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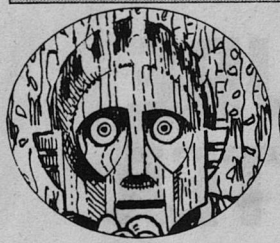

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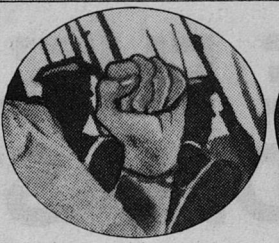

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Guest Editorial

THE FUTURE OF DISASTER

Gregory Benford

Until technology came along, disaster was always natural—floods, storms, plagues. Consider earthquakes, nowadays the universal fear of Californians. To people who lived on the land, without the comforts of houses, they were once no more troubling than a passing squall. With technology came disaster of a different kind—self-inflicted. It is our Faustian bottom line.

Alas, techno-risk brings with it the vexing problem of risk assessment. In 1900 the average lifetime in the U.S.A. was 48 years; now it's about 73. Science has been so successful in giving us years, we now seem to brood darkly on the possibility that it will, through accident and environmental effects, subtract a bit.

And perceptions differ greatly. In Table 1 the opinions of three different groups appear, including experts who know statistics. Notice how nuclear power takes a beating in the eyes of the reasonably aware public. Apparently, TV tells most of us that nukes are very bad. Cop shows make police work look more risky than it is. Interestingly, all the hospital shows seem to have reassured the public about the dangers of surgery. Having just barely survived a burst appendix two years ago, the bottom line of Table 1 looks to me very much like the metaphorical bottom line, too.

So, unsurprisingly, the public doesn't think like the experts. The media pictures they get of disaster stress spectacle. Good footage overrules careful weighing of alternatives. Also, paranoia is *the* simple plot device. Want an instant bad guy? Oil and nuclear power companies serve nicely. They are symptomatic of faceless, impersonal institutions. The public responds to these shorthand methods, and draws the wrong conclusions.

But what of the experts? I've spent a fair amount of time in the company of risk assessers, and it's striking that much of their work concerns air safety. Yet only one death occurs per billion

Table 1
Ordering of perceived risk for 10 activities and technologies. The ordering is based on the geometric mean risk ratings within each group. Rank 1 represents the most risky activity or technology.

Activity or Technology	League of Women Voters	College Students	Experts
Nuclear Power	1	1	20
Motor Vehicles	2	5	1
Handguns	3	2	4
Smoking	4	3	2
Motorcycles	5	6	6
Alcoholic Beverages	6	7	3
General (private) aviator	7	15	12
Police Work	8	8	17
Pesticides	9	4	8
Surgery	10	11	5

passenger miles, yielding a few hundred per year in the U.S.A. This, versus 150 deaths/day for auto accidents, and 100 deaths/day from smoking, for the whole U.S.A. population. The odds of dying are 1/10,000 per year for frequent flyers —comparable to the murder and suicide risk in the general population.

I conclude that concern with air safety is great because the rational, intellectual classes fly often. It's so quantifiable, so high-tech, so *clean* an issue. And "we" (the experts) do harbor some fear of flying.

What, then, of nuclear power? Chernobyl has yielded 31 dead already. Among the 24,000 living between 3 and 15 kilometers of the plant, a simple projection from the dose rate they got gives 131 added cancers in that population. That is a 2.6% increase in the expected number. If they all smoked, that would give a 30% increase. Considering the 75 million exposed in the Ukraine and Byelorussia, we get about 3,500 extra cancers. But this is only a 0.0047% increase in the expected 15 million cancers they should have in the future.

Newspaper headline, front page: 3500 DEAD FROM CHERNOBYL. Or, tak-

ing the other tack, there's a small item at the bottom of page 35 of that same newspaper: CHERNOBYL CANCER RATE "INFINITESIMAL PERCENTAGE" SAYS PHYSICIST.

Which one of these methods is "right?" Neither—they just weigh different aspects of the problem. But it's clear how the media play the game.

Burning oil and coal, on the other hand, kills about 10,000 people per year in the U.S.A. from increased lung cancer and emphysema.

Thus "no nukes" may well recall the old saying: For every complex problem there is a solution which is simple, appealing—and wrong. So why do people feel so strongly?

Part of the problem is that we think only of disasters, ignoring everyday

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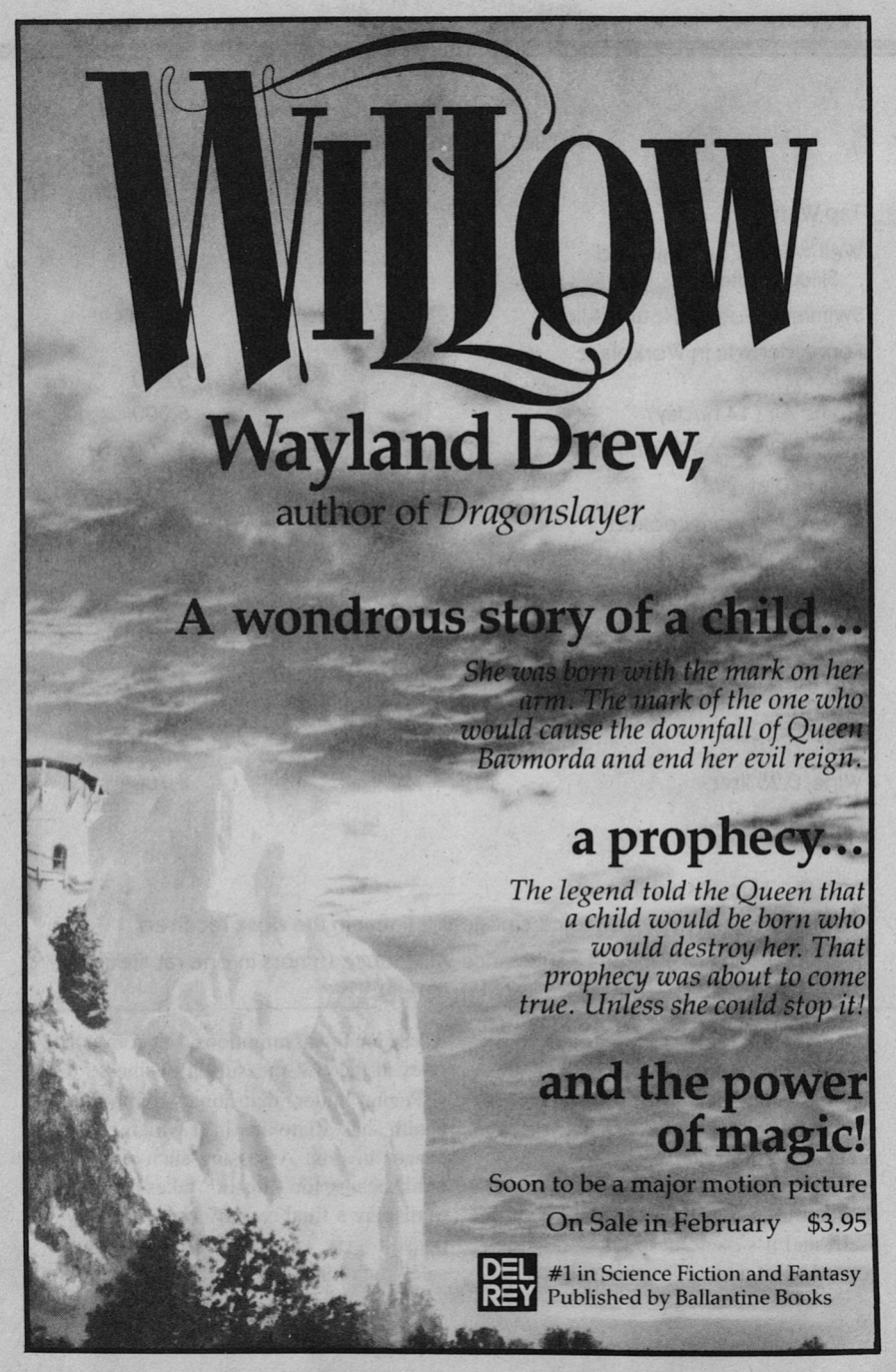
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Table 2

INVISIBLE EVERYDAY RISKS

	Carcinogen Exposure/Day
Tap Water	1
Well Water, Contaminated Silicon Valley	4
Swimming Pool, 1 Hour (Child)	8
Formaldehyde in Workplace Daily	5,800
Home Air (14 hr/day)	6,000
Mobile Home Air (14 hr/day)	21,000
PCBs in Diet	2
Bacon, 100 gram cooked	3
Comfrey Herb Tea	30
Peanut Butter Sandwich	30
Brown Mustard, 5 gram	70
Basil, 2 gm.	100
Diet Cola	60
Beer, 12 oz.	2,800
Wine, 0.25 liter	4,700

"Risk" assumes:

- Humans are like rats
- Human response to carcinogens is linear in the dose received
- Rating of 1 means a substance will induce tumors in one rat lifetime. This dose is then scaled to human daily use.

dangers. In Table 2 I've listed some common carcinogenic agents. All this data assumes humans resemble rats in the effects of exposure, and that you can generalize from rats exposed to a lot of, say, diet cola, towards humans who drink a little of it. (I hate the stuff, myself, and it's pleasant to know it causes cancer. But then, everything seems to.) These are big assumptions, but common ones in the risk-measuring business.

Peanut butter, that homey symbol of health, has aflatoxins in it which cause cancer in rats. Assessing such risks is hard because the "insult" takes decades to display a final cancer. Epidemiology doesn't give easy estimates of "how safe" anything is. Comparing one risk

to another is simple—but it tells you nothing about how close to "zero risk" you should go, or how to assess the costs of countermeasures.

An example: Years ago, British Rail decided to improve safety standards on their commuter lines. To cover costs they had to raise ticket rates. This drove some commuters to use their cars, lowering net revenue for Brit Rail—*and,* since car travel is about 1,000 times more dangerous than rail transport, the "safety upgrade" *increased* injuries and deaths among the commuters. this is a classic example of how nonlinear effects must be included in cost/benefit analysis.

Further, Table 2 shows that the popular notion of a benign nature, where evolution has equipped us to cope perfectly with natural toxic chemicals, is wrong.

After all, natural selection doesn't care about toxic threats to us after we've reproduced. Also, many of our defenses are general. We shed the surface cells of our digestive and lung systems every day, presumably to protect against "insults." We produce antitoxin enzymes and myriad defenses, but they can be damaged by other environmental effects, too. Finally, we eat many things our ancestors of only a few centuries back did not—potatoes, coffee, tomatoes, kiwi fruit. Evolution can't have defended us against them yet. Further, our own systems betray us by making hydrogen peroxide and other reactive compounds of oxygen, which probably contribute to aging and cancer.

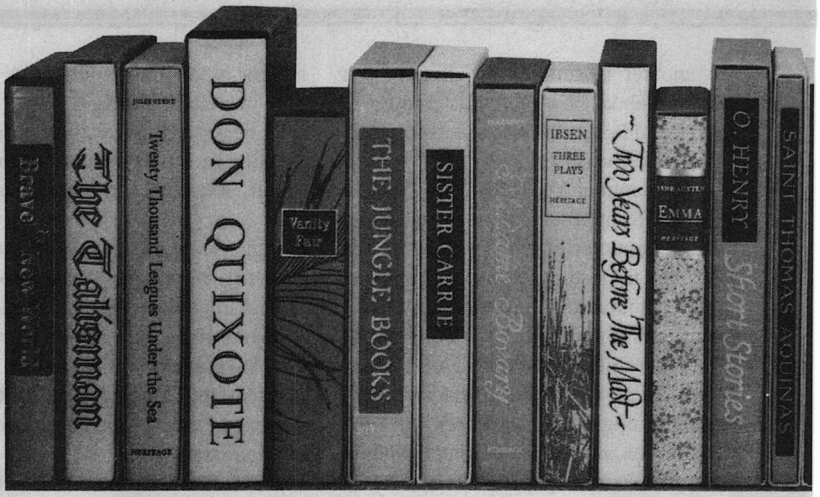
We ingest at least 10,000 times more natural pesticides (toxins) by weight than we do man-made ones. Natural ain't necessarily safer. The nation with the longest life expectancy is Japan, an urban, extremely crowded industrial land.

Take a common way of presenting risk information—the comparison. "Smoking two packs of cigarettes gives the same risk as a year spent breathing Los Angeles air." What are we to make of such facts, thrown at us by the risk-managers? Should we be rational *as the risk-assessers* define it?

First, there's no need to be. It's painfully obvious that the orderly, engineering mentality does *not* always lead to lowest possible risk. Look at nuclear reactor control rooms—banks of switches in bleached lighting. The most trivial switch looks much the same as the vital one. There are no personal touches to the room, no odd markers allowed. This guarantees that bureaucrats like the looks (so clean, neat, reassuring) and the people who work there hate it.

An impersonal, "professional" look causes just the boredom which is the enemy of look-sharp safety. A few years ago the crew manning one control room put pull-levers from beer dispensers on the vital controls, so they could see them right away in a crisis. ("Running hot—go for the Bud!") Their manager angrily removed them.

The future must allow more human environments in high-tech enterprises. The pyramid structure of familiar industrial firms has to be discarded, so that highly integrated teams, with real team spirit, run the show. And they have



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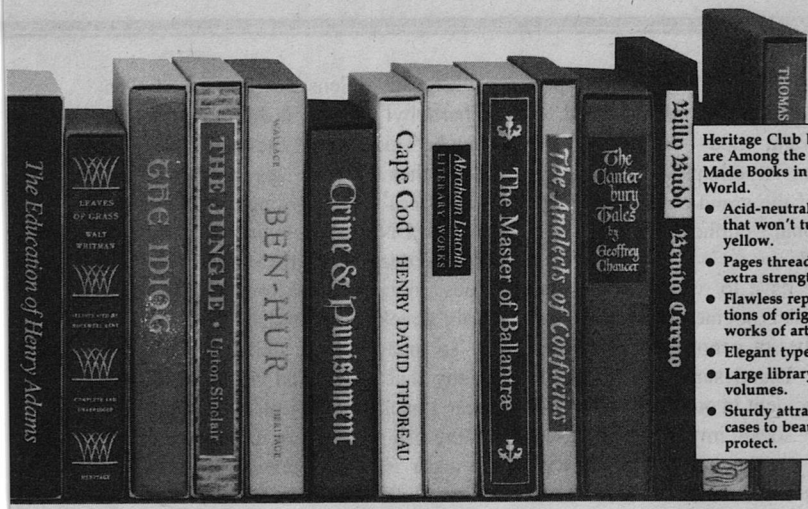

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to be tested regularly, *against each other*, to sharpen their performance.

All well and good—the perfect nerd environment is perhaps not the safest. But what of the grand conflict between the "irrational" public and the risk-statistics folk?

First, we have to recognize that the perceived risk is not merely proportional to the number of people hurt or killed. Three Mile Island surely proved this. No other accident in our history has had such costly social impact. It imposed huge costs on the utility and nuclear power industries, increased the use of dangerous oil and even coal, and prompted a more hostile view of other complex technologies (chemical manufacturing, genetic engineering).

How to explain this? Sure, the media do it—but why does such sensationalism work?

I believe the most important index in these spectacular disasters is *what they portend*. Train wrecks kill many, but they are ordinary and excite few. As the New Yorker said after the Bhopal catastrophe,

> What truly grips us in these accounts is not so much the numbers as the spectacle of suddenly vanishing competence, of men utterly routed by technology, of fail-safe systems failing with a logic as inexorable as it was once—indeed, right up until that very moment — unforeseeable. And the spectacle haunts us because it seems to carry allegorical import, like the whispery omen of a hovering figure.

