostly. If you have no other test, the real world is the world that *does* make sense, when you look at it very closely.

The trouble is that it doesn't.

Let's suppose that somebody out there is dreaming this world up. Let's suppose he's been dreaming it up for a long, long while now. (And of course he doesn't have to be *he*, or *she* either. There are all sorts of possibilities.)

But this dreamer ran into problems after a while. Throughout this century, things have been getting more and more ragged. There is now a fairly large

movement in favor of the notion that nothing whatever is really explicable —that reason and logic simply do not work worth a damn. And the more I look at this—

—the more it looks like a writer inventing himself into trouble he is not quite bright enough to invent himself out of. At first you patch and fake, and you can get away with that for longer than anybody would think. But if you go on, you keep finding more trouble, and the patches get more obvious, and you start getting tired of the whole thing, and then you get careless. . . .

The carelessness is really beginning to show now. (The red shift measures astronomical distances with good precision. Astronomers are now turning up pairs of objects, connected in space and at the same distance, with wildly different red shifts. And there used to be things called primary colors. Not any more: ask Edwin Land and the Polaroid people.) The question is: What happens now?

A writer, when he finds his story getting this scrambled, usually just scraps it and starts all over again with something simpler.

All right: here I am, being hit with this idea and these words in the middle of the afternoon, near my typewriter, with no advance warning of any kind.

Maybe this story has been dreamed up (not by me: I don't even want to think about any of this) for a purpose. Suppose this gets published?

It might be a rather bored, downbeat, understated way of wrapping things up, and just writing The End.

But it might be something else.

Maybe you other story characters have some ideas for patching things up. Maybe whoever is dreaming this world up (and he might be looking and acting like all the rest of us, just now) has this one last, desperate idea: if everybody pulls together to smoothe out the patches, the story doesn't have to be scrapped.

If so, we have sixteen years to go until the century ends, which looks like an obvious, planted deadline.

That isn't really a lot of time. But—does anybody have any ideas? I don't like this at all, but here I am writing it; and it does explain those odd spots in the universe.

I wish it didn't. ■

● Although plastic was brought into industrial use in 1909 by L.H. Baekeland of Yonkers, it was not until after World War II that the modern miracle substance was used in a wide variety of consumer goods, among them speedboats, dentures and flamingos. Previously flamingos were made of cement. Before that they were made by other flamingos.

William E. Geist, *The New York Times*

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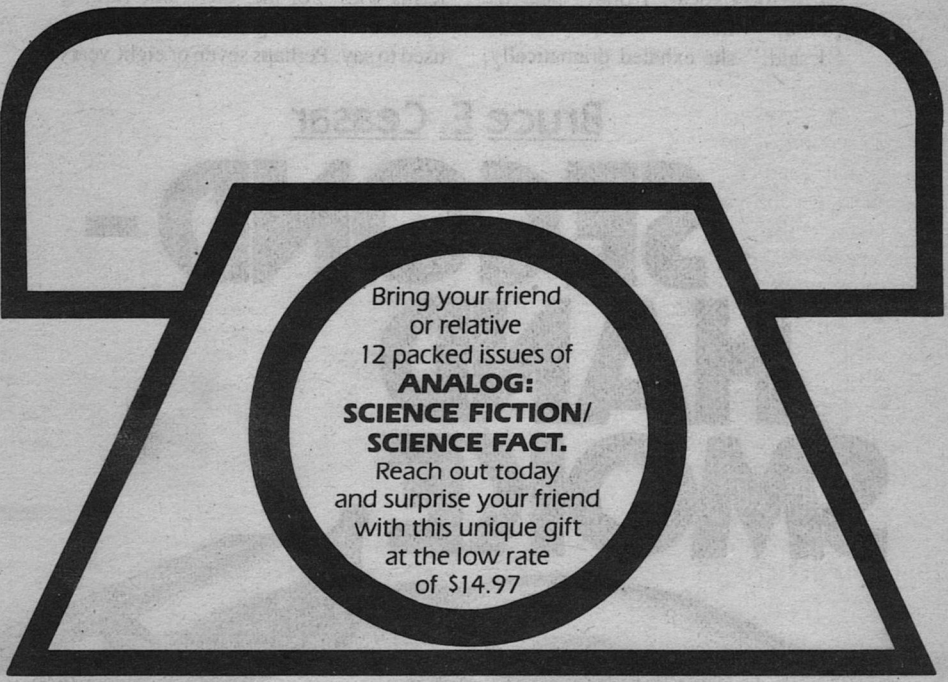

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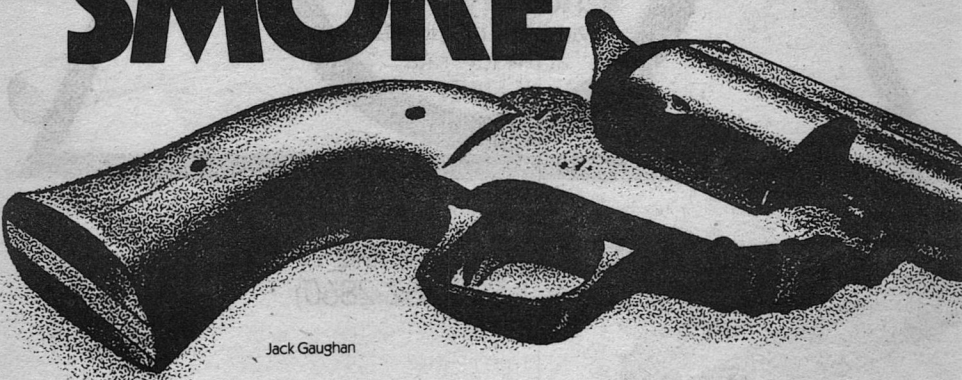
Bruce E. Ceasar

SECOND-HAND SMOKE



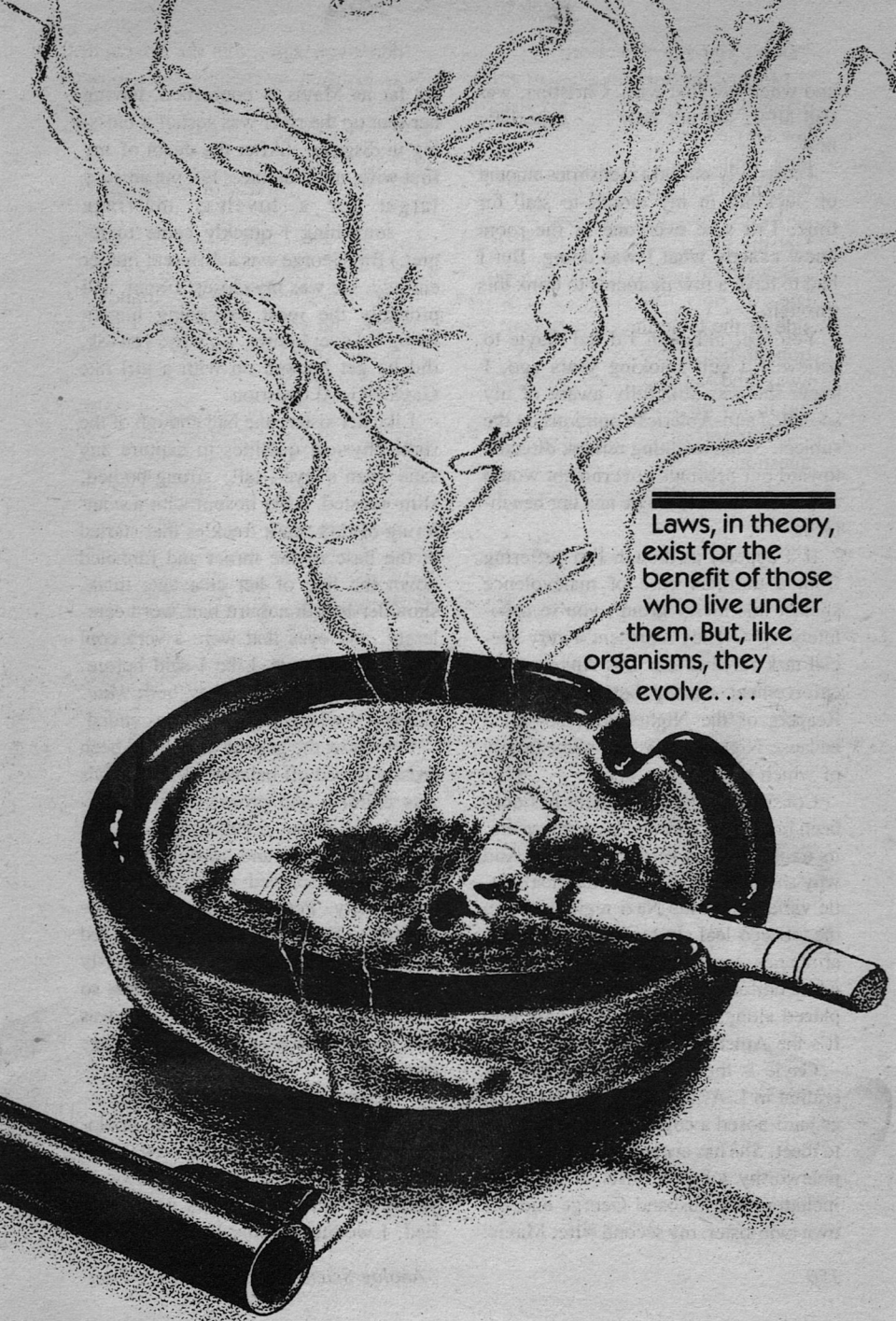
"Don't you agree, Nelson?"