Mt. St. Helens got less press than Chernobyl because it didn't *mean* very much. This is what the analyists mean when they speak of "psychometric factor spaces" in assessing the impact of events. DNA technology awakens many of the deep fears that nuclear power does, invading "factor spaces" that train wrecks never touch.

To many people, bland expert testimony that the annual risk from living near a nuclear power plant is equivalent to the risk of riding an extra three miles in a car is simply *dumb*—it omits the dimensions of human lives affected by the failure of so gargantuan a technology.

Yet we all know life is nothing without risk. It would be dull, gray, leached of zest. As Hal Lewis, the dean of nuclear safety experts, has remarked, reflect on how western civilization would be if we had elected to make the minimization of all risks our principal motivation. We'd be bored—and then extinct.

So we use stairs despite the risk of falls. We eat canned food, despite occasional botulism. We climb mountains (the riskiest sport of all is climbing in the Himalayas, where 1 in 10 die). We make love despite heart attack risk. We don't make love, despite the fact that married men live longer than singles.

Given our everyday acceptance of risk—indeed, open foolhardiness in smoking or driving long commutes—why do we balk at nuclear plants, for example?

I have a guess, and it will be as true in the future as it is now.

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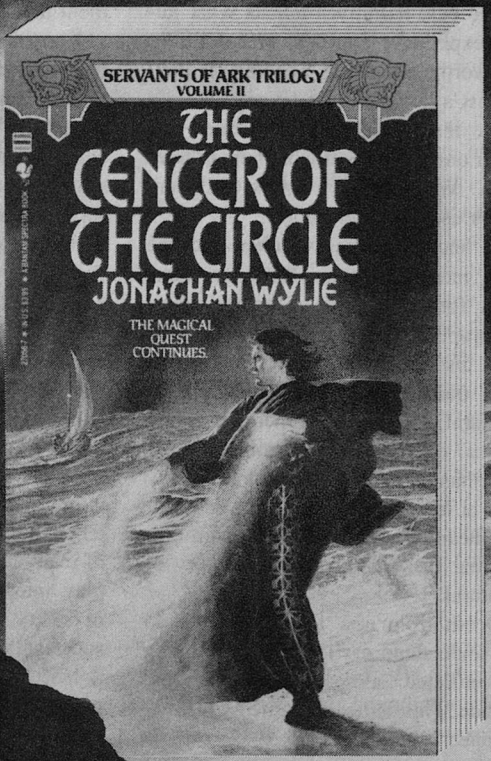

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Every storyteller knows that there are two crucial points in a narrative. One is the opener, the hook, where you draw the audience in. Even more important is the finish, which has to satisfy the tensions the story has set up. But one tension audiences expect will be released (though they probably couldn't say so consciously) is finally expressed in the question, *What's it mean?*

The best narratives tell us what human experience signifies, what our lives are worth, what role we play (if any) against a larger canvas (if any).

We instinctively dislike stories that lower our estimate of what human lives mean. We deplore disasters that seem to rob us of our self worth.

In ancient times, weather and the gods made disasters. Now *we* make them, for we are lords of the biosphere.

I propose that the myriad small deaths from disease, tornadoes, falls, or even from train wrecks, *all* seem to us as "natural." Dying of something nature makes, whether it's a microbe or a meteor, has about it a sense of harmony. This at least carries a freight of consoling meaning. And now we assign old, familiar technology to the category of "natural."

Death from new technology we do not understand carries a taint of being self-inflicted, almost of unintentional suicide. This demeans all life by making it appear trivially spent.

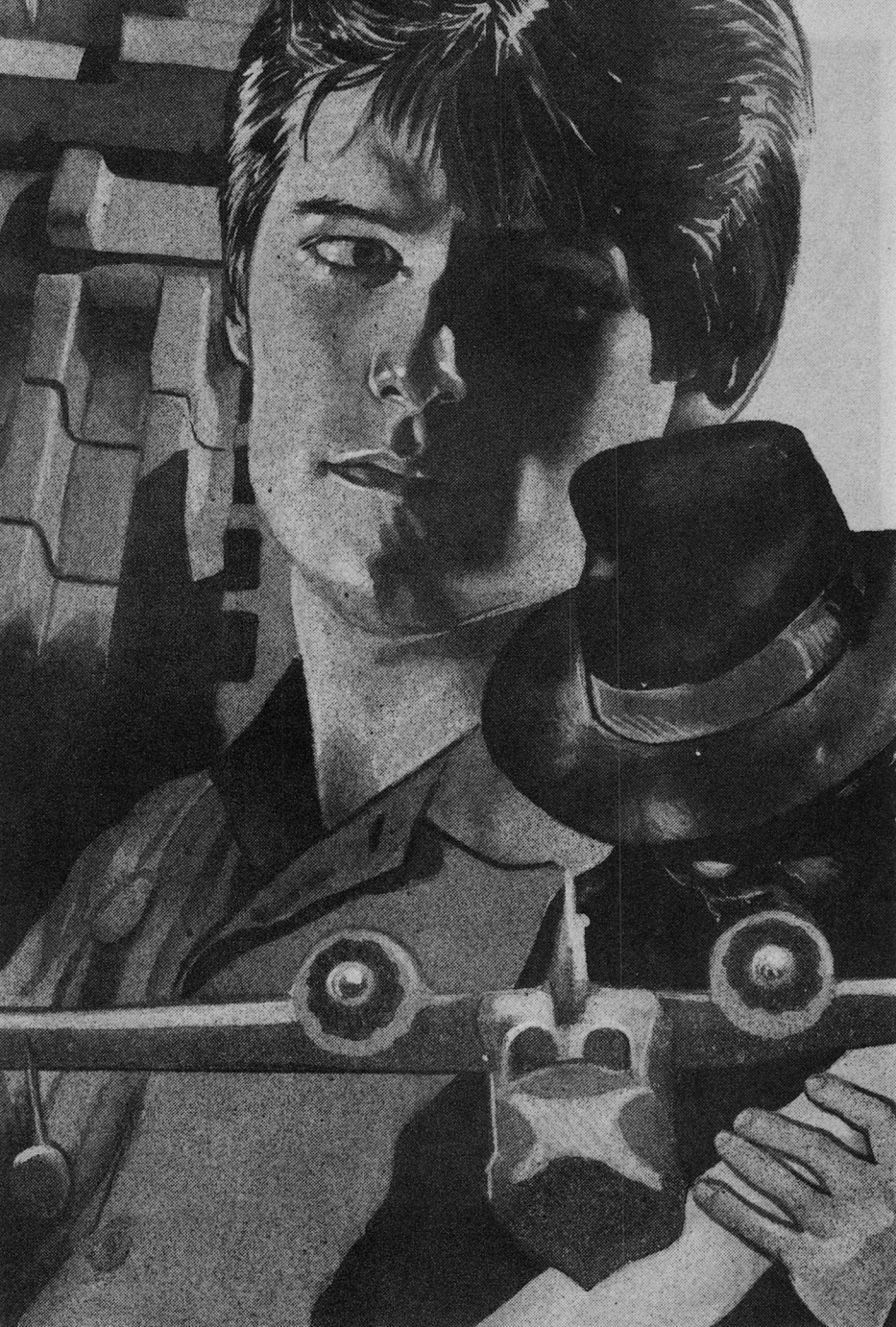
It may well be that the most important feature of modern times is not technology, but the fact that we dwell in the first era in which atheistic ideas are commonly (though not universally) accepted. Disaster means something if it comes from God or, failing that, at least from nature. Techno-disasters can't be rationalized this way, because we have only ourselves to blame.

So deploring the public's irrational views of risk can miss a vital point. People seek to invest events with *meaning*—they want more from risk assessment than body counts.

Knowing this, do we who have a hand in evaluating disasters have an obligation to cater to these psychodynamic needs? To some extent, yes—but we cannot simply rubber-stamp measures which divert society's attention from the serious threats, such as tobacco or saturated fats. It's been plausibly argued that we are spending a million times more *per life* to save people from side effects of nuclear power than we are to save sick children in the Third World. This sort of comparison can't be allowed to escape the disaster-dazed media audience.

More, we cannot concentrate on arguing about rare but spectacular disasters, like nuclear power, to the neglect of everyday deaths. That would merely play into the media-driven perception of safety as solely a matter of gaudy spectaculars.

No, I'm afraid that our moral obligation is to treat *every* separate life as important—to acknowledge the public's easy distraction by huge disasters, but remind them of the small ones—and thus in our own way give each life meaning. ■



WATER RITE

Ben Bova

Some things look like purely local matters,
but really aren't, because of what
lies beneath the surface.
But there may be subtler ways than
war to deal with such matters . . . .

Laura Lakey

Pavel did not notice them until almost too late.

He had heard of muggers and hooligans in other, more remote outskirts of Moscow, but never near the university, so close to the heart of the city.

Yet there were three young toughs definitely following him as he walked along the river promenade through the darkening evening, his fencing bag slung over one shoulder.

No one else was in sight. The towers of the university were brilliantly lit, thousands of students bustling among the many buildings. But here along the riverside all was deserted. Pavel had come for solitude, for a chance to think about the offer he had been given. Was it truly an opportunity to do good for his country? Or was it a scheme by the *apparatchiks* to get him out of the way for a while, perhaps forever?

An offer or a trap? He had been wondering as he strolled in the deepening cold of early evening. An opportunity or an ultimatum?

Then he noticed the three young men in their western-style leather jackets and zany hairdos. Up to no good, obviously.

Across the river was the Lenin Arena and the big sports palace complex. Hundreds of athletes were rehearsing for the November parades. But here on the riverside promenade, no one except Pavel Mikhailovich Zhakarov and three young hoodlums.

Pavel began walking a little more briskly. Sure enough, the trio behind him quickened their pace.

"Hey there, wait up a minute," one of them called.

There was no sense running. They would overtake him long before he got to an area where there were some people walking about. Of course, he could drop his fencing bag and leave the gear inside to them. It wasn't worth much. But I'll be damned if I give it up to three punks, Pavel said to himself.

So, instead of making a break for it, he turned and smiled at the approaching trio.

They were trying their best to look ferocious: leather jackets covered with metal studs. Wide leather belts and heavy, ornate buckles. Wild hair and faces painted like rock stars. Two of them were big, almost two meters tall and solid muscle from neck to toes. Pavel smiled. Probably solid muscle between the ears, as well. The third one, in the middle, was short and stocky, with an ugly squashed-nose face.

"What are you grinning at, little man?" he asked.

Pavel was not exactly little. True, he was barely 165 centimeters in height, and almost as slim as a girl. His face was delicately handsome, with dark eyes and brows, sculpted cheekbones and a graceful jaw line. His hair was dark and naturally curly.

"Pretty man," sneered the big fellow on Pavel's left. The other large oaf giggled.

Pavel said nothing. He simply stood his ground, left hand with its thumb hooked around the shoulder strap of the fencing bag, right hand relaxed at his side. They did not notice that he was up on the balls of his feet, ready to move in any direction circumstances dictated.

"What's in the bag?" the ugly little leader demanded.

Pavel shrugged carelessly. "Junk. It's worthless."

"Yeah?" The leader flicked a knife from the sleeve of his jacket and snapped it open. The slim blade glinted in the light of a distant street lamp.

"Hand it over."

"Not to the likes of you, my friend," said Pavel.

The other two pulled knives.

"It's worthless junk, I tell you," Pavel insisted. "Not even a balalaika."

"Open up the bag."

"But . . ."

"Open it up or we'll open you up."

Pavel sank to one knee, slung the bag off his shoulder and unzipped it. Opening it wide so that they could see it was fencing gear and nothing more, he grasped one of the sabers and got to his feet.

The two oafs stepped back a pace, but their leader laughed. "It's not sharp, it's for a game. Look."

They grinned and moved toward Pavel.

"I'm warning you," Pavel said, his voice low, as he retreated slowly, "what happens next is something you will regret."

The leader laughed again. "One against three? One toy sword against three real knives." His laughter stopped. "Slice him up!"

Pavel darted to his right, away from the promenade railing, where there was more room for maneuver. The first of the big thugs swung toward him and Pavel made a lightning-fast lunge. His blunted saber, thin and flexible as a whip, slashed at the oaf's hand and sent the knife clattering across the cement of the walkway.

The thug yelped in sudden pain. His companion hesitated a moment, and Pavel gave him the same treatment, ripping skin off his fingers.

The ugly little leader had circled around, trying to get behind Pavel. But Pavel danced backwards a few steps and easily parried his lumberingly slow jab, then riposted with a slash at his cheek. He screamed and backed away.

The first one had recovered his knife, only to have Pavel disarm him again and whack him wickedly on the upper arm, shoulder and back: three blows delivered so fast they could not follow them with their eyes. Then it was back to the leader again.

He faced Pavel with blood running from his cut cheek and eyes burning with hatred.

"I'll kill you for this," he snarled.

Pavel extended his arm and pointed the blunted tip of his saber toward his face. "I'll blind you with this," he said, as calmly as a man asking for a pack of cigarettes. "I'll take out your eyes, one by one."

The little hoodlum glanced over at his two accomplices. One of the thugs was sucking on his bleeding knuckles. The other was wringing his pain-wracked arm. The light faded from the ugly one's eyes. He backed away from Pavel. Wordlessly the three of them turned and started walking back the way they had come.

"Jackals!" Pavel called after them.

He retrieved his bag and zipped it up. But he kept the saber out and held it firmly in his right hand as he strode the rest of the way to his dormitory room.

Two days later Pavel was in a luxurious Aeroflot jet airliner, winging southward, away from wintry Moscow

and toward the sun and warmth of the Mediterranean.

He still felt uneasy.

"It is a mission of utmost importance," the bureau director had said, "and of the utmost delicacy."

Pavel had sat on the straightbacked chair directly in front of the director's desk. The director himself had called for him, a call that meant either high honor or deepest disaster; all other chores were handled by underlings.

He was a slim, bald man with a neat little goatee almost like that of Lenin in the gilt-framed portrait hanging on the wall behind his desk. But there the resemblance ended. Pavel imagined Lenin as a vigorous, flashing-eyed man of action. The director, with his soft little hands, his manicured nails and tailor-made Italian suits, looked more like a dandy than a leader of men. His most vigorous action was shuffling papers.

To the director, Pavel looked like a cat tensed to spring. A strikingly handsome young man, not quite twenty-five, yet he comes stalking into my office like a cat on the prowl, all his senses alert, his eyes looking everywhere. That is good, the director thought. He has been well trained.

Pavel's life history was displayed on the computer screen atop the director's desk. The screen was turned so that only the director himself could see it. Only child; mother killed at Chernobyl; father "retired" from his duties as Party chairman of Kursk due to alcoholism. There is nothing in his dossier to indicate romantic entanglements. Best grades in his class, a natural athlete.

For long moments the director leaned back in his big leather chair and studied the young man before him. Pavel returned his gaze without flinching. The director smiled inwardly and thought of the eternal game of chess that was his career. He may be the man we need: not a pawn, exactly. More like a knight. One can sacrifice a knight in a ploy that will win the game.

Pavel finally broke the lengthening silence. "Could you explain, sir, what you mean?"

The director blinked rapidly several times, as if awaking from a daydream.

"Explain? Yes, of course. We can't expect to send you on such an important mission blindfolded, can we?" He laughed thinly.

Pavel made a polite smile. "As you know, sir, I had applied for the International Peacekeeping Force."

The director gestured toward his computer display screen. "Yes, of course. A good choice for you. And you may eventually get it."

"Eventually?"

"After you have completed this mission—successfully." The director leaned back in his chair again and tilted his head back to gaze at the ceiling. "In a way, you know, this mission is somewhat like being with the IPF."

He is trying to stretch my nerves, Pavel realized. To see how far I can go before I lose my self-control. Very casually, he inquired, "In what way, may I ask?"

Still staring at the ceiling, "There is a certain Mr. Cole Alexander, an American, although he has not set foot in the United States in more than six years."

Pavel said nothing. He glanced upward too. The ceiling was nicely plastered, but there was nothing much of

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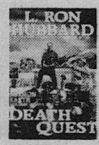

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interest in it, except for the tiny spider-web the cleaning women had missed off in the corner by the window draperies.

The director snapped his attention to Pavel. "This Alexander is a mercenary soldier, the leader of a band of mercenaries."

"Mercenaries?" Despite himself, Pavel could not hide his surprise.

"Yes. Oh, he claims to be hunting for the infamous Jabal Shamar, the man responsible for the Jerusalem Genocide. But he spends most of his time hiring out his services to the rich and powerful, helping them to oppress the people."

Pavel had heard rumors about Shamar.

"Is it true that Shamar took a number of small nuclear weapons with him when he disappeared from the Syria?" he asked.

The director's brows rose. "Where did you hear of that?" he snapped.

Pavel made a vague gesture. "Rumor . . . talk here and there."

Tugging nervously at his goatee, the director said, "We have heard such rumors also. Until they are clarified, all nuclear disarmament has been suspended. But your mission does not involve Jabal Shamar and rumored nuclear weapons caches."

"I understand, sir."

"You will join Alexander's band of cutthroats," the director continued, uncaring of Pavel's thoughts. "You will infiltrate their capitalistic organization and reach Alexander himself. And, if necessary, assassinate him."

The airliner landed at Palma, and Pavel rented a tiny, underpowered Volkswagon at the airport. He did not look like the usual tourist: a smallish, athletically slim young man, alone, unsmiling, studying everything around him like a hunting cat, dressed in a black long-sleeved shirt open at the neck and an equally somber pair of slacks.

Using the map computer in the car's dashboard, he drove straight across the island of Mallorca, heading for the meeting that agents employed by the Soviet consulate had arranged with a representative of the mercenaries.

Across the flat farmlands he drove, seeing but not bothering to take much note of the fertile beauty of this warm and ancient land: the green farms, the red poppies lining the roads, the terraced hillsides and tenderly cultivated vineyards. But he noticed the steep hairpin turns that scaled the Sierra de Tramunta as he sweated and cursed in a low, angry whisper while the VW's whining little electric engine struggled to get up the grades. A tourist bus whooshed by in the other direction, nearly blowing him over the edge of the narrow road and down the rugged gorge.

When he finally got to the crest of the range the road flattened out, although it still twisted like a writhing snake. And then he had to inch his way *down* an even steeper, narrower road to the tiny fishing village where he was supposed to meet the mercenaries.

Pavel was drenched with sweat and hollow-gutted with exhaustion by the time he eased the little car out onto the solitary stone pier that jutted into the incredibly blue water of the cove. He turned off the engine and just sat there for a few moments, recuperating from the harrowing drive. The smell of burnt

insulation hung in the air. Or was it burnt brake lining?

He got out on shaky legs and let the warm sunshine start to ease some of the tension out of him. The village looked deserted. Houses boarded up. Even the cantina at the foot of the pier seemed abandoned, its whitewashed cement walls faded and weathered. Not a single boat in the water, although there were several bright-colored dories piled atop one another at the foot of the pier.

He took his black overnight bag from the car and slung it over his shoulder, then paced the pier from one end to the other. He looked at his watch. The time for the meeting had come and gone ten minutes ago.

He heard a faint buzzing sound. At first he thought it was some insect, but within a few moments he realized it was a motor. And it was getting louder.

A black rubber boat came into view from around the mountains that plunged into the sea, a compact little petrol motor pushing it through the water, splashing out a spume of foam every time the blunt bow hit a swell. A single man was in it, his hand on the motor's stick control. He wore a slick yellow poncho with the hood pulled up over his head.

Pavel watched him expertly maneuver the boat into the cove and up to the pier. He looped a line around the cleat set into the floating wooden platform at the end of the pier.

"What's your name, stranger?" the man called in English.

"Pavel."

"That's good. And your last name?"

"Krahsnii." It was a false name, of course, and the lines they had exchanged were code words that identified them to one another.

"Pavel the Red," said the man in the boat, grinning crookedly. "Fine. Come on aboard."

So he understands a bit of Russian, Pavel thought as he trotted down the stone steps, onto the bobbing platform, and stepped lightly into the rubber boat.

"That's all you've got?" The man pointed at Pavel's bag.

"It's all I need," Pavel said as he sat in the middle of the boat. "For now."

"Want a poncho? The sun's pretty strong here." He lifted another yellow slicker from a metal box at his feet.

Pavel shook his head. "I like the sun."

"You could get skin cancer, you know," he said as he unlooped the line and revved the motor. "Damned ultraviolet—ozone layer's been shot to hell by pollution."

With a grin, Pavel shouted over the motor's noise, "Let me enjoy one day of sunshine, at least. In Moscow we don't see the sun from September to May."

The man grinned back. "Suit yourself, Red."

As they bounced along the waves Pavel thought he was more in danger of drowning than sunstroke. The spray from the bow drenched him thoroughly. His shirt and slacks were soaked within minutes. Pavel sat there as mute as a sainted martyr, enduring it without a word.

I have heard of new agents receiving baptisms of fire, Pavel said to himself, but this is more like the baptism of an ancient Christian.

* * *

"But I'm not an assassin," Pavel had blurted.

The director had smiled like a patient teacher upon hearing an obvious mistake from a prize pupil.

"You are," he corrected, "whatever we need you to be. You have been trained to perfection in all the martial arts. Your skills are excellent. Is your motivation lacking?"

Pavel suddenly saw an enormous pit yawning before him, black and bottomless.

"I am a faithful son of the Soviet Union and the Russian people," he repeated the rote line.

"That is good," said the director. "And if the Soviet Union and the Russian people require you to assassinate an enemy of the people, what will you do?"

"Strike without mercy," Pavel said automatically.

The director's smile broadened. "Of course."

"But . . ." the young man hesitated. ". . . why?"

The director sighed heavily. "We are in a time of great upheavals, my young friend. Enormous upheavals, everywhere in the world. Even within the Soviet Union, changes are coming faster than they have since the glorious days of the Revolution."

Pavel had been taught all that in his political indoctrination classes. And the fact that his father was allowed to retire peacefully and seek therapy for his addiction, instead of being sent to some provincial outpost in disgrace, was a more concrete proof of the changes sweeping the Party and the nation.

"The Soviet Union helped to create the IPF, and has led the way toward true disarmament," said the director, almost wistfully. Then he added, "But this does not mean that we have entirely foresworn the use of force. There are situations where force is the *only* solution."

"And this American represents one of those situations?"

"All that it is necessary for you to know will be explained to you in your detailed mission briefings. For now, let me tell you that this capitalist warmonger Alexander is working some sort of scheme to undermine the regime in Libya. We are the friend and protector of the Libyan regime. We will protect our friend by getting rid of his enemy. Is that clear?"

"Yes sir."

The man in the poncho cut the motor. The world suddenly became silent; the drenching spray ceased. Pavel unconsciously ran a hand through his soaked hair.

"You don't get seasick, do you?" the man asked.

Shrugging, "I don't know. I've never been closer to the sea than one thousand kilometers."

The man laughed. "Hadn't thought of that."

With the water-slicked yellow poncho on, there was not much of him that Pavel could see except for his face. Hunched over as he was, it was difficult to tell what his true size was. He seemed rather broad in the shoulder. His face was square, with an almost sad, ironic smile that was nearly crooked enough to be called twisted. His eyes were gray, cold, yet they sparkled with what could

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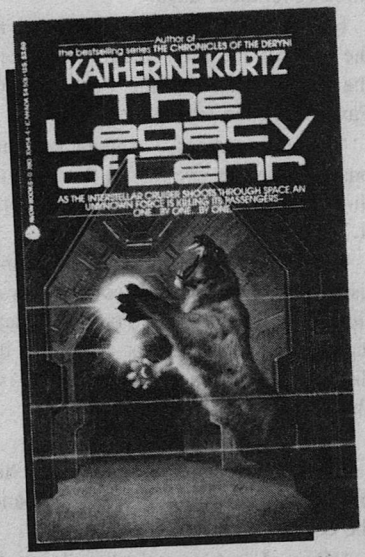

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only be a bitter kind of amusement. Altogether, his face was not unhandsome, but not truly handsome, either. He seemed big, perhaps close to two meters in height. Not a cowardly type. Yet he kept the poncho over him, claiming to be afraid of solar ultraviolet. A man of contradictions.

"Why are we stopped?" Pavel said. His English was of the American variety, as accentless as the typical Yankee news broadcaster.

"Security," said the man. "Out here we're safe from snoops who want to listen to what we say."

"I might be carrying recording equipment."

The man shrugged. "You might. But you're in *my* boat, and if you're going to work for me, you'll be on my turf for some time to come."

For a moment Pavel was speechless with surprise. "You are. . . ?"

"Cole Alexander." He extended his right hand. "Pleased to meet you, Pavel."

Alexander's grip was strong. Pavel said slowly, "I didn't expect you to meet me personally." He was thinking, I could crush his windpipe and push him overboard. The job would be done. But in the bobbing little boat he was not certain of his leverage or his footing.

"You present a problem to me, Pavel," Cole Alexander was saying. "My Russian contacts made it quite clear that your government wants you on my team. Otherwise I'll have *real* trouble with the Russkies. I figure that at the very least you're a spy who's supposed to tell the Kremlin what I'm going to do in Libya. At the most, you've been sent out here to murder me."

Pavel kept his face rigid, trying to hide his emotions.

Alexander grinned his crooked grin again. "If you're an assassin, this would be a good place to give it a try. Think you can take me?"

"You are making a joke?"

Alexander shrugged. "You're damned near twenty-five years younger than I. That's a lot of time; a lot of booze and women. On the other hand, I'm bigger than you. What do you weigh?"

"Sixty-eight kilos."

"I'm about ninety kilos."

"I am faster than you," Pavel said.

"In a foot race, sure. What about your hand speed?"

Pavel cocked his head to one side. It would not be wise to boast.

Alexander dug a hand inside the poncho and came out with a silver coin. "An American half-dollar. Worth about three cents these days."

He motioned Pavel to move back to the bow of the tiny boat, then placed the coin on the midships bench where Pavel had been sitting.

"Hands on knees," Alexander demonstrated as he spoke. "I'll count to three. First one to reach the coin keeps it."

Pavel put his hands on his knees and listened to the American count. This is ridiculous, he thought. A typical American macho contest. It's a wonder he didn't challenge me to a duel with six-shooters.

"Three!"

Pavel felt Alexander's hand atop his the instant his own fingers closed around the coin.

"Damn!" Alexander exclaimed.

"You *are* fast. First time anybody's ever taken money off me that way."

Pavel offered the coin back to him, but Alexander laughingly insisted he keep it. Holding it in his palm, watching the sunlight glitter off it, Pavel began to wonder if Alexander had deliberately allowed him to win. He is a very clever man, Pavel thought. Even by losing he makes me respectful of him. No wonder the director fears him so.

"Now then," Alexander resumed, "about my problem. If I don't take you in, I suppose your government will try to blow me out of the water and make it look like an accident. So you're in. But don't think you're getting out until we've finished the job we're on now. And don't think you can get word back to Moscow about what we're doing. You'll be watched *very* carefully."

Pavel nodded, not to show agreement but to show that he understood the situation. What Alexander did not know was that it was not necessary for Pavel to make contact with Moscow or anyone at all. And what Alexander does not know, Pavel thought, could eventually kill him.

"It is an extremely delicate situation," the chief briefing officer had told Pavel.

They had been meeting each day for more than a week, stuffing information and indoctrination into Pavel's aching head. The regular working hours of the day were spent inside the offices and conference rooms of the briefing team. Pavel had to carry on his physical training and normal exercises at night, alone in the gymnasium in the basement of the ministry building. He slept little, and the strain was beginning to make him edgy.

The chief briefing officer was wise enough to recognize Pavel's growing tenseness. She had invited him to dinner at her apartment. It was a large and luxurious flat in one of Moscow's best apartment blocks: a beautiful living room decorated with oriental carpets and precious works of art, a finely-equipped kitchen, and a frilly but comfortable bedroom with a large bed covered by a tiger skin.

"It's only imitation," the chief briefing officer had told him when she showed him through the place. "But it keeps me warm and cozy."

Her father was a high Party official, a "young turk" when Gorbachev had taken over the Kremlin; one of the older generation desperately clinging to his power now. She was at least ten years Pavel's senior, but she was still attractive in his eyes. Almost his own height, a bit stocky, although her bosom seemed to strain at her red blouse. Her face had a slightly oriental cast to it that made her seem exotic in the light of the artificial fire glowing electrically in the artificial fireplace.

Over dinner she explained that, since the Soviet Union was one of the founding members of the International Peacekeeping Force, it was impossible for the USSR to overtly support Libya.

"When Col. Qadaffi was finally assassinated everyone thought that Libya would return to being a quiet country that produced oil instead of terrorists."

Pavel sipped his hot borscht and listened, trying to keep his eyes off her red blouse. One of the buttons had come undone and it gapped invitingly.

"But Rayyid is more rabid than Qaddaffi ever was, as you know from your briefings. He is not the kind of man we would have chosen for an ally, but the inexorable forces of history have thrown us into the same bed—so to speak. Therefore, any attempt to undermine him must be stopped by us, with force, if necessary."

"But quietly," Pavel added, "so that the world does not know the Soviet Union has supported a madman."

She smiled at him. "Only the madman will know, and feel more dependent on us. And, of course, we will discreetly inform certain others who must be made to realize that the Soviet Union protects its friends—without the kind of stupid publicity that the Americans go in for."

"I can see why it is desirable to crush a band of mercenary soldiers," Pavel said, "but I still don't see why we support a nation that sends terrorists around the world. Wasn't Rayyid responsible for blowing up that Czech airliner last year? Two hundred people were killed!"

The chief briefing officer smiled again at Pavel. "Yes, it is true. And regrettable. But international politics is very complicated. Sometimes it is necessary, as I said, to get into bed with someone you do not love."

Pavel thought of the word *whore*, but did not speak it.

She saw that he was unconvinced. She spent the rest of the night explaining things to him. And he allowed her to, not daring to refuse and—later, when they were both wrapped in the imitation tiger skin, not wanting to refuse.

Alexander started the motor again and the little boat leaped across the waves once more. Just as the sun was starting to dry me out, Pavel thought sourly, squinting into the spray.

They rounded a cliff that tumbled from the wooded ridge line far above straight down into the blue sea. Pavel saw a seaplane tucked into the cove formed by a niche in the line of mountains.

"Home sweet home," shouted Alexander over the drone of the motor.

It was as beautiful a piece of work as anything Pavel had ever seen: the clean graceful lines of a racing yacht wedded to the lean swept-back wings of a jet airplane. Big engine pods bulked where the wings met the plane's body. The T-shaped tail leaned back at a rakish angle. The plane was painted sea blue, although the underside of the wings were a lighter hue, the color of the sky, Pavel saw as they approached.

A hatch popped open halfway between the wings and tail, and two men tossed out a rope ladder. Alexander maneuvered the rubber boat to the ladder and hooked a line to it. He gestured Pavel into the plane, then clambered up the ladder after him.

"This is where I live," he told Pavel. "This is home, headquarters, and transportation all wrapped up in one." Tapping a forefinger against Pavel's chest, he added, "Let me give you a piece of advice, friend: Never stay in one place long enough for the tax collectors to find you!"

Pavel saw that they were in a utilitarian work area, bare metal walls curving over a scuffed and worn metal flooring. It was tall enough for Alexander to stand erect. He was just under

two meters, Pavel estimated. The two other men were deflating the boat and bringing it aboard for stowage.

"My car . . ." he suddenly remembered.