I looked up from my plate of pineapple duckling and glared at my sister-in-law Gayle, who sat at the head of the long white Formica dining table. She was smiling at me with a look of inner, dark glee—the same look that makes me feel the way I do when I've spotted a "Beware of Canine" sign seconds too late . . . only this is worse. On each side of the table the cocktail conversation of her guests was quickly dying away; and one by one, heads began turning in my direction.

"I'm sorry, dear. I didn't hear the question," I lied.

"I said," she exhaled dramatically, "don't you agree that the government was justified in changing our tobacco laws?"

She knew damned well I didn't. For twenty-four of my forty years I have puffed on cigarettes of every description: filtered, non-filtered, regular, menthol, extra-long, extra-slim, natural light, ultra light, Turkish rounds, Havana ovals, mint-flavored, brandy-flavored, and yes, even lemon. To put it simply, I am a smoker. It's not something I'm proud of. It's an addiction that only recently in my life have I come to terms with. For me, there's no turning back, no "kicking the habit" as they used to say. Perhaps seven or eight years


Laws, in theory, exist for the benefit of those who live under them. But, like organisms, they evolve. . . .

ago when my first wife, Christina, was still alive; but not now . . . especially now.

I purposely stuffed a monstrous amount of duckling in my mouth to stall for time. I'm sure everyone in the room knew exactly what I was doing. But I had to have a few moments to think this through.

You see, although I'd led Gayle to believe I'd quit smoking years ago, I knew she was still fully aware of my so-called anti-American opinions on the subject. So an insulting remark directed toward our precious government would also be an insult to Gayle and her henchmen.

If it appears as though I'm suffering from a terminal case of malevolence against this merry group, you're absolutely right. They represent a very special task force of our Los Angeles law enforcement agency better known as Reapers of the Nightshade—so-called because Nightshade is the plant family of which tobacco is a genus.

Considering the department has only been in existence for the last three years, its track record is very impressive. And why shouldn't it be? It is America's little variation on the Nazi regime—from the tobacco-leaf cluster insignia on their armbands to the jackboots and crisp, white uniforms. To be a Reaper is to be placed alongside Mom and Apple Pie. It's the American Way.

Gayle is the commander of this operation in L.A. (a captain, no less) and as hard-nosed a cop as you'll ever want to meet. She has accumulated some very noteworthy tobacco busts in the past, including her husband George and her own twin sister: my second wife, Mavis. As far as Mavis is concerned, having her sent up the river was sort of a blessing in disguise. (After the death of my first wife, my loneliness left me an easy target for a loveless marriage . . . something I quickly came to regret.) But George was a different matter entirely. He was my closest friend, and probably the most easygoing human being I'd ever known. So why, you ask, did he get hooked up with a girl like Gayle? Good question.

Like her sister, she had enough of the right physical qualities to capture any sane man's eye—tall, strong-bodied, slim-waisted, a big bosom with a smattering of tiny, dark freckles that started at the base of the throat and funneled down the line of her cleavage; thick, shoulder-length auburn hair worn carelessly, and eyes that were a very cool shade of chestnut. Like I said before, she was a knockout. They both were. But that's where the similarities ended.

Somehow the genetic scales had been grossly tipped off balance. Where Mavis was childish and prosaic, almost bordering on sheer mindlessness, Gayle had intelligence and resourcefulness, and often displayed overt dominance and cruelty. Perhaps that's what drew George to her, that inner need to be led around by the umbilical cord. Obviously it's what made their marriage work, so who was I to criticize? Back then, it was all I could do to keep my own marriage from . . .

"Nelson. We're waiting."

I looked up at Gayle with an apologetic smile, and wondered how I was going to answer her question. If I said yes, I did believe the laws were justified, I would not only be down-facing

my own convictions, but surrendering myself to further humiliation. On the other hand, if I said no I might start drawing suspicion to myself. It was sort of like dancing on the coals to keep from standing in the fire. Some choice.

I swallowed my food and cautiously said, "No, not exactly."

From around the table came a unison of choral gasping. My God, how they played it to the hilt. Their eyes were wide with shock, their faces twisted in disgust, as though I'd just spat that mouthful of mush clear across the table, smack-dab in the middle of Gayle's forehead. Which, now that I think about it, would probably have been an excellent idea. For Gayle's expression never changed in the slightest. She kept right on smiling at me, egging me on with that wide doggy grin.

"For the sake of my guests, don't you think you should elaborate on that a little more?"

"I'd be glad to," I said, taking an extra sip of water just to draw out the scenario. "Actually, it's quite simple. It's not that I'm opposed to the prohibition of cigarettes. On the contrary, I found it to be long overdue. What I object to is this country's method of punishment."

By the look in her eyes, I could see I was beginning to touch on a sensitive area. Slowly, she crossed her arms on the edge of the table and leaned forward. "Are you implying that life imprisonment is too severe?"

"Not at all. In fact, I've come to the conclusion that it's been too lenient."

"So what are you suggesting?"

"Why, the death penalty, of course."

Again the wolfhounds gasped together on cue. But this time, I couldn't help myself, and I began to laugh. "How do you do that, Gayle?"

"Do what?"

"How do you get them to do that all at the same time? Is it done with wires? Or are you giving them some sort of signal on your secret decoder ring?"

The ludicrous smile instantly vanished, and she cursed under her breath. At the same time, some joker on my left stood up and jammed the barrel of his gun against my ear. "You horse's ass! This is the last time you'll mock a Reaper!"

"Sergeant! Put that weapon away!" Gayle shouted.

"But Captain, how can you let him get away with this?"

Gayle's voice suddenly became low and deadly. "Since when did you deem it necessary to question my orders?"

"I'm not . . . I mean, I only thought—"

"You're not supposed to think, Sergeant. That's not your job. Besides, you don't have the mental capacity for it. You're a lackey, a toad. Always remember that, and you'll remain a part of this team. Now, don't make me repeat the order."

He immediately withdrew his gun and sat back in his chair, not looking at anyone.

For a moment, I could not move or think. I was that terrified. Then I began to feel a trickle of blood drip down my neck where the sight had gouged my ear, and I gently dabbed it with a napkin. "If you'll excuse me, I think I'll get this cleaned up," I said, sidling around the table.

"Certainly, Nelson. But before you

go, will you answer one question for me?''

''What?''

''Were you serious about the death penalty?''

''Yes.''

''Can you tell me why?''

''Two reasons. One: I feel it would be a pretty good political move right now. And two: I don't see why we should waste any more government money, keeping these criminals alive. They're altogether too much of an embarrassment to the country.''

''I agree. But we'd still have to spend hundreds of thousands exercising that death penalty.''

''That's not entirely so. Not if the execution took place at the time of the arrest. And not if you automatically had the bodies routed to the fertilizer plants.''

This time there wasn't any community inhalation. Not one word was exchanged. And at that point, I really didn't care whether they believed me or not. I was getting out of there with nine tenths of my hide, and that's all that mattered.

In the bathroom I sat on the chill edge of a marble bathtub, trying to figure out what had prompted Gayle to have that discussion. I'm sure she didn't suspect me, unless sometime tonight that acute nose of hers had detected a faint trace of cigarette smoke. I doubt it, though. I'm too overly precautious. So why the third degree?

It was at that point the custom-made, wall-to-wall vanity caught my eye. George had built it at her request right after they were married. It was a gaudy monstrosity, with four sinks and a huge recessed mirror that ran the vanity's entire length. And to top it off, the whole thing was done in bright yellow.

Unbeknown to Gayle, George had made one small alteration in the cabinet. Below one of the bottom shelves near the center of the vanity he constructed a cache. And as secret hiding places go, this had to be the best. The only way you could gain access to it was by ap-

plying pressure with your fingertips to each side of the shelf until a soft click could be heard. This triggered a safety catch inside, releasing it; then the entire shelf would slowly climb upward.