"All taken care of, don't worry," Alexander said as he wormed out of his yellow slicker. He was wearing a turtleneck shirt and jeans. The uniform of a burglar, Pavel thought. His hair was youthfully thick and full, yet dead white. Another contradiction.

Crooking a finger for Pavel to follow him, Alexander strode to the forward hatch and went through. The next cabin almost took Pavel's breath away. It was what he had imagined, as a child, that a plutocrat's yacht would look like. Brass and polished wood. Comfortable cushioned armchairs—with lap belts. Round portholes. Small tables bolted to the deck, which was covered with a thick carpet of royal blue.

"I've got to go forward for a minute and talk to the pilots," said Alexander, as Pavel took in all the luxury. "Your bunk is the first hatch on the right, forward of this cabin. You might want to get into some dry clothes before we take off."

Even his "bunk" was a well-appointed private compartment, small as a telephone booth yet comfortable, with a foldout desk and a display screen built into the foot of the bed. I should be able to tap into his computer files, Pavel told himself, given a bit of time.

As he dropped his bag on the bunk and unzipped it the plane's engines roared to life. The compartment shuddered. Through the porthole Pavel could see that they were turning seaward.

"All personnel, please take seats and strap in. Takeoff in three minutes."

Pavel tucked the bag in the drawer beneath the bunk, lay down and buckled the safety strap across his middle, and was asleep by the time the plane lifted off the water.

It was still daylight when he awoke. Pavel showered and shaved in the coffin-sized bathroom, marveling that he had such facilities all to himself. He dressed in his spare outfit, a loose-fitting maroon shirt and western jeans, not unlike those Alexander wore. He had only one pair of sneakers: snug and silent.

He went out into the passageway and counted eight sleeping compartments. From his memory of the plane's exterior, he judged that there was another big compartment forward, before the control deck. He went through the open hatch and back into the wardroom where he had last seen Alexander.

The two men who had pulled in the boat were sitting there at a table laden with sandwiches and coffee cups. A young woman sitting with them noticed Pavel.

"Might as well come over and have some chow."

She was small, rather plain looking, with red hair cut short, almost boyishly. A freckled face with a small stub of a nose. Her face looked almost suspicious as Pavel approached; he saw that her brown eyes watched him carefully.

"I'm Kelly," she said, getting up and offering her hand.

"Pavel Krahsnii," he said, making himself smile at her.

"And these two chowhounds are Chris Barker and Nicco Mavroulis."

They mumbled greetings without ris-

ing from their seats. Pavel nodded to them.

"Better eat while you can," said Kelly. "Briefing in ten minutes. And in nine minutes these guys will have gone through all the sandwiches."

Pavel took the chair next to Kelly and reached for one of the sandwiches. He noticed that the table was covered with a real cloth spread.

"I haven't the faintest idea of what's going on here," he said. "I've just arrived."

"We know. The boss is worried that you're a spy from the Kremlin. He thinks the best way to prevent you from doing us any damage is to put you to work right away while we keep a close eye on you."

Pavel took a bite of the sandwich, tasting nothing as he assessed the situation. Six eyes were staring at him, none of them friendly.

"The three of you will—" he tried to recall the phrase exactly, "—keep a close eye on me?"

"Mostly me," Kelly said. "These guys have plenty of other work to do. The boss doesn't let anybody have much free time."

"The boss is Alexander?"

"You better believe it!" answered Kelly.

Deciding to disarm them with a measured amount of candor, Pavel munched thoughtfully on his sandwich for a few moments more, then said, "The boss is perfectly correct. I am a spy. My government is concerned about your activities and I have been sent to observe what you are doing first-hand."

"I knew it," said Mavroulis. He was dark and hairy, with thick ringlets almost down to his eyebrows and a day's growth of black stubble on his chin. Heavy in the shoulders and chest, like a wrestler. He glared at Pavel.

The other one, Barker, looked English. Light brown hair, almost blond, with calm blue eyes and a faint smile. The kind who could slit your throat while apologizing for it.

"Why does Moscow have any interest in our little operation?" he asked, in a high nasal voice. "We don't threaten the superpowers in any way."

Pavel made a small shrug. "Perhaps they fear that you threaten one of our friends."

"Libya," said Kelly. It was a flat statement, toneless.

"Is that where we are going?" Pavel asked.

"We'll find out," she replied, glancing at her wrist, "in eight minutes."

Pavel took another bit of his sandwich.

Kelly forced a smile. "Coffee or tea?" she asked, as innocently as a child.

Alexander himself conducted the briefing, which confirmed in Pavel's mind that his band of mercenaries was actually quite small. Perhaps every one of them is aboard this airplane, he thought. Perhaps an accident could wipe them all out of existence.

They cleared the food and cups from the table when Alexander came into the wardroom, each person taking his or her own dirty dishes to a slot set into the aft bulkhead. Pavel followed Kelly and did what she did. By the time he turned around, Alexander had removed the cloth table cover, revealing that the table top was actually a large display screen.

"It *is* Libya," said Kelly as she sat down again.

"It is Libya," Alexander confirmed.

Pavel sat next to Kelly. But he noticed that this time Mavroulis sat on his other side.

"Qumar al Rayyid is one of the world's leading pains in the ass," said Alexander. He touched a keypad set into the table's edge and a photo of the Libyan strong man appeared in the upper corner of the map, a sun-browned face half hidden by dark glasses and a military cap heavy with gold braid.

"Several of his neighbors, who shall remain nameless," Alexander glanced at Pavel, "have hired us to get rid of him. Paid good money for it."

"You plan to assassinate him," Pavel said.

Kelly looked surprised, almost shocked. Mavroulis gave a disgusted snort. "The Russians—first thing they think of is murder."

Pavel felt sudden anger flushing his cheeks.

Smiling his crooked smile, Alexander said, "No, my red-faced friend, we are not assassins. We are not even mercenary soldiers, in the old sense. Like the Peacekeepers, we deal in minimum violence."

Out of the corner of his eye Pavel saw Kelly flinch slightly at the word "Peacekeepers." Why? I must find out.

Aloud, he said, "Minimum violence? Such as bombing Tripoli while Rayyid is making a speech there?"

"And killing everybody in the crowd?" Alexander shook his head. "What good would that do? Rayyid would probably be in a blastproof shelter by the time the first bomb fell. And besides, we want to destroy his power, not make a martyr out of him."

"Then what. . . ?" Pavel gestured at the electronic map.

Alexander spelled it out. For more than ten years the Libyan government had been working on a grand project to tap the vast aquifer deep beneath the Sahara and bring the water to the coast, where it would provide irrigation for farming.

"Qadaffi talked about doing it," Alexander said. "Rayyid is making it happen."

Barker arched his brows in a very English way. "What of it? It's entirely an internal Libyan operation. That's no threat to any other nation."

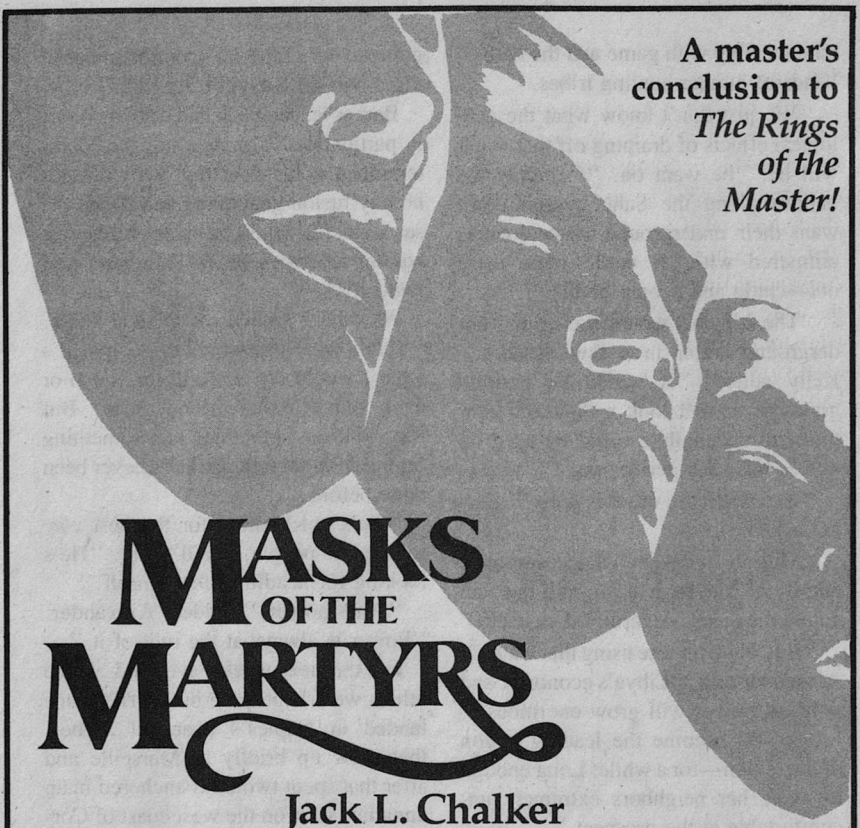
"Isn't it?" Alexander scratched lazily at his jaw. "My sainted old Uncle Max was a dedicated Greenpeacer. Got himself arrested by the Russkies once, trying to save whales from their hunting fleets. He always told me, 'Son, it just ain't smart to tamper with Mother Nature.' "

"You are against the Libyan project for ecological reasons?" Pavel could not believe it.

Alexander considered him for a long moment, locking his wintry gray eyes on Pavel. Finally he answered, "Of course. Why else? If it's not good ecologically, then it's bad politically, as far as I'm concerned."

Pavel said nothing, but he thought to himself, this Alexander is either a liar or a fool.

The aquifer beneath the Sahara had been created more than one hundred thousand years ago, Alexander explained, when glaciers covered Europe and northern Africa was a fertile grass-



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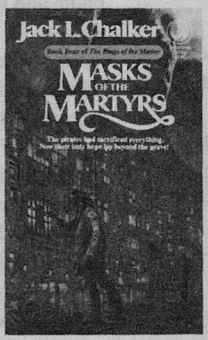

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land teeming with game and the earliest bands of human hunting tribes.

"We just don't know what the ecological effects of draining off that water will be," he went on. "Certainly the nations along the Sahel region don't want their underground water sources tampered with. It could wipe them out—cattle and people both."

"The Libyans would use up the underground water in a few decades," Kelly added. "It would be entirely gone: water that took a thousand centuries to accumulate could be used up in less than one generation."

"And when the water is gone?" Barker asked.

"Millions will die," said Mavroulis angrily. "Maybe tens of millions, all across the Sahel, Algeria, Libya itself."

"But while they're using that water," Alexander said, "Libya's economic and political power will grow enormously. Libya will become the leading nation of the region—for a while. Long enough to make her neighbors extremely uncomfortable at the prospect."

"Which is why they've hired us," said Barker.

"Right."

Pavel shook his head. "You are going to kill this man over water. Water that legally he has a right to."

Alexander regarded him with a pitying smile. "You keep talking about killing. We don't kill—we cure."

Puzzled, Pavel asked, "What do you mean?"

Alexander's cold gray eyes shifted away from Pavel. "We're working on a plan that will stop the aquifer project. That's our goal and that's what we're going to do. I have no intention of harming a hair on Rayyid's armpits."

Barker leaned back and said to no one in particular, "The man has the Mediterranean at his doorstep. Why doesn't he buy fusion generators and desalt the sea water? It would be cheaper than this aquifer scheme, and less damaging ecologically."

Alexander smiled his cynical smile. "That's what *you* would do, Chris. It's what I would do, or Kelly or Nicco or even our Russian friend, here. But Rayyid wants something *big*, something impressive, something that's never been done before."

"He's not looking for the best way to help his people," said Kelly. "He's looking for headlines for himself."

"And power," added Alexander. "Power is always at the root of it."

For the next week Pavel and all the others were kept quite busy. The plane landed in Naples's beautiful harbor, then flew up briefly to Marseille and after that spent two days anchored in an unnamed inlet on the west coast of Corsica.

Pavel began to understand that this plane and the eight men and one woman aboard it were only a part of Alexander's operation. How large a part, he had no inkling. Obviously the man had tentacles that extended far.

None of them left the plane for very long. Alexander stayed aboard constantly. Pavel was allowed to walk the length of the dock in Marseille, but no farther. Kelly watched him from the hatch, and Mavroulis or one of the others was always at the end of the pier. Each night they slept aboard the plane, which always taxied far out from the

shore before anchoring. It was like sleeping on a yacht. Pavel enjoyed it, even though he felt somewhat confined.

Now and again the name of Jabal Shamar popped up in conversations. Pavel asked indirect questions, spoke little and listened a lot. Apparently Alexander has a personal hatred for the elusive former leader of the Pan-Arab armies. His parents had been killed in the nuclear exchange of the Last War.

"Is it true that Shamar has his own nuclear bombs?" Pavel asked Mavroulis one afternoon, while they worked side by side loading crates of foodstuffs into the plane's refrigerated cargo bay.

The Greek nodded sourly. "Why do you think Alexander accepted this Libyan job? Shamar might be there, under Rayyid's protection."

"With the bombs?"

Mavroulis grunted as he heaved a crate marked as oranges. "He doesn't care about the bombs. He wants Shamar."

But Moscow must care about the bombs, Pavel thought. Do they *want* Rayyid to have access to nuclear weapons? He wished he could contact the director for clarification.

Wherever he went, the Kelly woman stayed beside him. She was cool, friendly—up to a point—and extremely intelligent. Pavel saw that she could program computers and use other electronic gear with impressive facility.

The second morning at Corsica she approached Pavel in the wardroom shortly after breakfast and asked, "Uh, you want to go for a swim?" She seemed somewhat reluctant, almost troubled, as if someone had forced her to ask him.

Pavel was too surprised to be wary. Kelly provided him with a pair of abbreviated trunks, then ducked into her own compartment to change.

In a bathing suit she revealed what Pavel had guessed earlier: her figure was practically nonexistent. Yet her round, plain face had a kind of prettiness to it. She was not beautiful, by any means. But that did not matter so much. The prospect of pumping information from her in bed began to seem not merely possible, but attractive. Yet, although Kelly smiled at him, her brown eyes were always cautious. Pavel thought there was something very sad in her eyes, something that he should strive to find out.

They used the plane's main cargo hatch as a diving platform and plunged into the sun-warmed waters. Pavel had swum only in Moscow pools; he was surprised at the lack of chlorine in the water, and its saltiness.

After nearly an hour, they climbed up onto the wing and stretched out on giant towels to let the sun dry them. The sky arching overhead was brilliant blue, cloudless and achingly bright. Pavel squeezed his eyes shut, but still the glow of the fierce Mediterranean sun blazed against his closed eyelids.

"You swim very well," Kelly said. There was real admiration in her voice. The earlier reluctance had washed away.

He opened his eyes and turned toward her.

"Not as well as you," he replied, noticing how the sunlight glinted off the water droplets in her hair. It was a bright Irish red, the kind of coloring that the Vikings had brought with them down

the long rivers of Russia that eventually gave the country its name.

She was a trained athlete, he found out. Gently leading her on to tell her life story, Pavel learned that she had been a skater but had failed to make Canada's Olympic team.

"The competition must have been very strong in a nation like Canada," he sympathized.

She still seemed saddened by that failure. Then she had joined the International Peacekeeping Force, and had served for almost a year as a teleoperator. She had been involved in stopping the abortive war between Eritrea and the Sudan.

"Why did you leave the Peacekeepers?" he asked.

Kelly's freckled face almost pouted. "I had some trouble with my superiors. Not following orders exactly. Exceeding my mission goals."

"But exceeding one's goals is a good thing!" Pavel felt truly surprised.

"Maybe for you. For me, it just got me in trouble."