Here George had kept all kinds of goodies, including a very large stock of cigarettes. (Tobacco wasn't illegal then, but Gayle so strongly detested George's habit that she often chucked any stray tins he left lying around.) I thought I was the only other person who knew about it. But after tonight, I wasn't so sure. I wonder if Gayle had accidently stumbled across the cache some time ago. If she had, she'd certainly have noticed the obvious drop in George's supply on the days I came to visit. Which would have made me public enemy number one, I guess. But if that were the case, wouldn't I have been nabbed sooner? Maybe. But maybe, in my old age, I'm just suffering from chronic paranoia.

I sat there for quite awhile, feeling very much alone. I needed someone to talk to. What I really needed was a cigarette, and a friend to share it with. I couldn't remember feeling this bad since the last evening George and I had spent together. The evening this country gave a new meaning to the word "freedom."

It had been hot that night, terribly hot. We were sitting on George's back porch, drinking highballs filled mostly with crushed ice, and listening to a KRTH rock-and-roll special featuring the music of an oldie but goody, Bruce Springsteen. George was carefully unwinding the metal tab of a fresh tin of cigarettes (that new type with the special vacuum seal) when our program was suddenly interrupted by a news bulletin. On any other given day George would have almost broken his neck trying to switch off the radio. I mean, that's the kind of guy he was. There was nothing he hated more than being (as he would so often put it) bombarded with a lot of depressing chitter-chatter that was obviously going to ruin the rest of his day. But that night he just casually reached over, turned it up, and without a word walked into the house. I didn't understand his odd behavior until I heard the announcer's voice boom out over the airwaves. The tobacco bill had finally passed. Beginning at twelve midnight, Eastern Standard Time, any individual on American soil caught using or selling tobacco in any form or quantity would waive the right of due process and be sent to prison.

"George! George! Did you hear it?" I yelled over the back of the rattan lounging chair.

"I heard, Nelson. I heard," he moaned.

He stood inside the doorway, holding a wet hand towel to his forehead. Legs shaking, he tentatively walked to the chair and sat down.

"Are you all right?" I said, rising from my own chair.

He motioned me back down with the palm of his hand and smiled sheepishly. "I was just curious to see what my supper looked like after it had a chance to blend properly."

"Something that didn't agree with you?"

He looked back at the radio. "Yes, I guess you could say that."

"Then you knew about this earlier?"

"I did."

"But why didn't you tell me?"

"Because I know you too well, Nelson. If you'd have caught wind of this sooner, you'd have been out hoarding cigarettes from every liquor and grocery store across the county."

"So?"

"So, that is exactly what our local police force is expecting. It's going to make their job a great deal simpler."

"Computer security scanners?" I asked.

"Exactly. The moment you step into any business establishment, that little device has got you photographed, fingerprinted, indexed, and categorized down to the last minute specification."

"But it doesn't take a detailed inventory of what you buy."

"True. But your currency card does."

He was right. Paper money had been outmoded years ago, replaced by a piece of personalized celluloid that, once inserted into a merchant's computer, would send an itemized description of the article in question to your local bank. The bank, in turn, would log the transaction and instantly return its certification that you were good for the money. "But George, you're not honestly going to sit there and expect me to believe that this is really going to work? I mean, even if they do catch us all, there's just too many smokers for our prisons to handle. Face it, there isn't enough room."

"There won't have to be."

"There won't? But I thought—"

"Nelson, are you aware of the ratio of smokers to non-smokers today?"

My stomach was beginning to churn and bubble like a hot spring. "No."

"One in every thirty. And for those who are caught, how long do you think they'll be able to survive cold turkey?" He stuck his palm back up not wanting me to answer. "I can't give you the exact figure, but believe me, by this time next year the suicide rate in prisons will be astronomical."

He fished two cigarettes out of the new pack and handed me one. For once in my life, I really didn't want it. A cold sweat was running into my eyes as my stomach kept rolling over and over in that continuous clothes-dryer motion. It was then five minutes to nine. "God, it's hard to believe this is really happening. I . . . I don't think I can live without tobacco."

"Jesus, is that all you're worried about, a few petty cigarettes? Don't you have the slighest conception of what's really going on around here?" He threw th towel at the radio in disgust. "Nelson, the government has only just begun! They've gotten their feet wet for the very first time, and now they're itching to see how far they can wade into the stream. First it's cigarettes, then alcohol; then they'll try for something more daring like controlled population or forced military involvement in our schools. Finally, they'll move into the big time and start weeding out all the undesirables.

"And who do we have to blame? No one but ourselves. We had our chance, but we avoided it. For years we've seen our neighbors walk down this same dangerous path. Mexico, Canada, Australia, Europe, they've all fallen one by one. And very steadily their poison has been spilling into our country, smothering us, infecting us, polluting us like . . ." A sullen smile began to turn

the corners of his mouth. "Like second-hand smoke."

For the next several minutes we both fell into a reflective silence, each lost in his thoughts and fears of what the future might bring.

"So what are we going to do, George?"

"The question is, what are *you* going to do?"

"Me? What about you?"

"I imagine I'll be spending the rest of my days in a poorly ventilated prison cubicle in Barstow."

"Gayle wouldn't dare . . . I mean . . . well, dammit all, she's your wife! She's not going to arrest her own husband!" But even before the words left my lips, I knew she would. Among her enemies and cohorts, Gayle's reputation for being a "strictly by the book" police officer was legend. There were never any exceptions, or immunities, or privileges in her vocabulary. Why should she feel the slightest remorse arresting George? For that matter, why should she feel anything for me? "I guess this means we'll be seeing a lot more of each other from now on."

"Not necessarily. I think you've guarded your secret very well. That is, of course, if it's true that Mavis is as naive about your habit as you say she is."

"She is," I said, and felt that familiar twinge of guilt again. Maybe I shouldn't have kept it from her. But I knew that if she ever found out she would've pilfered every last cigarette I owned. And cigarettes didn't come cheap. She had her own weekly allotment and seemed to survive on it pretty well. She didn't need mine too.

"Well, I'm positive Gayle doesn't suspect anything, either. But that doesn't mean you're in the clear, my friend. If you were smart, you'd quit smoking right now."

"I . . . I can't. You know that."

"Indeed I do. That's why I took the liberty of preparing a list of contacts who'll be of help to you when purchasing your tobacco. You'll find it in the cache."

He lit another cigarette and stared at me for several moments, then stuck his big hand out in a last farewell gesture. "I'm going to miss you, Nelson. I really am."

Just as I went to grasp it, the first spasm hit me. With one hand pressed firmly against my mouth, I turned and ran for the bathroom. I don't know how I managed to make it all the way upstairs, but I did. I knelt there on that hard linoleum, clutching the yellow porcelain bowl for a very long time. My head was pounding, my sides ached, and my throat was raw. After it was over, I washed my face and walked woodenly back to the porch. But when I got there, George was gone. And in his place sat Gayle, proudly glowing in her triumph.

"Good evening, Nel—"

"I can't believe it! Thirty minutes into the hour, and already you've arrested him! For God's sake, were you that damned anxious to get rid of him?"

"I know you're upset, Nelson, but he broke the law," she said with an almost frightening calmness.

"But couldn't you, at least, have given him one more day? I didn't even get to say—"

"He broke the law."

"I don't care about your stinking law! What do you want me to say, Gayle? That it was the correct thing to do? Should I get down on my knees and thank you?"

"I'm sorry. I'm sorry about George . . . and I'm sorry about Mavis."

I guess that was the zinger that was supposed to totally devastate me. But all I could say was, "Oh . . . oh, that's too bad."

Her eyes narrowed, her mouth tightened, and she jumped up and started shaking me by the shoulders. "Don't you understand? I arrested her. I had to do it. I tossed her in a cell and threw away the key. Don't you even care?"

"Sure . . . sure I do," I said, almost a little too dreamily. "You were right to do it. Remember, she did break the law."

"Well, I don't think you understand at all! You're in shock. The best thing for you to do now is go home and go to bed."

And that's just what I did. But even to this day she can't accept my reaction. I suspect she invites me over here for that very reason—just to see if I've changed my mind yet.

I glanced at my watch, and decided I'd better get back before they sent an escort for me. I hurriedly washed up, then confiscated the remaining tins in the cache, neatly concealing them in the special lining of my sportcoat. I should have taken them all months ago. I suppose I've always thought it an amusing game, a means of getting back at Gayle. But now "Old Man Paranoia" was getting the best of me. I was beginning to run scared.

Shortly afterward the dinner party broke up, and I left without incident. The night was still fairly young, so I drove up and down the main boulevards, scanning the marquees for something interesting to watch. But after an hour or so I gave up. Even the motion picture industry had been grossly affected by the tobacco law. Not only was smoking taboo in the theaters, but also in the pictures themselves. About ninety percent of the old classics were either banned or severely butchered. Movies starring Humphrey Bogart or Groucho Marx weren't even in existence anymore. No longer did the Indians smoke their peace pipes, or the English detectives puff on their calabashes. Those films had vanished forever. And along with them an important slice of America.