"And because of that you were cashiered from the IPF?"

"I wasn't thrown out. I quit."

"Because of that?"

"Not really," she said. "That helped, but it wasn't the real reason."

"Then why?"

She turned her head to look at him, lying beside her. Pavel saw pain and anger in her eyes. And something else, something he could not identify. Suddenly uneasy with her this close to him, he lay back again and closed his eyes against the sun.

"A man," she said. "I thought he was in love with me. I thought I was in love with him."

"Were you?"

"I guess I was," she said, almost in a whisper. "But he wasn't."

"Couldn't you have transferred to another part of the IPF?"

She shrugged her bare shoulders. "Maybe. But Cole Alexander asked me to join his group."

"Alexander offered you better pay?"

He heard Kelly chuckle. "I wish. You don't know him very well yet."

"I don't understand."

"I joined his group because he asked me to. Cole Alexander is my father."

Pavel felt stunned. "Your father? But your name is not . . ." He stopped short, suddenly realizing that he now was treading on very sensitive, dangerous ground.

"He never married my mother," Kelly said, matter-of-factly.

"And she. . . ?"

"She loved him 'til the day she died. And so will I."

They left Corsica, after Alexander had a top secret meeting in his private quarters just aft of the flight deck with six men who wore expensive suits and dark glasses. They arrived in six different yachts, and for a few hours the lonely unnamed inlet on the rugged Corsican coast looked like a holiday playground for millionaires.

He serves the rich, Pavel remembered the director's words. He helps them to oppress the poor.

The yachts departed and the seaplane took off, landed and refueled at Gibraltar, then flew out over the Atlantic and down the curving bulk of the Af-

rican coast. Pavel slept poorly that night. The plane flew steadily, with hardly a noticeable vibration. The sound of the engines was muffled to a background purr. But still something in that deepest part of his brain that was always alert kept warning him that he was in danger, that he was surrounded by enemies, and that there was nothing between him and a screaming fall to his death except several miles of thin air.

He breakfasted with Kelly and the others, then was summoned on the plane's intercom to the flight deck. Kelly accompanied him along the passageway that led through the sleeping compartments and her father's private quarters.

"His bedroom is on this side," she gestured to an unmarked door in the passageway, "and his office is here on the starboard side."

A flight of three steps marked the end of the passageway.

"Flight deck's up there," Kelly said.

"You are not coming?"

"I haven't been invited. He wants to see you. Alone."

She seemed more guarded than ever this morning, as if she regretted having revealed so much about herself. Pavel went up the metal steps and rapped on the door with the back of his knuckles. Nothing happened. He glanced back at Kelly, who motioned for him to open the door and go through. With a shrug, he did.

Strong sunlight poured through the wide windows of the flight deck. Pavel winced and, squinting, saw that the stations for the navigator and electronics operator were unmanned, their chairs empty even though the display screens of their consoles glowed with data. He had expected the noise from the engines to be louder up here, but if it was, it was so marginal that Pavel could discern no real difference from the rest of the plane.

"Come on up here, Red," came Alexander's voice. From the pilot's seat.

Making his way past the unoccupied crew stations, Pavel saw that Alexander was indeed piloting the plane. He was smiling happily in the pilot's seat, wearing aviator's polarized sunglasses tinted a light blue.

"Don't look so surprised, kid," Alexander said, grinning at him. "Flying this beautiful lady is most of the fun of having her. Sit down, make yourself comfortable."

Pavel slid into the copilot's chair.

"Want to try the controls?"

He knew he was wide-eyed with astonishment, despite his efforts to rein in his emotions. All that Pavel could say in reply was a half-strangled "Yes," and a vigorous bobbing of his head.

"Take 'em!" Alexander removed his hands from the U-shaped control yoke. The plane ploughed along steadily.

Pavel gripped the yoke in front of him and felt the enormous solidity of this huge plane. Alexander began explaining the instruments and controls on the bewildering panels that surrounded Pavel's chair on three sides: altimeter, air speed indicator, radios, throttles, trim tabs, radar display, turn-and-bank indicator, artificial horizon, compass, fuel gauges . . . there were hundreds of displays that could be called up through the plane's flight computer.

"In about ten seconds we have to

make a twelve degree turn southward. That's to our left. Ready?"

"Me?" Pavel heard his voice squeak excitedly.

"You're the man with his hands on the controls, aren't you?"

His mouth suddenly dry, Pavel swallowed once, then nodded. "I am ready."

"Okay . . . now."

Both of them watched the compass as Pavel started to turn the yoke leftward.

"Rudder!" Alexander yelled. "The pedal beneath your left foot. Easy!"

The plane responded smoothly, although Pavel overcontrolled and had to turn slightly back toward the right before the compass heading satisfied Alexander. He was sweating by the time he took his hands off the yoke and let Alexander resume control.

"Not bad for the first time," Alexander said, smiling his sardonic smile. Pavel could not tell if he were being honest or sarcastic.

Alexander flicked his fingers across a few buttons, then let go of the controls.

"Okay, she's on autopilot now until we reach Cape Verde airspace."

Wiping his palms on his jeans, Pavel said, "I have never flown an airplane before."

"Uh-huh." Alexander studied his face for a moment, then asked, "Okay, Red, what have you learned about us so far?"

Pavel searched for the older man's eyes, saw only the blue-tinted glasses. "You mean, what will I report back to Moscow?" he asked, stalling for time to think.

Alexander nodded. His grin was gone. He was completely serious now.

"You are planning to attack Libya, a nation that has friendly ties to the Soviet Union. Your plan involves destroying the Libyan aquifer project, a project that could bring precious water to farmers and herders along the Mediterranean coast—water that legally belongs to Libya, since it now lies under Libyan soil."

"Go on," Alexander said.

"You are conducting this attack for money paid to you by those six men who came aboard this plane in Corsica. One of them I recognized as an Egyptian; two of them were blacks, presumably from Chad and Niger, two neighbors with whom Libya has been at war, off and on, for many years."

"Not bad," Alexander said. "The other three were from Algeria, Tunisia and France."

"France?"

"The Frogs have had their troubles with Libyan terrorists, over the years."

"So they are paying you to get rid of Rayyid."

"Not exactly."

Pavel snorted. "Not exactly? Come now."

Alexander laughed. "Ah, the righteous defender of the poor."

"Well, is it not so?" Pavel shot back. "Aren't you taking money from the rich? Won't your schemes hurt the poor farmers and herdsmen of Libya?"

Tapping a finger against his lips for a moment, Alexander seemed to be debating how much he should tell. Finally, he said, "Chad is a helluva lot poorer than Libya. And the Chadian you saw at our little conference represented sev-

eral nations of the Sahel area. They're damned worried about Libya draining that aquifer."

"Then let them dig their own irrigation systems."

"With what? They don't have oil money. They don't have *any* money."

"Except a few millions to pay you."

"They're paying me nothing. My money's not coming from the Sahel. And what I *am* getting for this caper is barely enough to pull it off and keep us from starving. I'm not a rich man, Red. This plane and the people in it are my fortune."

Pavel did not believe that for an instant. But he said nothing.

"Besides, my egalitarian friend, Libya is much richer than most of its neighbors."

"That's not true. . . ."

"Yes it is. Check with the World Bank if you doubt it." Alexander's crooked smile returned. "Oh, the *people* of Libya are shit poor. Those farmers and herdsmen you talk about are on the ragged edge of starvation, sure enough. But there's plenty of gold in Tripoli. Rayyid's rolling in money. He could buy fusion desalting plants and string them along his coastline, if he wanted to. Instead, he's using part of his gold to build this monster irrigation project. The rest goes into terrorism."

"So you say."

"Listen kid," Alexander pointed a forefinger like a pistol, "a helluva lot of Libyan oil money goes straight to Moscow to buy the guns and explosives that Rayyid terrorist squads use in Paris, Rome, London, and Washington."

Pavel leaned back, away from that accusing finger. "So it is all the fault of the Soviet Union, is it?"

"Did I say that?" Alexander put on a look of snow-white innocence falsely accused. "It's the fault of Qumar al Rayyid, and we're going to take steps to stop him."

"By destroying his aquifer project."

"Damned right. And letting his own people see that he's been spending their hard-earned money on projects that bring *him* prestige and leave *them* penniless."

"Very clever," Pavel admitted. "You stir up his own people against him, so that when they tear him to pieces you can say that you did not assassinate him."

"What the Libyan people—or, more likely, what the Libyan military do to Rayyid is their problem, not mine. My problem is to see to it that the bastard doesn't drain that aquifer dry and cause an ecological disaster that'll kill millions of people over the next generation."

"I could ruin your plans," Pavel said.

Alexander arched an eyebrow.

"I could escape from you and tell all this to the nearest Soviet consulate. Once they knew that Algeria and France were paying you . . ." Pavel let the sentence dangle.

Alexander grinned at him. "First you have to escape."

Pavel bowed his head in acknowledgement.

"Actually, it wouldn't be too tough for a man of your training," Alexander said, leaning back in his chair. "You're sitting on an ejection seat, you know."

"Really?"

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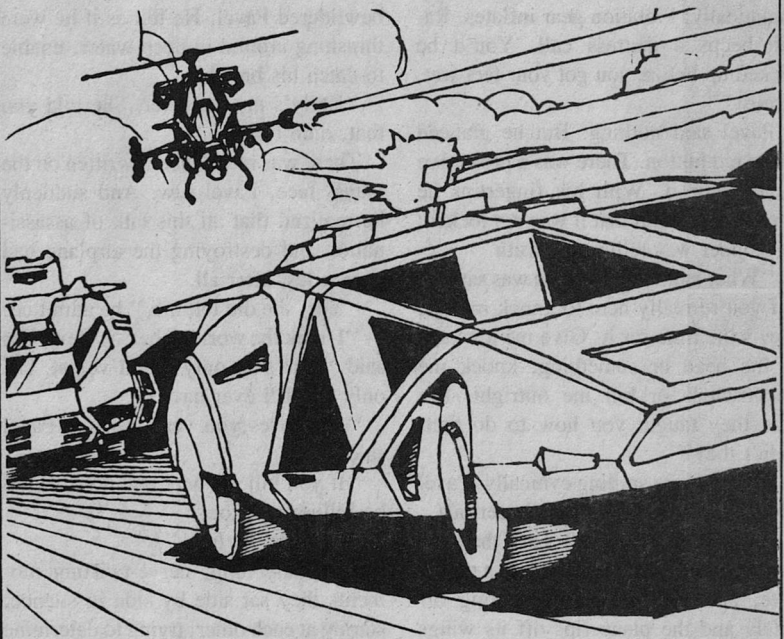

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"Just strap yourself into the harness and hit the red button on the end of the armrest and *whoosh!*" Alexander gestured with both hands, "Off you go, through the overhead hatch and into the wild blue yonder. Parachute opens automatically. Flotation gear inflates. Radio beeps a distress call. You'd be picked up before you got your feet wet, almost."

Pavel said nothing. But he glanced at the red button. There was a protective guard over it. With his fingertips he tried it and found that it was not locked; Alexander was telling the truth.

"What's more," the man was saying, "if you're really here to knock me off, now's the time for it. Give me a whack in the head or something, knock me unconscious or kill me outright. I'm sure they taught you how to do that, didn't they?"

His lips were smiling cynically, Pavel saw, but his tone was deadly serious.

"Then slam the throttles and the yoke hard forward, put the plane into a power dive, and eject. You go floating off safely and the plane rips off its wings and hits the water at six hundred knots. No survivors, and it looks like an accident. You'd get a Hero of the Soviet Union medal for that, wouldn't you?"

"You are joking," Pavel said.

Alexander went on, "You'd kill me and everybody else on board. Wipe out all of us."

Pavel could not fathom Alexander's motives. Is this a test of some sort? he asked himself. A trap? Or is the man absolutely mad?

"You could knock me out, couldn't you? After all, I'm an old man. Old enough to be your father."

Is he actually challenging me to a fight? Pavel wondered. Here? In the cockpit of this plane?

"She told you I'm her father, didn't she?" Alexander asked.

The sudden shift in subject almost bewildered Pavel. He felt as if he were thrashing around in deep water, unable to catch his breath.

"Kelly's my daughter. She told you that, didn't she?"

There was real concern written on the man's face, Pavel saw. And suddenly he realized that all this talk of assassination and destroying the airplane had been a test after all.

"Yes, she did tell me," he admitted.

"I think the world of her," Alexander said. "She's the only child I've got. The only one I'll ever have."

"She loves you very much," Pavel said.

"If you kill me here and now, you'd be killing her, too."

"Yes, that is true."

For many long, nerve-twisting moments they sat side by side in silence, staring at each other, trying to determine what was going on behind the masks they held up to one another, while the plane droned on high above the glittering gray ocean.

"When you go into Libya on this mission," Alexander said, "Kelly will be with you. She has a tough assignment, a key assignment."

"And I?"

Alexander took in a deep breath, let it out slowly in a sigh that had real pain in it. "I'm asking you to watch out for her. Protect her. I don't care what your government wants you to do to me. I can take of myself. But my little girl is

going to need protection on this job. I'm asking you to be her protector."

He *is* mad! Pavel thought. Asking me to protect the woman he has assigned to watch me. His own daughter. Absolutely mad . . . or far more clever than even the Kremlin suspects. Yes, devious and extremely clever. He has been watching the two of us together. Now he places her safety in my hands. Extremely clever. And therefore extremely dangerous.

"Hey look," Alexander exclaimed, pointing past Pavel's shoulder. "The Madeira Islands."

Pavel glanced out the window to his right and saw a large island, green and brown against the steel gray of the ocean, a rim of whitish clouds building up on its windward side. He could see no other islands, but puffy clouds dotted the ocean and might have been hiding them.

"There's an example of ecological catastrophe turning into something good," Alexander said, as chipper and pleasant as if they had never spoken of death.

Pavel gave up trying to figure out this strange, many-mooded man. He is too subtle for me, he concluded.

"Madeira is the Portuguese word for wood," Alexander was explaining. "The early Spanish and Portuguese explorers working their way down the coast of Africa, looking for a way around to the Indies, they stopped at the islands to cut down trees for lumber and fuel. Masts, too. Cut down so much of it they totally denuded the islands in just about a century."

"A tragedy," Pavel said.

"Yeah. But somebody got the brilliant idea of planting grape vines where the forests used to be. Now the islands produce one of the world's greatest wines. Madeira was a favorite of Thomas Jefferson's, did you know that?"

Pavel shook his head.

Alexander tilted his head back and began singing in a thin, wavering voice that was slightly off-key:

"Have some Madeira my dear,
"You really have nothing to fear
. . . ."

His mind whirling, Pavel excused himself and left the flight deck.

For two days the plane stayed anchored in the harbor of São Vicente, in the Cape Verde Islands. Alexander remained aboard, constantly locked in his office, speaking by coded tight beams to contacts over half the world. He must have his own private network of communications satellites, Pavel thought. Then he realized, Of course! He must have free access to commsats owned by half a dozen nations and private capitalist corporations.

The rest of the crew apparently had nothing to do except guard the plane and replenish its stores. Pavel watched closely, but saw no weapons brought aboard.

There was no way for Pavel to make contact with Moscow. He was watched every moment, and each night the plane was moored far from land.

On the second day, though, Alexander insisted that Pavel take Kelly into the town for an afternoon of relaxation.

"Do you both good to get out and away from here for a few hours," he said.

Pavel wondered what Alexander had

planned for the afternoon, that he wanted Pavel out of the way—escorted by his watchdog. Or does he want his daughter to have a free afternoon, escorted by *her* watchdog? It was too devious for Pavel to unravel.

Kelly had stayed distant from Pavel since the day they had swum together. But now the two of them took one of the inflatable boats to the port and spent an afternoon gawking at the town, like any ordinary couple. They wore inconspicuous cut-off jeans and T-shirts—and generous coverings of sunblock oil over their bare arms and legs.