The movie industry wasn't the only facet of the arts affected by the law; literature, music, painting—they all were. When you sat right down and thought about it, everything had been touched in some way. George once said we had no one to blame but ourselves, and that we had avoided the matter and blew our opportunities. But that's only partially true. I believe the change had been so subtle, so gradual, we weren't even aware of its existence until the day the new ordinance was dropped into our laps.

It began sometime in the late '60s with the elimination of tobacco from both television and radio commercials. By then the surgeon general was warning us that cigarettes were dangerous to our health. Through the '70s, the Cancer

Society had launched a full-scale campaign against smoking. Environmental agencies were screaming about air pollution. Medical offices, grocery stores, department stores, and some small businesses and restaurants had banned it from their premises completely. In the '80s, the government started placing special taxes on all forms of tobacco. In 1984 a carton cost close to ten dollars. By 1991 that cost had sky-rocketed to almost forty dollars.

By that time the tobacco companies were in deep trouble. The big six—American, R.J. Reynolds, Brown and Williamson, Lorillard, Phillip Morris, and Benson and Hedges—had merged in a last-ditch effort to keep from going bankrupt. They called themselves the Universal Tobacco Company, and tried every strategic maneuver in the book to sway public opinion their way again. They gained some ground back, but it was evident they wouldn't be able to hold on too much longer. By now the surgeon general was telling us, not warning us, that cigarette smoking was, without a doubt, fatal.

Still, no one ever thought it would turn out the way it did. This was America—home of the free, land of the brave. This was the country where the inalienable rights of men were protected. It's stated right there in the Constitution. But then again, nobody ever dreamed the government would rewrite the Constitution, either. But it was rewritten—side by side with the epitaphs of a lot of good Americans.

It was nearly eleven by the time I got home. A heavy fog had rolled in over the basin, and the air was strong with that salty, fishy tang of the Pacific. I quickly changed into an old jogging suit and tennis shoes I kept in a plastic bag in the basement. I transferred the tins to the jacket, grabbed a small flashlight, and started down the shoreline.

My destination was an abandoned beach house about a mile south of my home. It was a two-story structure of typical Spanish design that sat on a narrow ridge overlooking the bay. Pieces of glass, stucco, and red clay tile circled the outside perimeter of the house like a moat. There were several gaping holes in the floors and walls, and over the many decades the testimony of adolescent love had been inscribed in every nook, every cubbyhole, every recess of this ancient abode. It certainly wasn't a very nice place to live, or the kind of place you'd take your girlfriend on a Saturday night. But for my purposes it was ideal.

As I reached the house, I thought I heard a small snapping sound above me. I scanned the second-story windows, but there was nothing to be seen in the misty darkness. I stood there, holding my breath, listening. Nothing. I finally shrugged it off, plucked my trusty crowbar from beneath the back steps, and walked in.

The place reeked of wet rot. Mice scattered in every direction, squeaking their warnings of impending danger. I waited until they had all safely found refuge, then made my way upstairs to a bedroom at the rear of the house.

In the far corner of the room, below half an inch of solid oak flooring (the only floor in the whole place that hadn't warped or buckled yet), I kept my stash. I knelt down, jimmied the crowbar in a groove, and pried two boards out.

Sixteen tins of cigarettes winked up at me out of the darkness like a treasure of priceless jewels. In a sense, they were. At least, with the extra eight tins I picked up today. Christmas had definitely come early this year.

I lit a cigarette, turned off the flashlight, and sat back against the wall. I was just about to take a second drag when a bright beam of light struck me square in the face. I let out a yelp and jumped a full three inches off the floor. My first instinct was to run, but I found myself cemented to the floorboards. No matter how hard I tried, I just couldn't move.

When I could speak again, I said in a hoarse whisper, "Who . . . who's there?"

"Hello, Nelson."

I squinted into the harsh glare. "Gayle?"

She didn't answer right away, and when she finally did, her voice took on that dark, inhuman quality again. "I'm really disappointed in you, Nelson. You've been lying to me all along, playing me for a genuine ass. I bet you think that's hilarious, don't you? Well, funny man, I don't hear you laughing now."

"How . . . how long have you—"

"Known? Not long, really. Four or five days at the outside. And what's ironic about it is that I never linked you with it until tonight. You were very careless. In your haste to leave, you forgot to put a few things back in the vanity. You know, you're not very good at this at all. George was, but he lacked assertiveness. By comparison, you're just a cheap imitation."

She had me dead to rights. I was never cut out for this type of intrigue. I'd been kidding myself for too many years. And now, when I should've been planning some means of escape, all I could think about was how long I'd last in prison. "So when do the rest of the musketeers join us?"

"Oh, they'll be along soon. There's no need to hurry."

I pointed to my cigarette. "Then you don't mind if I finish this, do you?"

"As a matter of fact, I do."

"Well that's just too bad, sister-in-law. Because I'm smoking it anyway," I said, feeling more and more indignant by the second.

"I wouldn't do that if I were you."

"Why? What are you going to do? Shoot me?"

"It's funny you should bring that up. I've been standing here considering that very possibility."

My cigarette dropped to the floor and rolled into the darkness. "You're not serious."

"Oh, but I am. You yourself convinced me of its advantages—fantastic political move, a shot in the arm for the budget—you remember. And just imagine the power someone might gain from introducing such an idea. It makes me light-headed just thinking about it."

"And I'm supposed to be the example of how efficiently this new system will work."

In that great stillness, I heard the metallic click of her service revolver as she gently pulled the hammer back.

"Precisely."

The flesh on the back of my hands and neck began to crawl. This was it—the final act, the last hurrah, goodbye Charlie. The cavalry wasn't going to make it this time. In my mind, I kept

picturing the little round hole over the bridge of my nose where the bullet would hit me. "You're forgetting one thing, Gayle. What if they don't go along with it? You'd be in big trouble then, wouldn't you?"

"That tiny problem has already been covered. You see, I have an iron-clad alibi. You threatened me with your weapon, and I had no choice but to shoot you. It's simple."

"What weapon?" I said, gesturing with my hand in the area of that circle of light. It was then that something outside the circle seized my attention. It was my crowbar, that thick piece of finely crafted steel that had always executed the tasks demanded of it without the slightest complaint. This was the out I'd been looking for. The question was, could I slip my hand out of the light without arousing suspicion?

"Oh, you'll have one. Don't you worry your handsome face over it."

"Before you pull that trigger, would you grant this condemned man a last request?"

"You're kidding. Why? What for?"

"Because I'm about to die, dammit! If you can't do it for that, then how about for the simple reason we're still kin. That's got to count for something!"

"Jesus," she exclaimed with obvious impatience, "I must be out of my head. Okay, okay! What is it!"

"May I finish the rest of that cigarette," I said, motioning to the glowing ember at my far right.

She started to laugh. "Right to the dying end, eh, Nelson?"

I chuckled along with her. "Yes . . . right to the dying end."

"It's all yours."

Very slowly, I reached out of the circle of light for the cigarette with my left hand while grabbing hold of the cold, blue steel with my right. I picked the cigarette up, and felt my muscles begin to tense. This was what they call the moment of truth. It's fourth down, goal to go, a second left on the clock. Either you make it, or you don't. I estimated the distance, held my breath, and began counting to three.

"What's the matter, Nelson? Second—"

With all of my strength, I sidearmed it at her. At the same instant there was a deafening roar of pistol fire, and I slammed against the wall. The bullet hit me on the upper half of my chest. My whole left side went numb. I waited for the second shot, but strangely enough it never came. I heard shouting outside, people thundering up the stairs, and an odd, wet hissing sound I couldn't quite place. I slid down on my right side, and into the arms of a busty California beach maiden. We lay there in each other's arms, singing slow, lonely ballads. And together drifted to a place far, far away.

First of all, I'd just like to say that I honestly don't understand how I got so lucky. By all rights, I should be dead. That's what everybody's been telling me since the night I killed Gayle at the beach house. It was in all the papers. Apparently, the crowbar had caught her at an angle just above the small concavity at the base of the throat. It smashed the esophagus, pierced one of the main arteries, and nailed her solidly against the wall.

I later found that when Gayle's troopers had stormed the bedroom that night,

it was Sergeant Quick-draw himself (Mr. Congeniality from the dinner party) who had saved me from being the target of someone else's vengeance. Why he didn't let them have me right then, I'll never know. But I somehow get the feeling he was trying to prove he was capable of making decisions on his own. I'm sure he thought he was then. It would be interesting to see how he feels about it today, given he's still alive.

When I finally regained consciousness in the hospital, they explained to me just how close to death I'd come. I had a perforated lung, a chipped collarbone, all kinds of muscle damage, and pneumonia. Two months later I was released and taken into protective custody to await my execution. That's the penalty for killing a Reaper in this state.

Ninety days before any execution, it's customary that the prisoner chooses the method in which he is to be put to death. Anything is accepted, as long as you're not breathing when it's over. So before I gave them my choice, I called an attorney friend of mine from San Francisco—he was just one of the many tobacco contacts I periodically did business with—and got him to fly down to Barstow to see me. The next day I gave them my selection.

Death by cigarette smoke. At first the courts weren't going to allow it. I can't say that I blame them. It was one hell of an odd request. But finally, after another month of deliberation, my petition was granted. Well, what else could they do? They certainly weren't going to argue with the surgeon general, were they? Uh-uh, no way. I had them by the tail, and they knew it.

So here I sit, day in and day out, slowly killing myself with cigarettes. Six tins in a twenty-four-hour period, or I get severely beaten. But prison life isn't so rough. I read a little and smoke, eat a little and smoke, and gossip with the guards a little and smoke some more. Yesterday, I heard something that was quite fascinating. It seems that an alarming amount of Reapers have been getting knocked off lately. Who knows, maybe I've started a new trend. ■

the reference library

By Tom Easton

The Seren Cenacles, W. Norwood and R. Mylius, Bantam, $2.95, 256 pp.
The Best Rootin' Tootin' Shootin' Gunslinger in the Whole Damned Galaxy, M. Resnick, Signet, $?, ? pp.
The Sword of Winter, M. Randall, Timescape, $14.95, 288 pp.
Ghosthunt, J. Clayton, DAW, $2.50, 189 pp.
Earthseed, P. Sargent, Harper & Row, $6.95, 289 pp.
Phantoms, D. Koontz, Putnam, $15.95, 352 pp.
The Best SF of the Year 12, T. Carr, ed., Timescape, $3.95, 357 pp.
The 1983 Annual World's Best SF, D. Wollheim, ed., DAW, $2.95, 255 pp.
Universe 13, T. Carr, ed., Doubleday, $11.95, 181 pp.
Gusliar Wonders, K. Bulychev, Macmillan, $16.95, 320 pp.
Olaf Stapledon: A Man Divided, L. A. Fiedler, Oxford, $19.95 cloth, $7.95 paper, 236 pp.
Nebula Maker & Four Encounters, O. Stapledon, Dodd, Mead, $14.95 cloth, $7.95 paper, 272 pp.
The Cosmic Dancers, Amit Goswami with Maggie Goswami, Harper & Row, $18.50, 292 pp. (Reviewed by Stanley Schmidt)

Warren Norwood has been giving us the *Windhover Tapes*. Now, with Ralph Mylius, he offers **The Seren Cenacles**, an action yarn whose fulsome melodramatics make it seem outrageously pretentious space opera. It is as if Norwood and Mylius had brought a soap to the opera house, complete with arias.

The story itself isn't that bad. What spoils it, among other things, is the conversion of technical jargon to meaningless noise. There is a "photon sonar." The villain ends squeezed into nothingness, in "an irreversible geometric progression which stretched into infinity, reducing everything that was Rosenthal . . . by a factor of point-five until he was no more." The story takes place at a protein mine, where "psychomin-

ers'' mentally turn inside out pockets of ''isoleucine-graphite'' ore, all in order to save a hungry galaxy.

Isoleucine is an amino acid, not protein and not, by itself, food. People are better and more lastingly fed by agriculture than by mining. But an agricultural food-base wouldn't permit quite the same story, and the ore pockets permit a link among the hero, the trouble-shooting Free Syndic Bedford Odigal; his immortal symbiote Issy; a legendary race of aliens, the Seren; and the problem.

The story begins when a mine manager, the ex-miner Kalissae, sends her half-sister to work a troublesome ore pocket, which promptly kills her. Word of the disaster brings a ruthless company rep who plans to destroy the mine to prevent word from leaking out. Odigal shows up, loses Issy to the ore pocket, is kidnapped, returns, gains Kalissae's love, regains Issy (in a way), and defeats the villain. All ends happily. And if that synopsis seems sketchy, it is so because I don't want to give away Norwood's and Mylius's surprises. Aside from the technical gaffes and the fulsome touches, the story is absorbing and the characters fairly appealing. If you don't notice the gaffes and don't mind excess melodrama, you'll enjoy the tale, and I shouldn't spoil it for you. On the other hand—

SPOILER WARNING: The gaffes will probably spoil the tale thoroughly for the average *Analog* reader. So—would you believe that the ore pockets are actually alien graveyards? That they are ancient watchposts staffed by members of Issy's race? That the one in the mine is still so staffed, that its occupant emerges to join with Odigal, and that Kalissae, Odigal, and their symbiotes wander off, arm in arm together, into the sunset at story's end?

'Tis so, 'tis so.

Much better is the fourth and last of Mike Resnick's Tales of the Galactic Midway, **The Best Rootin' Tootin' Shootin' Gunslinger in the Whole Damned Galaxy**. Here the focus is Billybuck Dancer, the long-term mainstay of Thaddeus Flint's Galaxy-roaming carnival. Billybuck is a trick-shot artist capable of feats that I don't believe possible (without a little cheating gimmickry) for a moment. (For instance, Mike says the Dancer can plug four cards out of fifty-two while all fifty-two are fluttering in the air!) He is obsessed with the past, dreaming constantly of Doc Holliday and other gunmen of Earth's Wild West, wishing he could meet them and test his mettle against them. He chafes at his life of tricks. He yearns for a worthy opponent and worries not that such an opponent might mean his own death.

The last volume in the series, *The Wild Alien Tamer*, demonstrated the blood-thirst of alien audiences. Here we see it again. Billybuck decides to copy the wrestling act. He will challenge his audiences, take on all comers, and shoot only to disarm, while they can shoot to kill. His first opponent dies of a heart attack. The rest are no challenge, not even the top gunslinger on a planet of gun freaks. Not even five at a time.

The final solution is a robot, designed to imitate Doc Holliday himself. Flint and his alien partner Ahasuerus commission it and send it on the road by itself. It draws the ravening attention of billions to the scheduled showdown with Billybuck, and it seems marginally faster than the human. Flint coppers his bet by buying a slower duplicate, but Billybuck catches on and destroys the ringer. He insists on a genuine challenge with real risk when it comes to the final

shootout, scheduled for a Galaxy-wide audience.

What happens in that final shootout? Who wins? I won't say. The result again expresses Mike's jaundiced view of macho games, but it also validates the Dancer's life and dreams and tells the rest of us how wrong it is to seek a life without risk. I suspect Mike has some admiration for the macho of mountain climbers, test pilots, and astronauts, who embrace danger and count their lives well lost if lost in the pursuit of achievement.

What about Thaddeus Flint? The Dancer's climax does not kill the carny. It will go on from planet to planet, though Flint returns home, turning his back on success. With wealth, he loses his savor for the carny. He would rather struggle than succeed. He is another who embraces risk, albeit of a different sort.

What about Batman and Jupiter, the wild aliens of volume 3? They abandoned risk and became pitiable. So too, perhaps, does Mike comment on modern America.

Marta Randall's **The Sword of Winter** is set on a world resembling both Medieval and Industrial Revolution Europe. Science and technology are encroaching on a feudal society, threatening an old guild structure. Lyeth is a Rider, a messenger sworn to Lord Gambin, a man of evil nature and worse kin. Her own guild is threatened by a new telegraph and by plots that could turn it into a secret police of sorts.

As the story opens, Lyeth is spreading word of a coming conclave to pick the dying Gambin's successor. In the village of Pelegorum, she finds a stableboy, Emris, an orphan who hates Riders and tries to sabotage her horse. To punish him, she carries him off. She intends to send him home before long, but she ends by adopting him, returning with him to Gambin's city of Jentesi, and doing her best to protect him.

In the city, Lyeth fights plots and seeks the secret of Emris's family. She succeeds in both tasks, saving both herself and Emris, but she ends committed to a realm she has hated.

Randall's characters are believable and her story rich. She is good, and if you like historical fantasy, you will enjoy *Winter*.

Jo Clayton's **Ghosthunt** comes somewhere near completing the saga of Aleytys the Hunter and her symbiotic diadem. Volumes ago, she lost her infant son to an evil woman and dispatched a thief to steal him back and take the boy to his father. She has never learned what happened. Now she is given the assignment to catch a kidnapper who threatens bigwigs on a vacation world. The criminal slips through all defenses, leaving as few traces as a ghost, and inevitably escapes with his ransom. He reminds her of Stavver, her son-seeking thief, and by page 50 we know her son is his assistant, armed with powers akin to Aleytys's own.