A big passenger liner was tied to the main pier, and they mingled with the brightly dressed tourists, watching the black-skinned islanders unloading bananas from boats that plied the waters between the Cape Verde Islands and Dakar, nearly a thousand kilometers eastward. Then they climbed the volcanic rocks to the crumbling old Moorish castle that had flown the red and green flag of Portugal for half a millennium.

He stood on the bare hilltop with Kelly beside him and looked back at the harbor, the ships anchored along the modern concrete quay, a rusting hulk half-sunk next to a rotting old pier, the seaplane riding the gentle swells out by the breakwater. The equatorial sun was baking its heat into his bones, yet the trade winds were cool and refreshing.

"It's beautiful, isn't it?" Kelly said, smiling out at the view.

Pavel turned his gaze to her. "You are beautiful, too," he said. And he kissed her, wondering just how much he meant what his words, his actions, said. Kelly clung to him for a moment, then broke away.

Shaking her head slightly, she said, "Don't play games with me, Pavel."

"I'm not playing games."

"Not much."

"Kelly, honestly . . ."

"Let's see the town." She turned away from him, and started down the steep path that led back down to the port.

Pavel followed her down the sloping path. They reached the quiet, sun-drenched streets where the stucco fronts of the buildings were painted brilliant hues of blue, yellow, green and white. Children in school uniforms sat up on the roof of a single-storey building, intently reading. The outdoor market was noisier, the tang of spices filling the air while women in colorful dresses bargained noisily on both sides of the stalls over freshly-caught fish and teeming bins of vegetables. Clouds of flies buzzed over the fish and red meats; Pavel waved at them annoyedly, ineffectively.

Finally he took Kelly by the wrist and led her away from the stalls.

They found a tiny cafe with a patio that looked out on the municipal square. The food was good, the wine even better. Pavel began to fantasize about spending the rest of the afternoon in a romantic hotel room, but he knew that Kelly would never agree.

Yet she suggested, "Let's go back up the hill and find a quiet spot where we can take a nap."

His thoughts churning, Pavel brought her back to the abandoned Moorish castle. She has almost as many contradictions about her as her father, he said to

himself. It's almost as if she is fighting within her own soul.

But another voice in his mind warned, Her loyalty is to her father; always remember that. Your loyalty is to the Soviet Union and its people. Her loyalty is to her father.

They climbed solid stone stairs to the topmost turret, stretched out in the sun and almost immediately fell asleep, more like brother and sister than prospective lovers.

Pavel woke shivering. The sun had dropped toward the horizon, leaving him in the shade of the turret's parapet. It was cold, lying on the stones. Kelly was nowhere in sight.

He sat bolt upright, then quickly got to his feet. Ah, there she is! Kelly was leaning on the weathered stone parapet, off at the other side of the turret, gazing down at the town and the harbor. Pavel felt an immense flood of relief. She had not deserted him. She had not been abducted.

Wondering which reason was the stronger within his own mind, Pavel walked over to her side.

"You were snoring," she said.

"Impossible. I never snore."

"How would you know?"

"Hasn't your father told you that in the Soviet Union, everyone is watched all the time? If I snored, there would be a tape recording of it, and my superiors would have warned me to cease such bourgeois affectations."

Kelly laughed. "Snoring isn't allowed in the USSR?"

"Of course not," Pavel joked, surprised at how happy her laughter made him feel. "We are striving to create the truly modern man. Snoring is definitely not modern."

They laughed and joked their way down the mountainside and back into the town. The sun was setting, so they walked back to the pier and the rubber boat they had left tied there. Kelly inspected the boat carefully once they had hopped into it, even taking a small electronic beeper from her belt and passing it back and forth over its length twice.

"Don't want to bring any bugs back to the plane with us," she said. "Or bombs."

Pavel sat beside her as she started the motor. "Your father has enemies."

"Yes, he does," she replied. Then, staring hard into his eyes, she asked, "Aren't you one of them?"

He had no answer. They rode back to the seaplane without further words. Pavel felt grateful that the roar of the boat's motor made intimate conversation impossible.

From São Vicente they flew to Dakar, on the bulge of Africa's Senegalese coast. Again, Alexander suggested that Pavel take Kelly into the city. But when Kelly said she wanted to go dancing, both men were dubious.

"I don't like the idea of you two out in the wild life district at night," Alexander said grimly. "Dakar isn't a tourist's city; it's a rough, grungy town at night. It can be dangerous."

Kelly shook her head stubbornly. "We won't go into the red-light district, for god's sake! We'll stay with the country club crowd."

Pavel had a more serious objection. "I don't know how to dance," he confessed.

She grinned at him, her father's sardonic, superior semi-sneer. "I'll have to teach you, then."

So Pavel escorted Kelly on a tour of the city's night life, sampling capitalistic delights such as dancing in private clubs that boasted live musicians and dining in posh restaurants, all the while wondering when—if ever—Alexander was going to get his Libyan mission underway.

It was obivous that Alexander wanted Pavel away from the plane for long hours at a time. But under constant observation, nonetheless. Pavel wondered also about his relationship with Kelly. She is Alexander's daughter, he kept telling himself. She is intelligent, charming, lovely in her own way—but she is Alexander's daughter, and her first loyalty is to her father.

Pavel found himself wishing it were not so.

"This is our last night of fun," Kelly said, over the din of a torrid Senegalese rock band.

"What?" Pavel had heard her words. With a shock, he realized that he did not want things to change.

Kelly leaned forward over their minuscule table. Two plastic coconut shells half-filled with poisonously delicious rum drinks tottered slightly between them. The nightclub was lit by strobing projectors flashing holograms of video stars that sang, played their electronic instruments and even "danced" with the living customers. Couples gyrated wildly to the throbbing drum-heavy music, casting weird shadows across Kelly's snub-nosed face. She was wearing a sleeveless frock, its color impossible to determine in the flashing strobe lights.

"Tomorrow the real work starts," shouted into Pavel's ear.

He took her by the wrist and led her across the edge of the dance floor, threading through bluish clouds of smoke and past the wildly thrashing couples, even directly through several of the oblivious holos. Once the thickly padded main door of the club closed behind them, the parking lot outside was blessedly quiet. The stars glittered in the breaks between low-scudding gray clouds. The air was damp and heavy with mingled odors of flowers and oil refineries.

"Had enough of the rich capitalist life?" Kelly teased.

"You said our mission begins tomorrow?"

"The real work starts tomorrow, yes," she said. "The exact timing for the mission is still a secret."

"Rayyid will officially open the irrigation system next week," Pavel pointed out. "The news is in all the headlines."

She nodded, began walking slowly toward the rows of parked cars.

"Kelly . . ." Pavel began.

Turning back toward him, her face lit by the garish glow of the nightclub's animated sign, she seemed to be waiting for him to speak the right words.

"A few days ago . . . you said I was one of your father's enemies. That is true."

"I know it."

"But I don't wish to be your enemy."

She sighed and shook her head. "Can't be his enemy without being mine, Pavel."

"I have my orders. I am a loyal Soviet citizen. He knew that when he accepted me."

Kelly took a step toward him. "Pavel—I don't make friends easily. I've always been a loner. . . ."

"Me too," he admitted.

She started to say something, changed her mind. Pavel could sense the emotions battling within her.

"Maybe we'd better leave it that way," she said at last. "It might've been good between us, but . . ."

A blow struck between Pavel's shoulderblades like a boulder smashing him. He went down face first, heard his nose crunch on the asphalt of the parking lot. Kelly screamed.

There was no pain. Not yet. Pavel half rolled over, and a massive black man loomed over him, a thick length of pipe in his upraised hand. Beyond him, Pavel could see two others grabbing at Kelly, twisting her arms painfully and laughing as they tore at her dress.

Without thinking consciously, Pavel blocked the downward swing of the pipe-wielder's arm and kicked his legs out from under him. He went down with a surprised grunt and a thwack as Pavel scrambled to his feet.

Kelly smashed the heel of her shoe into one of her assailant's insteps, wrenched her arm free from him as he yowled in sudden pain, then drove her cupped palm into the nose of the other man holding her. His head snapped back.

Pavel took out the man hopping on one foot with a swift stiff-fingered shot in the throat, then whirled to face the other one. But Kelly smashed lightning-fast chops at his solar plexus, kidney and groin. He hit the asphalt like a dead man.

The big one who had struck Pavel was scrambling to his feet. Feeling utter fury boiling within him, Pavel launched a flying drop-kick at his head, knocking him to his knees. Pavel landed catlike on the balls of his feet and wrenched the pipe from the man's hand. With every ounce of his strength he swung the pipe into the big man's ribs and felt them give way. Then backhanded across the face and he went down heavily. Then a two-handed swing across his back.

"Stop it! Stop it!" Kelly hissed, grabbing Pavel's shoulder. "Do you want to kill him?"

"Yes!" Pavel snarled. But he stopped. He was trembling with rage, and he knew that it was only in part from the shock of being unprovokedly attacked. They had tried to hurt Kelly.

He turned to the two who had grabbed her, stretched out on the asphalt.

"Subhuman bastards," he muttered.

"Come on," Kelly said, "let's get to the plane."

They took one of the battered ancient taxicabs waiting in line at the club's entrance. As it jounced toward the waterfront, Kelly peered at Pavel's face in the dim light of the occasional street lamps.

"Your nose is bleeding."

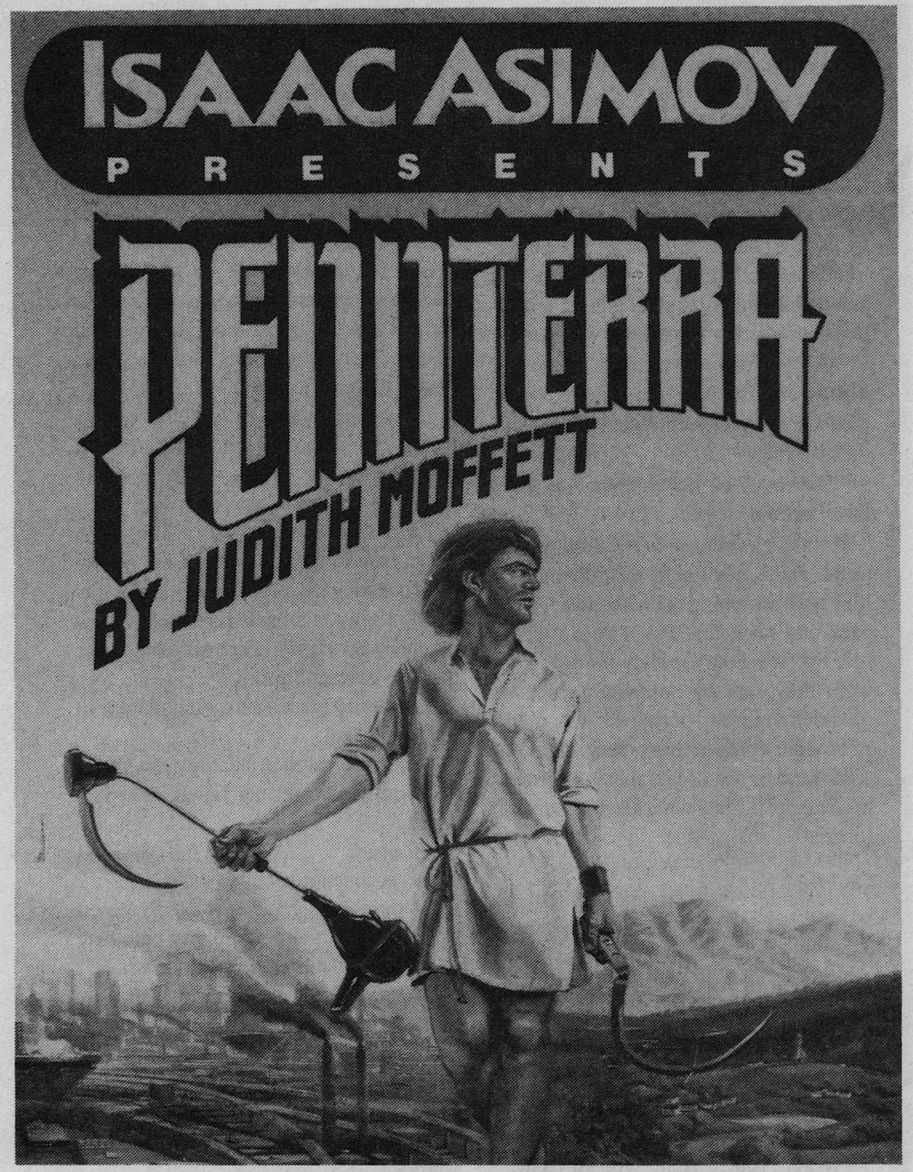
"They tore your dress."

"Is it broken?"

"No, I don't think so. There's a bruise on your shoulder."

"That's nothing. What about your back?"

"It feels numb."



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"You're lucky no bones are broken."

"Where did you learn to fight like that?"

"From when I was a kid. Then training at the IPF. My father's people have taught me a few new tricks, too."

Suddenly they were laughing together. Bruised, bleeding, sweating, trembling with delayed reactions of fear and anger—they laughed almost uncontrollably all the way to the waterfront.

"A fine pair of warriors we are," Kelly said, as they passed the armed guard at the pier's entrance. "We must look awful."

"But we look better than *they* do," Pavel reminded her.

It wasn't until they were halfway back to the plane, with cold spray drenching him and throbbing pain starting in his back and face, that Pavel began to ask himself, were they merely muggers? Or were they sent by someone? Enemies of Alexander's, perhaps? Or could Alexander himself have sent them, as some kind of test of my ability to protect his daughter? The man is devious enough for that.

Alexander was strangely silent as Kelly explained what had happened. Pavel stood beside her in the softly-lit wardroom, his back blazing with pain, his nose still trickling blood, and watched Alexander. No one else was present.

The man listened grimly to his daughter and replied only, "I told you it was a dangerous town."

"When you're right, you're right," Kelly admitted.

"Well . . ." Alexander let out a sigh that was almost a snort, "you're both okay. No permanent damage. That's the important thing."

"Pavel needs treatment for his back."

Turning his steel-gray gaze to Pavel, Alexander said, "Yeah, I guess so. Come with me."

Without another word to his daughter, he led Pavel from the wardroom and down the passageway to his private quarters. His bathroom was as large as Pavel's whole compartment, and wedged between the shower stall and the toilet was a narrow deep tub.

"My one luxury," Alexander muttered. "Whirlpool bath." He touched a button on the tub's control box and steaming hot water started filling it.

Pavel caught a glimpse of himself in the mirror above the sink. His upper lip was caked with blood; his cheek was scuffed raw. His back was so stiff now that he knew he could not raise his arms, even to defend himself.

Alexander placed himself squarely in front of Pavel.

"I asked you to protect my daughter, and you nearly get her raped and murdered."

"I nearly . . ." Pavel felt shocked at the accusation.

"Don't you have any goddamned sense? Where the hell did you take her, to some goddamned junk bar or what?"

"It was a private club that *she* selected."

"You're supposed to *protect* her," Alexander snarled. "You're supposed to be on the alert, have some common sense in that thick Russian skull of yours."

Anger flamed through Pavel. "So it's the fault of the Russian barbarian that muggers and hoodlums infest Dakar!"

"You damned near got her killed!"

And Pavel's anger dissolved as quickly as it had appeared. There was real fear in Alexander's eyes, real anguish in his voice.

"I know," he said, his voice low. "I love her too."

Alexander's mouth opened, but no words came out. He gestured toward the rapidly-filling tub. Through the steam, Pavel saw that there was a set of three steps built into its side. In silence, Alexander helped him into the tub, turned on the whirlpool action, and then left Pavel alone.

It took two days of rest and whirlpool treatments to heal Pavel's back. The hot swirling water eased the pain and swelling to the point where Pavel felt only a twinge when he raised his arms above his head. During those two days he saw Alexander only when he knocked for admission to the bathroom.

Kelly seemed cheerful and friendly, but nothing more. Pavel hoped desperately that her father had not told her of his admission.

On the evening of the third day after the attack Alexander abruptly called for a final mission briefing. Pavel, Kelly, Barker and Mavroulis gathered around the display table in the wardroom. A detailed map of the Libyan aquifer facility glowed in the otherwise unlit compartment, throwing weird shadows across their faces.

Alexander asked each of them to recite their assignments.

Barker spoke about flying from Dakar and landing in the desert, pointing to a spot marked on the map some twenty kilometers from the Libyan facility.

Mavroulis took over. "We meet Hassan and his men here," he tapped on the tabletop display screen, "and proceed to the aquifer facility. We get past the guards and take over the facility."

"Timing?" Alexander asked.

Mavroulis rattled off a series of hours and minutes that meant nothing to Pavel. Obviously they had rehearsed this sequence of actions many times. They all knew exactly what they were supposed to do. All of them, except Pavel.

"Kelly?" her father asked. "Let's hear your story."

"Once we're inside the control building I proceed to the main computer center and reprogram the machine. Reprogramming tapes are in my kit."

Alexander gave her a long, serious look. "You're the key to this whole operation, young lady. Everything we're doing, all the risks we're taking, are so that you can get into their computer."

She nodded, equally serious. "I understand."

Mavroulis then told how they would retreat back to the spot where Barker was waiting with their aircraft. Barker said he would fly out of Libyan airspace to a rendezvous with a fighter escort waiting for them in Chad.

Alexander looked at each of them in turn, his lips pressed into a tight tense line, his gray eyes cold as scalpels. "Okay, sounds like you know your jobs."

"What about me?" Pavel blurted. "I'm going, too, am I not?"

Looking almost suprised, Alexander said, "Sure you're going, Red. Your job is very simple. You're Kelly's protection. Stay with her wherever she goes. If the operation blows up, you're

to get her out and back to me. Don't come back without her. *Pahnyee-mahyo?*''

His Russian was execrable. ''I understand,'' Pavel answered in letter-perfect English.

Pavel could not overcome the feeling that they were being watched. And followed.

Four would-be tourists: an American woman, an Englishman, a Greek and a Russian. From Alexander's seaplane anchored out in the harbor they went to the waterfront of Dakar in two separate groups of two, Pavel and Kelly first, then Barker and Mavroulis. All dressed in casual slacks and sport shirts, with overnight bags slung across their shoulders. In two separate taxis they went to the airport, where they bought four separate tickets for Casablanca, Tunis, Cairo and Malta.

Each of them started for the gates where their respective planes were waiting. Each of them handed their tickets to strangers who identified themselves as part of Alexander's operation. The strangers boarded the planes while the four of them ducked through an emergency exit (conveniently left unlocked thanks to a small bribe) and ducked into an empty luggage carrier that just happened to be parked there. Barker drove the electrically-powered van into a hangar on the far side of the sprawling airport.

A swivel-engined hoverjet sat alone in the echoing hangar. It looked old and hard-used. Paint worn and chipped, except for a fresh-looking smear where the name of the plane's previous owner had been whited over. The only identification on the craft was its registration number, back on the tail. The bulky engine pods, out at the ends of the stubby wings, were black with oil and dirt. Pavel began to wonder if this machine would make it all the way to their base camp in the desert. And back again.

Wordlessly the four of them climbed into it. The plane smelled sourly of oil and tobacco smoke and old human sweat. Barker took the pilot's seat, Kelly the copilot's—to Pavel's surprise. He sat behind them, with Mavroulis beside him, glowering like a dark mountain at Pavel as they strapped on their safety harnesses.

They taxied out onto the ramp, Barker chatting with the traffic controllers in the clipped, professional English of the airways. Pavel watched as they rolled out to a vertical take-off area marked by wide red and yellow painted circles. The plane's two turboprop engines tilted slowly backward, their big propeller blades scything the air until they became an invisible blur. The engines roared with full power, shaking the cabin so furiously that Pavel began to worry that the plane might fall apart.

With a lurch, they snatched off the ground and rattled up and away, banking so precariously that when Pavel looked out the window on his side, he was staring straight down at the looming roof of a hangar and the bird nests and droppings that covered it. It looked terrifying close.

The plane climbed steadily, though, and soon enough the engines slid back to their horizontal positions and they surged ahead, winging across greenly forested mountains with the sun at their backs.

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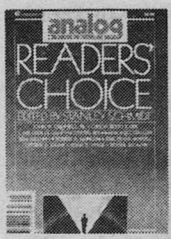

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For days Pavel had searched for a way to warn Moscow, to get out the word of what Alexander was planning to do and how he would do it. But there had been no chance. He was always watched, never alone. And now he rode with three of the mercenaries on their mission of destruction, not entirely sure that he wanted to stop them. That would mean placing Kelly in unbearable danger, possibly getting her killed.

Miserably confused, Pavel sat in the swiveljet and did nothing. There seemed to be nothing he could do.

The landscape changed slowly, subtly; by the time the long shadows of twilight were reaching across the ground, Pavel was watching low, gently undulating hills of bare rock with patches of pitifully thin grass here and there. Dark circles of waterholes appeared every few kilometers; most of them seemed to be wells dug by men rather than natural springs. The grass was worn away around the waterholes, leaving only bare gray dry-looking soil that wafted away in long dusty streamers with each passing gust of wind.

Just at sunset Pavel saw a tiny herd of emaciated cattle moving slowly toward one of those waterholes. Three stick-thin persons in gray dust-covered robes walked behind them. Pavel could not tell if they were men or women, from this altitude.

It was well past sundown when they landed, coming down vertically in a sea of absolute blackness; not a light anywhere except for the stars strewn across the dark bowl of night. Straining his eyes, Pavel saw briefly a flicker of a campfire down there; it looked very small and lonely. Between Barker's and Kelly's shoulders, Pavel could see a glowing display on the radar panel. But he did not feel safe until the plane thumped onto solid ground.

It felt good to stretch his legs again. Pavel tried lifting his arms and stretching his spine, carefully. A twinge, nothing more. He was ready for action.

Barker became their team leader. He strode across the sand to the tiny campfire, and spoke with a trio of men swathed in desert robes and burnooses who were waiting there. Then he beckoned to Pavel and the others.

"Everything's on schedule," Barker pronounced it *shed-yule*. "Hassan and his people will rendezvous with us here tomorrow morning."

They spent the next two hours dragging out camouflage nets and radar dispersers to hide the plane from aerial surveillance, then pitching a tan igloo-shaped tent for themselves to sleep in, while the three robed strangers watched in unmoving silence in the flickering light of their fire.

It was surprisingly cold on the desert, although Pavel kept warm by working hard. He did not want his back to stiffen on him. They ate a quick meal from metal foil packages that heated themselves when their tops were pulled off.

"Sleep now," Barker said. "Big show tomorrow."

Pavel asked, "No one stands guard?"

Barker nodded toward the three bedouins by the fire. "They're our guards."

"You trust them?"

"They're in on this with us."

"I think we should have a guard of our own."

"Now see here . . ."

Mavroulis's voice came out of the

dimness like a distant roll of thunder, "For once I agree with the Russian paranoid."

Pavel grinned. "I will stand watch until midnight."

"Hokay," said Mavroulis. "I will take midnight to two."

Kelly offered to take the next two hours and, reluctantly, Barker agreed to the final two.

All four of them crawled into the round tent. Pavel strapped a battery-powered heating pad to his back, then pulled a thermal jacket over it.

"Take this, if you're going to be our guardian," said Barker. He pushed a slim flat pistol in Pavel's hand. "It's a Beretta nine millimeter automatic. Do you know how to use it?"

Pavel flicked off the safety with his thumb and cocked the pistol.

"For heaven's sake, don't fire the thing unless it's absolutely necessary!" Barker warned.

"Good night," said Pavel, calmly returning the gun to its safe condition.

The others muttered goodnight and crawled into their sleeping bags. Pavel ached for Kelly to say something more, but soon all he heard was the gentle breathing of his companions. Mavroulis began to snore.

He tucked the pistol into his belt, its weight solid and comforting. It was warm and drowsy inside the tent. And there was utterly nothing to do. Pavel decided to duck outside. At least I can count the stars, he told himself.

A wind had come up. Not enough to stir the desert sand, but Pavel walked around the tent to the leeward, then sat cross-legged on the ground. He could not see the campfire from this spot, though, and that bothered him somewhat.

But the spectacle of the heavens was so overwhelming that he almost forgot everything else. The stars were incredibly bright in the desert night; so brilliant that he almost felt he could reach out and take them in his fingers. For what seemed like an hour Pavel studied the heavens, as excited as he had been at his first visit to a planetarium.

He renewed his acquaintance with the Great and Little Bears, the Princess, the Hunter. A meteor blazed briefly across the sky, silent and cold despite its fire. The Moon was nowhere in sight. The arching beauty of the Milky Way glowed alluringly, much brighter than he had ever seen it from the streets of Kursk or Moscow. And there was Mars, shining red on the horizon. Russians are there, living and working on another world, Pavel thought with a surge of pride.

Pavel tore his gaze away and looked at the glowing digits of his wristwatch. Hardly half an hour had elapsed. He got to his feet and slowly paced around the tent, hunching his shoulders against the cold wind and pushing his fists deep into the jacket's pockets.

The campfire was down to a few pitiful embers. The men were sleeping beside it, on the bare ground.

There were only two men there!

Pavel tensed. His hands came out of the pockets; his right held the pistol. He cocked it; in the dark night the clicking noise sounded like the heavens cracking asunder.

"Tovarishch." It was a whisper.

Slowly Pavel turned his head. A shadowy form stood near the tent behind

him. He whirled, the gun levelled at the bedouin's waist.

"Tovarishch! I am a friend!" the man said in a mixture of Russian and English.

"Who are you?" Pavel whispered.

"A friend. To help you."

"Help me?"

"I was told a Russian would be among the infidels who came to this camp, and he would be a friend to us. I was told to make myself known to the Russian."

In the dim light of the stars Pavel could not make out the man's face, deeply shadowed by the hood of his burnoose.

"Who told you this?"

"Hassan's men. The faithful of God," replied the bedouin. "Hassan himself will be here in the morning. He will remain here while you go to the water machinery. He and the faithful will be waiting for you when you return."

"And then?"

"You will be spared," the man whispered. "Hassan knows who the true friends of God are. You will be spared."

A burning tendril of red-hot fear crawled along Pavel's gut and clutched at his heart.

"And the others?" he asked, in an urgent whisper.

"God knows."

"What do you mean?"

"They are infidels, are they not? What does it matter?"

A thousand questions boiled up in Pavel's mind, but he clamped his lips shut so tightly that his teeth hurt. This bedouin is only a messenger, he told himself. He knows very little. And the more questions I ask, the more suspicious he will become.

"Go with God," said the bedouin, tapping his right hand to his chest.

Pavel grunted and nodded, thinking that it was an unlikely alliance: a Moslem fundamentalist and a Soviet atheist.

The bedouin went as silently as a wraith back toward the embers of the campfire. Pavel stayed on his feet, wide awake, and forgot the stars that hung above. Even after Mavroulis came out and took the gun from him, Pavel went inside the tent and stretched out in his sleeping bag but found that he could not keep his eyes closed.

Tense as a hunted lion, eyes burning from lack of sleep, Pavel rolled out of his sleeping bag with the first glint of dawn. He had spent the night debating where his loyalties lay: assassinating Alexander did not mean that he should stand aside and let these desert savages slaughter his companions. He could not let them harm Kelly. Never. Besides, it would make his assignment more difficult if Kelly and the others were killed or even held hostage.

Who is this Hassan? What game is he playing? Is Alexander's plan already known and countered? Are we already in a trap, our necks in nooses?

Kelly and the others gave no sign of apprehension. They shared a quick breakfast of yogurt and honey with the three bedouins, who smilingly assured them that Hassan would soon arrive. Pavel tried to identify which of the three had spoken to him during the night. He could not.

Kelly broke out tubes of dark cream

makeup. "We've got to look more like Arabs," she said.

"A red-haired Arab," Mavroulis joked, taking a tube from her.

"I won't be red-haired for long," Kelly shot back, grinning.

Pavel took the tube she handed him.

"You're already a lot darker than you were when you first came to us," she said. "Your skin is almost golden, like toast."

"Tartar blood," Pavel said.

"And those beautiful dark eyes," Kelly added. "You won't need contacts to disguise them."

Pavel felt himself blush.

By the time Hassan and his men arrived, in a pair of armored, wide-tracked personnel carriers, Kelly, Mavroulis and Pavel had daubed their skin as dark as their bedouin companions. Barker had declined to disguise himself.

"I am to remain here with the plane and stay out of the sun," he said, with an almost smug air of English self-satisfaction.

Hassan turned out to be a colonel in the Libyan army. He jumped down from the turret of the leading sand-colored crawler, a handsome energetic man in his late forties, wearing a crisply-creased green and gold uniform with his cap cocked at a jaunty angle and a pair of mirrored sunglasses that hid his eyes very effectively.

He looked over the four mercenaries, up and down, as he casually took a flat gold case from his tunic chest pocket and put a slim brown cigar to his lips. Pavel noticed that he sported a pencil-thin moustache.

One of his aides, dressed in sand-colored battle fatigues, nearly leaped forward to light the colonel's cigar. Hassan blew out a thin cloud of smoke, then nodded as if satisfied.

"You will do, I suppose." Without turning his head back to the vehicle, he raised one hand and snapped his fingers. "Uniforms!"

Within five minutes Kelly, Mavroulis and Pavel were decked in the green and gold uniforms of the Libyan army. Pavel thought them overly gaudy: uniforms meant for show, not for fighting. They did not fit terribly well; Kelly's in particular sagged on her diminutive frame.

Hassan disdained to speak to them, but looked them over like a drill sergeant inspecting a trio of recruits, his lip curled slightly in distaste. Kelly had tucked her dyed hair inside her cap, so she looked properly boyish.

"That APV will take you to the water facility," Hassan said in British-accented English. "The crew is instructed to wait for you until precisely fifteen-ten hours. Then they will return here, with you or without you. Is that clear?"

Mavroulis said, "The timetable is understood."

Hassan took the cigar from his lips and gestured to the personnel carrier. The three of them climbed up the metal rungs of the ladder and in through the hatch. Two soldiers were already inside, dressed in khaki fatigues and wearing sidearms in well-oiled black holsters, sitting on the padded bench that lined one side of the metal compartment. The three mercenaries sat along the bench on the opposite side. The metal bulkhead felt hot against Pavel's back; almost as good as the heating pad, he thought.

Through the forward hatch in the

compartment, Pavel could see two more men in the driver's cab, one of them an officer. With a roar of diesel engines and a bone-shaking rattle, the personnel carrier started off across the desert.

Heat. The armored vehicle was like an oven in the desert morning. Sweat oozed from every pore of Pavel's body. The stink of their bodies became almost nauseating as the APV lurched and swayed. Their uniforms turned dark with perspiration, under the armpits, across the back, everywhere.

"They don't believe in air conditioning," Kelly said, her voice bleak with misery.

One of the soldiers wordlessly climbed up into the top turret and popped its hatch open. A hot breeze like the blast from a furnace blew in. Mavroulis grunted and swore in Greek under his breath. Pavel wondered if the soldiers understood English.

"Tell me about this aquifer facility. How does it work?" Pavel said to Kelly, more to forget the heat and cover his growing tenseness than any desire to learn.