The thief is clever. So is Aleytys, and if she does not catch him before his next crime, she does before he can escape. Then must she decide: should she turn her own son over to the local law? Or should she let thief and boy go once she has their prey?

Her choice is no surprise. Nor is much else in this smoothly working book, not even in the lives of the kidnapper's victims, carefully detailed to dovetail a revolution into the events of crime. The book is nevertheless a pleasant read. Enjoy it.

In **Earthseed**, Pamela Sargent gives

teenagers a salutary lesson in learning to live with other people. For most of the tale, the scene is Ship, a vast construct designed to carry human seed to the stars, ripen it in artificial wombs near journey's end, and educate the results till the new generation of colonists is ready to settle a new world. Yet Ship's children include individuals who want power over others, and they display it first in a trek designed to test competence and ingenuity, then in a final, role-playing interlude. Ship turns off its sensors in its forested, wild interior and instructs its charges to live on their own, to build and farm and govern just as they will when freed. The power-lovers become brigands, pirates, kidnappers, only to be displaced when greater brigands, actual Earth folk, emerge from freezers hidden in Ship's unused corners.

Sargent's heroine is Zoheret, an intelligent, observant girl. She escapes the brigands, agemates and ancestors both, and enlists allies to defeat them. She it is who finds resolution and maturity and leadership.

Perhaps oddly, one major character is Ship itself. It has intelligence, and as it discovers its builders' deceptions and learns from its human charges, it too matures. In the end, the reader is serenely optimistic about the fate of the new colony and very curious about those Ship will plant in the future. Its approach promises to be less constrained by programming, more pragmatic, more adaptive. It has become a model and a reflection of the maturing human.

Earthseed will appeal to adults, but also—and perhaps more—to youngsters. Buy a copy for your favorite kid.

Dean Koontz's **Phantoms** opens as a bored deputy sheriff hears screams, rises from his office chair, checks his gun, and hears a noise in the empty room behind him. He turns—and suddenly he is no longer bored. Later that same night the town doctor returns with her orphaned kid sister to find the town empty. Everyone is either dead or vanished. The dead bear no marks except looks of horror. Some are barricaded behind locked doors. Others hold empty guns, and the walls around them bear no holes; they had hit whatever they shot at, but there is no blood.

The book looks like supernatural horror, but it isn't. Dr. Jennifer Paige summons the police, who call the army. Men die, seized by monsters of the night and by gross whatsits that erupt from the sewers. Slowly it emerges that here is a science fiction novel. The horror is an amoeboid ravener, a Proteus, eons old, come to the surface for one of those periodic feeds responsible for mass disappearances throughout history. And there is a solution.

Koontz establishes the mood of horror and suspense within his first few pages. He brings the reader immediately to the sleepless edge of his (or her) seat, and he keeps him there. He milks his situation, and he milks it, and he milks it. Perhaps he milks it too much, for *Phantom*'s horror *is* that of the bludgeon, with precious little subtlety.

Yet I enjoyed the story. The characters lack full depth, but Koontz draws them well enough that I could sympathize with their plight. The mythogenic monster is just conceivable enough. The gleam of technology and science suffuses a tale that could so easily have been lost in mysticism. Here indeed is the primal night scream redefined in a new setting, and again and again I found myself thinking, "What a movie this could make!"

It's that time of year—both Terry

Carr and Don Wollheim have brought out their "Best of the Year" collections. For Carr, it's **The Best Science Fiction of the Year 12**, thirteen stories most of which were prominent on the Nebula recommendations list and in the discussions of the 1982 Nebula Jury (to which both Carr and I belonged). Two won Nebulas; four have been nominated for 1983 Hugos. There are Silverberg's "The Pope of the Chimps," Bruce Sterling's "Swarm," Russ's "Souls," William Gibson's "Burning Chrome," Pohl's "Farmer on the Dole," Bill Johnson's "Meet Me at Apogee," Le Guin's "Sur," Disch's "Understanding Human Behavior," Benford's "Relativistic Effects," Connie Willis's "Firewatch," O. Niemand's pseudonymous "The Wooing of Slowboat Sadie," Nancy Kress's "With the Original Cast," and Bruce McAllister's "When the Fathers Go." You've seen them here, in *Asimov's*, in *The New Yorker*, in *Omni*, in *F&SF*, and in Alan Ryan's *Perpetual Light* and Carr's *Universe 12* anthologies. Some are better than others, but all are good, and there's enough variety of style and treatment to suit most tastes.

Wollheim's book is **The 1983 Annual World's Best SF**, and it overlap's Carr's surprisingly little. "Farmer on the Dole," "Souls," and "Swarm" are there. Willis is represented by her other 1982 Nebula winner, "A Letter from the Clearys." The rest are James White's "The Scourge," Dozois and Dann's "Playing the Game," Tim Zahn's "Pawn's Gambit," Tim Sullivan's "The Comedian," Tanith Lee's "Written in Water," and Rudy Rucker's "Peg-Man." They come from *Analog*, *Asimov's*, *Omni*, *F&SF*, *Twilight Zone*, and *Perpetual Light*. They include only one Nebula and three Hugo nominations, and the difference in the "medal score" between Carr's and Wollheim's efforts just may reflect the overall difference in quality as well as anything else I can point to. Carr picks more of the better stories, and he doesn't pretend to cover the world. He seeks thoughtfulness, where Wollheim seems to lean more to the nifty gimmick. Both are good anthologies. Both contain some of the best stories of the year. But if you can afford only one, buy the Carr.

Speaking of Carr, I also have his **Universe 13**. As usual, it is a very good original anthology, but other volumes of the series have appealed to me more. Here the best single story, the one that will appear in next year's "Best" volumes and on the award ballots, may be Michael Bishop's "Her Habiline Husband," in which the last *Homo habilis*, sole survivor of a relict band brought to Haiti from Africa by a slaving American diplomat, shows up in Georgia, and is adopted and finally married by the narrator's ex-wife. The tale is a warm and witty encounter among anthropology, racism, immigration law, greed, and humanity. You may well feel the book is worth its price for this story alone.

Ian Watson's "The Width of the World" is wit of another sort. Here the world's distances suddenly stretch, and surplus population falls through the cracks. Kim Stanley Robinson's "Stone Eggs" is an unsatisfying meld of psychosis and time travel. Bill Bickel's "The Widow and the Body Sitter" recounts the hazards of letting someone else occupy your body while it is suffering and dying. Lucius Shepard's "The Taylorsville Reconstruction" offers a secret test of mind control on a small Southern town; the result is ambiguity, for we are never sure whose delusions rule the resulting future. Leanne

Frahm's "A Way Back" accounts warmly for the vanishing of the dinosaurs in an interfading of time zones. Bruce Sterling's "Cicada Queen" extends the future of his "Swarm" and other tales; here, an alien Investor has become the center of a space habitat subculture, and her death brings chaos and regeneration.

Kirill Bulychev is a Soviet SF writer of considerable reputation. That reputation must be based on his work in his own language, for in translation his worth shines but dimly. Roger DeGaris's translation of the stories in **Gusliar Wonders** is stiff and inelegant—the word he renders as "May-bug" should, I suspect, have come out as "mayfly," unless an American June-bug is truly called a May-bug in Russian. Nevertheless, Bulychev preserves a charm, an innocence, that avoids ideology most cunningly in precisely those stories a Westerner would exploit as vehicles for social gibes. I suspect Bulychev would have written Bishop's "Habiline Husband" in a very different way.

The book's title refers to seven tales set in Great Gusliar, a hinterland village with delusions of its own importance. Each tale centers around Udalov, a man of similar self-importance, to whom things happen. He meets an alien road-repair crew, a time traveler, aliens with gifts and needs, a wizard, and a superbaby. He even catches an intelligent, ten-legged octopus in the local lake.

The Gusliar tales exist in a familiar tradition. The eight others in the book stand more independently. A time-viewer ensnares a watcher. A thought-projector works. A telekinetic rebels against his domineering mother. An alien child grows attached. A hero saves an interfering entomologist from a mine in a giant turnip. A seedling sprouts. A marriage rejuvenates when Kolya sees what Valentina truly thinks.

Bulychev's focus seems always small. Though all writers use the world as a stage, he works in a community theater. People matter, he quietly insists. The world at large is beyond our knowing, and what shakes it first shakes the individual. We can see this same view in our own nation's SF, but here there is always the effort to include the larger view, to find significance in ramification.

In **Olaf Stapledon: A Man Divided**, Leslie Fiedler proves a digressive writer too fond of verbal convolutions. Yet as he discusses Stapledon's works in this latest of Oxford University Press's critical appraisals of SF writers, he brings Stapledon alive as a man of grand vision and bleak spirit, insensitive to the actual currents in the world around him, in love with fate, and devoted to the philosophical view of God as an emergent epiphenomenon.

Fiedler gives Stapledon credit as a seminal early worker in the fields of SF. There is not a writer of the last fifty years who owes him nothing, for he shed visions the way a dog sheds hairs. Still, Stapledon was a stiff and stodgy writer whom no one has cared to imitate. To my mind this makes him far less laudable than Wells or even Heinlein. Fiedler seems too easily impressed by grand visions, and not enough by clumsiness.

If you care to check *my* rating of Stapledon against Fiedler's, you can find Stapledon's several novels in libraries, if not in bookstores. Try his best: *Last and First Men* (1930), *Odd John* (1935), *Star Maker* (1937), and *Sirius* (1944). Or you can go for a new one, published for the first time in the U.S. in 1983. It's **Nebula Maker**, a precursor to *Star*

Maker, and it's distinctly second rank.

Subtitled "Exploring the Physics of Science Fiction," **The Cosmic Dancers** is a book of great scope, considerable wit, and highly individual outlook. Professor Goswami, born in what is now Bangladesh and now a member of the physics department at the University of Oregon, explores the entire realm of physics—including the newest concepts—as it has been reflected in, and sometimes anticipated by, science fiction. It is neither a physics text nor a critique of science fiction, but can enable a reader who is somewhat familiar with either to learn quite a lot about the other. Goswami understands, respects, and (perhaps most important) enjoys both, and that enjoyment shines through on nearly every page.

The author says he wanted to write a book "in which you would always get the message of the whole book from whatever page you read," but reasonably doubts that he quite succeeded. The book does, however, lend itself surprisingly well to browsing, particularly if you heed his note that it divides rather naturally into sections on exploration of the solar system, interstellar travel, "hyperspace and related concepts," and the connection of mind and reality, with only the single chapter on waves being a prerequisite to everything that follows. Under those broad headings he provides a tantalizing introduction (perhaps a bit too nontechnical for a seriously aspiring scientist or science fiction writer, but there's also a big Bibliography) to virtually any topic in physics you can think of, including those which so far have appeared only or mostly in science fiction. Dean drives, for example, are in the same chapter with Newtonian mechanics, time machines and tachyons with special relativity, exobiology with entropy, and telepathy with nonlocal hidden variables in quantum mechanics. You *can* browse, but you'll get the most out of the book if you read straight through—and don't stop before the end, even if some of the earlier material seems too familiar, because the last chapters are the most intriguing. Here the Goswamis explore the really far-out consequences of some of the newest ideas and experiments, such as quantum duality, Bell's theorem, and several kinds of complementarity. Some of those consequences get surprisingly close to ideas previously little known outside of Oriental mysticism, and Dr. Goswami's Indian background may have helped him to develop and convey a special insight into the parallels.

This book could easily have been a mere recital of science-fictional versions of physical ideas, quite possibly tinged with scorn for the places where science fiction didn't get things quite right. Fortunately, it is not. The discussions of physics and the examples (including extensive quotations) from fiction are deftly interwoven, and Goswami shows plenty of respect for the writers who got there *first*, even if they didn't get all the details right. It may be, in fact, that one of the book's two greatest strengths is that it recognizes, with unusual clarity, the important symbiosis which has long existed between science and science fiction. The other is an open-mindedness appreciably beyond that of the average physicist, expressed, for example, in a willingness to point out the unfinished and uncertain areas of physics wherever they occur, and to recognize (and seek rational bases for) the possibility of "paranormal" phenomena. ■

brass tacks

Dear Mr. Schmidt:

I have been a reader of *Analog* for close to ten years now and will almost surely continue to subscribe to the magazine in the future. I do however, seem to have one tiny problem.

You see, I am a "born-again, baptized-in-the-Spirit, literal-Biblical-account-of-creation" Christian. According to some individuals who read *Analog* and write letters, apparently "intelligent scientist" and "Christian" are incompatible terms.

Up until the June 1983 issue, I was willing to overlook the buildup of criticism and insults both to my beliefs and my intelligence—mostly because I have grown to LOVE (Gasp! What an emotional statement!) the magazine. Irritations, insults, changes of publisher and all. I enjoy the mental exercises that SF and science fact invite me to go through. I have even enjoyed the anger that some of the editorials and letters invoked in me because they forced me to search my Bible (another sharp intake of breath) and seek the Lord for some answers.

But name-calling? Aw c'mon.

I refer specifically to Eugene Austin's letter in the June 1983 issue of Brass Tacks. Don't get me wrong—I don't support the Moral Majority or 90% of what Jerry Falwell preaches. But somehow a letter that refers to "Jerry the Fallen and his Moral Morons" strikes me as being a bit out of place in the pages of *Analog*. I realize that reader's opinions are not necessarily the opinions held by the magazine, but if you could keep the name-calling to a minimum, it might make some letter writers appear less "obnoxious" and keep the magazine's image closer to "impartial." (I did, by the way, agree with some of Mr. Austin's points, though for different reasons.)

The editorial and the letter from J.R. MacDonald in the August 1983 issue were only the most recent in a continuing series of letters and editorials that seem to me to be implying that one cannot be a Christian AND be intelligent also. I am the former for sure, and I like to think that I am the latter also.

I enjoy the challenges presented in *Analog* SF and SF, and I am trying my hand at writing a story or two that will challenge others from my side of the fence.

Keep up the good work, and please be assured that all Christians are not denser than neutron stars and half as intelligent as paremecia.

GUY STEWART
1924 Sugarloaf Trail
Brooklyn Park, MN 55444

I never said or implied that they were! If there has been a preponderance of letters that you think suggest that, it merely indicates that I haven't been getting enough suitable letters from "your side of the fence"—but I am *printing yours. In general, my sole criteria for selecting letters are reasonably clear expression and content which I expect to generate interest and further discussion among the readers. I may not agree with their style, but in general I won't tamper with it unless they say something actionable. Brass Tacks is a forum for the readers, and if it is really to be that,*

they must be free to say their say in their *terms, not mine.*

Let me add one caution, though—when a piece of writing offends you, please make sure it really *says what you think it says. That editorial, for instance, does not even remotely suggest that "one cannot be a Christian and be intelligent also."*

Dear Stan,

Readers of Joe Goodavage's article in the April *Analog* may be interested in the results of a test of astrometeorology that I carried out a couple of years ago.

I have been intrigued by this technique for weather forecasting ever since I first read about it in *Analog* twenty years ago, and when I was writing my book *The Death of the Sun* I decided to include a proper scientific test of the power of astrometeorological forecasts. I was preparing the paperback (Delta) edition of that book in the fall of 1980, and had to hand Joe Goodavage's book *Our Threatened Planet*. So I simply took his forecast for the winter of 1980/81 from that book and included it in my book. The point is that this was essentially a random choice from several forecasts in his book, and had I been writing my book a year later I would have picked the '81/82 forecast. By putting in print in the fall a forecast about the coming winter which would be read only when the book was published in the spring of the following year, I gave my readers an immediate chance to check the accuracy of the forecast. This is how it worked out.

Goodavage's prediction, based on planetary positions, was for a bitterly cold winter, particularly in the northeastern, northwestern, and border states of the U.S., "throughout the Canadian northwest, and especially in Europe and the Soviet Union." He forecast that the deep freeze would last from "December 21, 1980 through January, February and March of 1981, more intensely so during Saturn's stationary position centering on January 25, 1981. This promises to be the most bitterly cold week of the most bitterly cold winter within living memory," he said.

He was wrong. The winter of 1980–81 was not the worst in living memory, and across England and much of Europe it was unusually mild. While there was some severe weather in the U.S., we had worse in 1977–78 and also in 1981–82. So what can we learn about astrometeorology from this experiment?

The test—a classic example of the scientific method—establishes to my satisfaction that astrometeorology is not a precise tool that can be used confidently to predict the weather for specific weeks or months. But this does not rule out the possibility that the technique can be used effectively in a statistical sense. I believe that the influence of planetary alignments on weather is just one factor among many, but that we can use the alignments to predict, for example, that five out of the next ten winters are likely to be very severe, even though we cannot say which five out of the ten that will be. I've elaborated these ideas in *Beyond The Jupiter Effect*, published in the U.K. by Macdonald but not yet available in the U.S. Joe Goodavage has done a really good job of pointing out the possibilities of astrometeorology, but it is now very important to recognise its limitations, as well as its strengths, so that other scientists will take the idea seriously. It will be interesting to see the next report in *Analog*, in April 2003!

DR. JOHN GRIBBIN

Dear Dr. Schmidt:

Enjoying "Credos" in your August

issue, I was even more pleased to find what I thought was an error. On page 122, "Relativity theory shows you can't move matter faster than the speed of light. But of course you can . . . move information instantly—massless, you know." I've always interpreted Relativity Theory as banning faster-than-light velocities for either mass *or information*.

DON BURCHAM
A long-time subscriber
La Cañada, CA

Most physicists have interpreted relativity your way in the past; Brown's stories are set rather far in the future and the theory has evidently been modified in this single respect. A suspicion is already beginning to grow, among some physicists, that some such modification may be necessary.

Dear Dr. Schenck:

Mr. Pilson's story, "The Geometry of Narrative" (August), was one of the best I've read anywhere. I've enjoyed reading it many times. There's only one problem with it: the whole idea of narrative geometry makes a hell of a lot of sense.

Yours truly,
Stanley Schmidt

Hilbert Schenck tossed the letter on the others that now covered his desk. For crying out loud, what kind of people were reading *Analog* these days, anyway? That must have been the fiftieth letter talking about "narrative geometry" as if it were real. He'd go through the pitcher of martinis *fast* tonight.

Turner flung the latest *Analog* away in disgust, and it landed in a corner on top of other old magazines, old underwear, old beer cans, and some mass that was by now completely unidentifiable. That did it, he thought. He was definitely going to let his subscription lapse. He couldn't waste any more time on SF, not even the lectures Dr. Schenck, *Analog*'s editor, was giving at the university. All his energy would be devoted to struggling through English Lit. Especially now.

He started out the door for class. Christ, he hoped that creep Stang kept his mouth shut today. He'd already caused enough trouble.

GERRY L. TURNER
Quincy, IL

Dear Stan,

I just now reread your June 1983 editorial, and it has prompted me to share some additional thoughts on the subject of capital punishment. I have for many years held opinions similar to those you expressed in the editorial: strong reservations about capital punishment based on the probability of irreversible mistakes.

I have also, for many years, held a running argument with my father, who is a strong advocate of capital punishment. While he has not yet persuaded me completely, I find myself increasingly moving closer to his position. His response to the issue of the execution of innocent people is, "So what?"

Before you react too strongly, take a minute to consider. The increase of crime in our society has had a drastic effect on lifestyles since my father was born. Locked doors, general distrust, the inability to take evening walks without fear even in the better neighborhoods, the almost paralyzing fear that many of our senior citizens experience —all these are consequences of society's inability to control crime.

But people have always been willing to sacrifice some members of their societies to preserve or improve lifestyles. American deaths in World War II exceed any reasonable expectation of mis-

taken executions for decades. Indeed, how many lives have been spent to preserve the right to drive oneself home after a cocktail party?

So my father's argument is that the small number of innocent people who will suffer from the reinstitution of capital punishment is the price our society must pay to regain an acceptable lifestyle. In fact, he proposes that we extend capital punishment to cover repeat offenders convicted of all serious crimes, since he considers repeat offenders to be sociopaths that we are currently unable to cure.

My problem with this whole idea has to do with the effects such a policy might have on the rest of our society. Iran, with its very extreme punishments, has a very low crime rate. I wonder, though, whether there might be a relationship between the violent reaction to crime in Iran and the less desirable aspects of that society. My mind certainly isn't made up. I feel it is important that Americans continue to discuss and think about these issues.

DAVID CANTOR

Kalamazoo, MI ■

● "Grievous complaint (was made) that many people of the same town brew their ale and make their meat with water of the river of the said town, the which said river there being certain persons dwelling upon as Tanners that cure many diverse hides . . . to the impairing and corruption of the water of the river beforesaid, and in destruction of the ffysche therein and to great harming and nuisance of the said people."

—Complaint of Colchester Ale-makers against upstream Tanneries, 1425.

(Egads! I bet the ffysche weren't too thrilled; and I'd think twice about drinking ale made from tannery wastes. It would certainly be a great harming and nuisance to me, as beforesaid.)

—Michael F. Flynn

INDEX

Here is the Index to *Analog*'s fifty-fourth year: 1983, Volume 103. Entries are arranged alphabetically by author, with month and page. (There were two issues in September, abbreviated Sept and MidS.) Multiple entries by the same author are listed in chronological order. When the author's name and/or part of the entry's title is omitted, it is the same as that of the previous entry. Collaborations are listed under all authors, with cross-references. Unless otherwise noted, each entry is identified as a novelette (n), short story (ss), or fact article (a).

Anderson, Poul, "Science and Creation," a ..... Sept 53
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a calendar of analog upcoming events

12–14 December
Winter Simulation Conference at Arlington, Va. Info: Jerry Banks, School of ISYE, Georgia Tech, Atlanta GA 30332. 404–894–2312.

13 December
Computer Networking Symposium at Silver Spring, Md. Info: Computer Networking, Box 639, Silver Spring MD 20901. 301–589–8142.

13–15 January
BRAVE NEW CON (1984-oriented conference) at the Sheraton International, Reston, Va. Guest of Honor—Frederik Pohl. Registration—$10 until 31 December 1983, $12 at the door. Info: W.A.C.O., Box 5818, Bethesda MD 20814.

13–15 January
CHATTACON 9 (upper-South SF conference) at Read House Hotel, Chattanooga, Tenn. Info: Chattacon 9, Box 921, Hixson TN 37343.

13–15 January
ESOTERICON (special-interest SF conference) at Sheraton Heights, Hasbrouck Heights, N.J. Pro Guest of Honor—Jacqueline Lichtenberg; Fan Guest of Honor—Marion Zimmer Bradley; Special Guest—Katherine Kurtz. Registration—$30 at the door. Info: Esotericon, c/o Anne Pinzow (Golar), Box 290, Monsey NY 10952.

20–22 January
RUSTYCON (Seattle-area SF conference) at SeaTac Hyatt House, Seattle, Wash. Guest of Honor—Robert Asprin; Artist Guest of Honor—William Warren, Jr.; Fan Guest of Honor—Jerry Kaufman. Registration—$16 to 31 December 1983, $18 at door. Info: Rustycon, Box 47132, Seattle WA 98146.

27–29 January
CORFLU (fanzine-oriented convention) at Claremont Resort Hotel, Berkeley, Calif. Guest of Honor—To be chosen at convention; TM—Terry Carr. Registration $24.31 (including banquet). Info: CORFLU, 263 8th Avenue, San Francisco CA 94118.

27–29 January
GENUINE CONFUSION (Ann Arbor-area SF conference) at Plymouth Hilton, Plymouth, Mich. Guest of Honor—Mike Resnick; Fan Guest of Honor—Martha Beck; TM—Dick Smith; Friday Night Speaker—Wilson Tucker. Registration—$12 to 15 January 1984, $15 at the door. Info: Ann Arbor SF Association, Inc., Box 2144, Ann Arbor MI 48106. 313–485–4824.

30 August–3 September
LA CON II (42nd World Science Fiction Convention) at Anaheim Convention Center, Los Angeles, Cal. Guest of Honor—Gordon R. Dickson; Fan Guest of Honor—Dick Eney; TMs—Robert Bloch & Jerry Pournelle. Registration—$40 until 31 December 1983, more later and at the door. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition, the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: LA Con II, Box 8442, Van Nuys CA 91409.

—Anthony Lewis

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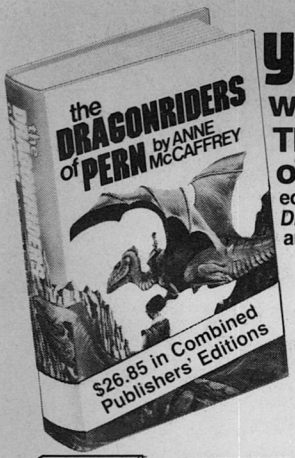

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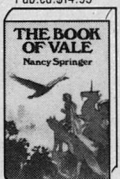

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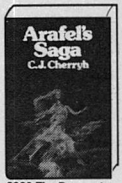

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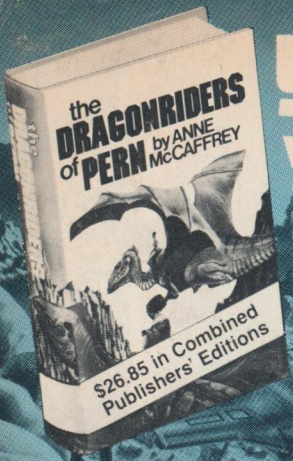

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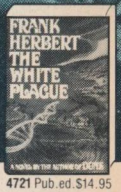

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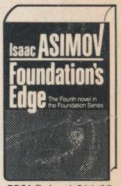

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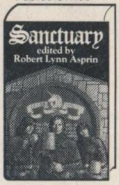

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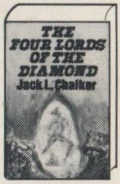

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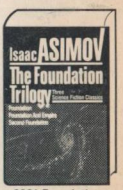

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