Kelly seemed glad of the diversion. She was nervous too, Pavel realized. She recited facts and figures for the remainder of the jouncing trip across the desert. The only thing that stuck in Pavel's mind was that the great underground aquifer was almost three thousand meters deep; nearly three kilometers below the desert sands.

Could the Libyans actually use up all that water in a single generation? There must be millions of tons of it beneath the Sahara, Pavel realized. Surely Alexander was spouting propaganda. But then he remembered how the vast virgin lands in Siberia had been polluted beyond belief in only a few decades. Exaggerated or not, Alexander was right: sooner or later the aquifer would be drained. Water that had been stored for a hundred thousand years would be sucked away and depleted in the blink of an eye. Kelly believes it, Pavel told himself, and she has no reason to lie to me. She is almost painfully honest.

"There it is!" announced the soldier up in the turret. One by one the three mercenaries climbed up to look.

Pavel saw an immense building made of poured concrete, gray and low against the gray-brown rocks and sand of the desert. Squat towers stood at each corner. Cooling towers for the gigantic pumps housed inside the building, Kelly told him. But they looked like good defensive posts to Pavel, where a few troops could hold off a small army of attackers. All around the building were smaller concrete complexes of pillboxes, missile launchers, and barracks.

The place is a fortress, he realized. And it is defended by Rayyid's best troops.

They drove past an outer fence of electrified wire and along a smooth road flanked by gun emplacements and dozens of similar armored tracked vehicles, all in sandy gray desert camouflage. Pavel heard the thrumming whine of a helicopter. The inner perimeter was a concrete wall lined with troops. They drove past and up to the main gate of the building itself.

The driver stayed inside the vehicle, but the officer who had sat next to him, a captain, ducked into the main compartment and in Arabic directed the two soldiers there to break out automatic

rifles for the three mercenaries. Then he led all five uniformed figures out the rear hatch, past several sets of guards, and finally up a narrow concrete stairway to the roof of the main building.

The late morning sun poured down on them like molten lead. Not a breath of breeze, even up on the roof. The others seemed to cower away from the blazing sunlight and seek shelter in whatever shade they could find. Pavel had never seen a sky so cloudless, the sun so powerful; it turned the heavens into an inverted bowl of hammered bronze. He squinted out across the desert, shimmering in the heat haze. Not a tree or a blade of grass as far as the eye could see. Only the distant wavering gleam of a mirage, a cruel illusion of water in this utterly barren wasteland.

Guards lounged in the scant slices of shade offered by the big cooling towers. A pair of helicopters roared by: gunships, Pavel saw, manufactured in Soviet Russia.

We're in the middle of the Libyan army, he told himself. If anything goes wrong with our operation, we'll never get out alive. Then he recalled that even if they got back to their base camp, Hassan and his zealots were waiting there with sharpened knives.

Mavroulis spoke briefly with the captain, then turned to Kelly and Pavel.

"They've done their task," he said, in a low gruff rumble. "We're here. Now it's up to us. They will wait up here until 1500 hours. The APV will wait ten minutes more."

"Then let's get moving," Kelly said firmly.

"One thing," said Mavroulis, patting the rifle slung over his shoulder. "These guns are empty. They don't trust us with live ammunition."

Kelly glanced at Pavel, then said, "Just as well. We're not here to kill anybody."

Pavel thought, Kill or be killed.

They strode out across the roof to a stainless steel dome, one of many glittering in the high sun.

"According to the plans, this shaft will lead you to the computer center," said Mavroulis.

Kelly nodded. No hint of nervousness now. She was all business and anxious to get started.

"Good luck," said the Greek.

They both glanced around. No guards could see them. Kelly bent over and wormed her lithe body through the gap between the steel dome and the concrete lip on which it was based. Pavel started after her, touched his hand against the metal and flinched with pain.

"Idiot!" Mavroulis growled. "The metal's been sitting in the sun all morning."

Wringing his hand, Pavel ducked through the air space and hesitated a moment to let his eyes adjust to the cool shadows. Kelly was already a dozen rungs down the metal ladder set into the shaft's walls. He hurried after her, the useless rifle slapping against his hip with every move he made.

They reached a horizontal shaft, all cool metal, barely big enough for each of them to crawl through. Mavroulis would never have made it, Pavel thought.

The shaft widened enough for Pavel to slink up beside Kelly.

"These guns are in the way," he whispered. "Let's leave them here and pick them up on our way back."

She nodded and wriggled the rifle off her shoulder. Pavel did the same. Then Kelly took a slim sheet of what looked like microfilm from her tunic pocket. From the other pocket she brought out a miniaturized reader and put it to her eye.

"Okay," she whispered, tucking them back into the tunic, "we're in the main air conditioning shaft. Two cross-shafts, and then we take the next left fork."

Pavel almost grinned at her darkened face. "I thought the Libyans didn't believe in air conditioning."

She was totally serious. "This isn't for their people; it's for their computer."

The shaft got narrower and Pavel had to slide back behind Kelly. He realized that no one bigger than himself or Kelly could possibly use these air shafts. They inched along like two moles in a tunnel. Pavel felt blind and helpless.

Finally Kelly stopped and motioned with the wiggle of one finger for Pavel to come forward. He had to climb over her body to bring his face next to hers: not altogether unpleasant, he decided.

Three centimeters in front of their faces was a mesh grill, apparently set high in the wall of a large room filled with humming computer consoles. Several men and women in civilian clothes were sitting at consoles. Two technicians in coveralls had the back of one unit off and were installing new circuit boards. All of them looked oriental.

"Minolta J-300's," Kelly muttered, so low Pavel knew she was talking to herself. "C models. They told us they'd have A models."

"Is that a problem?" he whispered into her ear.

"Maybe. Maybe not."

Kelly wormed a hand down toward her right boot and pulled out a slim rod. Then she did the same with her left boot.

"You too," she whispered to Pavel.

Sure enough, his boots also carried a pair of concealed rods, about the thickness of normal electrical wire and not more than a dozen centimeters long.

"Okay," she said, "move back."

They inched along in reverse to a spot where a small side shaft branched away from the shaft they were in. Wordlessly Kelly took Pavel's two rods and wormed herself into the shaft. It was barely big enough for her shoulders to squeeze into. Pavel watched her slowly disappear into the tunnel, like a creature being swallowed by a snake, until only her booted feet remained outside.

After several minutes she started wiggling her feet. Pavel grabbed at her ankles and pulled her free.

Kelly was gasping. "Thanks. I got stuck in there. Damned plans said it was wide enough—but just barely."

"Those rods . . ."

"Knockout gas. It's circulating through the air conditioning vents now. Give it a couple of minutes."

"But won't we . . ."

She shook her head. "It's a nerve gas. Dissipates before it reaches us." Then, with a hard grin, "At least, that's what the specs claim."

They made their way to the grill again and saw that the people tending the computer had slumped over, unconscious. It took a few more minutes to remove the grill, but finally Pavel swung it open and lowered himself gingerly to the floor of the computer room.

He took a deep, testing breath, then reached up to help Kelly down.

"How long will they remain unconscious?" he asked.

Heading straight for the central console, Kelly said, "Until we spray them with the antidote."

She sat at the console, pulled a hand-sized computer from her waistband, and placed it on the desktop beside the keyboard. Unconsciously, Kelly flexed her fingers, like a virtuoso confronting a new piano for the first time.

Pavel looked around at the bodies strewn across the floor, and the single featureless door that apparently was the only way into or out of this computer center—except for the air shaft they had come through.

There were no surveillance cameras. Libyan security was concentrating on preventing anyone from penetrating from the outside; they did not think to observe what was going on inside their fortress. In the Soviet Union such laxness would never be tolerated.

"And what if someone tries to come in here?" he asked.

Without looking up from the display screen in front of her, Kelly said, "That's why you're here: to discourage interruptions."

He grunted.

Kelly's fingers were rapidly tapping across the computer keyboard. "Don't worry, Pavel," she said absently, her mind already absorbed on her task. "According to the information Hassan's people gave us, the routine around here is very strict. The soldiers don't bother the computer technicians. Actually, they're a little afraid of them."

Hassan again. Pavel paced the floor nervously, stepping around the bodies. They seemed dead. Totally unmoving. If they were breathing, it was very hard to detect. He thought about trying the pulse on one of them, but could not bring himself to touch any of the inert bodies. What if they are dead? It's not my fault. What if Hassan's fanatics kill these mercenaries? Kelly and Mavroulis and Barker, waiting for us back at the camp.

That was a different matter. Pavel could not pass it off so easily. Or at all.

"I see your reflection in the screen here every time you waltz by," Kelly complained. "Go find a console and sit. I'll put some TV on the screen for you."

Sighing with impatience and frustration, Pavel took an empty chair at one of the many consoles flanking the central position where Kelly was working. The main screen suddenly lit up with an outdoor scene in some city where the sun blazed down on whitewashed houses and low flat roofs, glittered off towers of glass and steel, danced across waves of the sea far in the background.

"That's Tripoli," Kelly called to him. "You can watch Rayyid and the ceremonies for the opening of the aquifer facility."

Pavel fidgeted in the chair.

"Put on the earphones. I'll pipe you an English language broadcast."

Slipping on the lightweight headset, Pavel heard a cultivated BBC voice describing the scene he saw on the display screen. The voice droned as the camera panned across sun-drenched Tripoli and its harbor, then cut to the outdoor stage where Qumar al Rayyid, the president of Libya and commander-in-chief of its army, would press the button that would

start the water flowing from the aquifer, hundreds of kilometers away, to the symbolic fountain in the center of the main square of Tripoli's government center.

"At precisely 1500 hours," the broadcaster's cultured voice explained, "that fountain will begin to flow with water that was put down into the ground a hundred thousand years ago."

Fifteen hundred hours! The words seared through Pavel's mind. That was when they were supposed to be back on the roof, heading for the tractor that would take them back to the desert camp.

Pavel tore the headset off and wheeled his chair across the concrete floor to Kelly.

"Rayyid's going to start the water flowing at 1500!"

Almost annoyed at his interruption, she shot him a quick glance. "I know."

"But that means the water must begin flowing hours sooner, doesn't it?"

Kelly took her hands from the keypad, flexing her fingers as if they had gotten stiff. "The water's already filling the underground aqueduct," she explained. "They've tested the system, for god's sake. When Rayyid punches the button, the pumps here start up again and begin drawing water. The fountain spurts and everybody in Tripoli cheers —if you don't stop getting in my way."

Pavel pushed his chair back slightly.

"It takes a lot of time and concentration to reprogram their computer," Kelly said, half apologetically. "We don't want them to know there's been any interference. It's got to look like they screwed it up themselves."

Pavel could not stand it any longer. "Hassan is a traitor," he blurted.

With obvious patience, Kelly replied, "We know. When Rayyid's water scheme collapses, Hassan will lead the *coup d'etat* that topples him. Then the French sell him fusion-powered desalting systems so that Libya can convert Mediterranean water for irrigation and drinking, and leave the aquifer alone." She turned back to the computer.

"No!" Pavel grabbed her by the shoulders and made her pay attention to him. "Hassan is a traitor to us! His people are religious zealots. They plan to kill you all when we return to the camp."

Kelly's brown eyes showed no trace of fear. Only sudden suspicion. "How do you know?" she whispered.

"I am a Soviet agent, remember?" Pavel answered bitterly. "They assured me that I would be spared."

"Then why are you telling me?"

"Because I don't want you killed! I love you!"

Kelly's head snapped back as if she had been struck in the face. "You . . . what?"

"It's a trap," Pavel insisted. "I don't know what Hassan's game is, but he intends to kill you once we get back to the camp."

"You love me?"

"Yes!"

Kelly grinned at him, half suspicious, half pleased. "We'll have to talk about that later."

"What are we going to do? Hassan . . ."

"First thing we've *got* to do is finish reprogramming this Japanese monster."

"But . . ."

"First things first," Kelly insisted. And she turned back to the keypad.

Pavel watched her for a few moments, then went back to the console where the scenes from Tripoli were showing on the screen. But he could not sit still. He got up, paced the room. It seemed close and stuffy, despite the air conditioning. He felt sweat beading his lip and brow, trickling down his ribs.

He checked the bodies of the Japanese technicians. They were alive, breathing slowly, regularly. What will happen to them? he wondered. Will they be blamed for the malfunctions Kelly is programming into their computer?

Somehow Pavel found himself at the one door leading out of the computer center. It was solid steel, like the hatch of a weapons bunker, and locked by an electronic combination lock. He could not get out that way even if he wanted to.

Hours dragged by. More and more he watched Kelly, her intent, utterly serious face reflected in the green-glowing display screen, her fingers flicking across the keys. The computer hummed softly as she worked it, and Kelly herself kept up a low-key obbligato of muttered curses and imprecations, alternating with soft crooning sounds, as if she were trying to soothe an infant to sleep.

On the TV screen Pavel saw a huge crowd jamming the square in Tripoli. Color everywhere, from the bright hues of the throng to the long billowing draperies hung from the public buildings, displaying the red, white and black colors of the socialist republic of Libya. There were plenty of deep green banners, too, the color that the desert-dwelling Arabs love most.

The stage where Rayyid would make his appearance was covered against the sun with brightly striped tenting. A slim podium, decorated with gold leaf, stood at its center, with a conspicuous red button atop it. The fountain in the center of the square was a modernist's nightmare of concrete and shining metal, all angles and thrusting arms, like an explosion in a steel yard.

If Kelly understood that their lives were in greater danger with every tick of the clock, she gave no sign of it. She continued to work smoothly, unhurriedly, at the computer console. Pavel glanced at the digital clock set into his console: 1420. Only forty minutes to go.

To go where? he asked himself. There was no answer.

Each change in the red numbers of the clock was an endless agony. To keep himself from going to pieces, Pavel put the headset to his ear once again, and listened to that imperturbable BBC voice while his guts churned and his mind kept shouting for him to do something, to move, to act, somehow to get himself and Kelly to safety.

But he sat, forcing himself to passivity, as Kelly plodded away at her task. He watched as the grandstand filled with dignitaries from thirty nations—including France and some of the others who were paying Alexander—wearing frock coats or dashikis or modern jackets, as their native customs required.

Fourteen-forty. The crowd began to surge and even the BBC announcer's voice took on a keener edge as a military parade, led by six armored cars exactly like the one Pavel and his companions had ridden, made its way down the cen-

tral area of the square and assembled, rank upon rank, before the stage where Rayyid would speak. The soldiers, each armed with an assault rifle, were more than mere decorations, Pavel knew: they were both a visible symbol of his power and a Praetorian Guard that shielded Rayyid against those who would strike at him.

A cool voice from the back of Pavel's mind reminded him that the Praetorian Guard of Rome often dispatched emperors who displeased them and put new men in their place. Were these troops loyal to Rayyid, or Hassan? Such grasping for power was the sign of a decadent capitalist society, not a true socialist republic. These Libyan barbarians sully the name of socialism, Pavel thought.

At last the crowd roared, the assembled troops snapped to attention, and the dignitaries rose to their feet. Rayyid was making his entrance, preceded by a phalanx of Arabs in rich robes and burnooses, then a squad of military officers in green and gold uniforms.

Finally Rayyid himself appeared, to the tumultous uproar of the crowd. They shouted his name, their voices blending into one gigantic swell of sound, crashing like waves on a rocky headland:

"Ray-yid, Ray-*yid*, Ray-YEED!"

He acknowledged their cheers with upraised hands. He smiled at his people. He wore the heavily-braided uniform of a general, with dark glasses shielding his eyes from the sun's glare. Pavel was shocked to realize how much he looked like Hassan. The two could be brothers.

The crowd silenced as if a regiment of guns had been levelled at them. The dignitaries resumed their seats. Rayyid stepped up to the podium. No microphone was visible, but his amplified voice boomed across the square.

Another BBC voice began translating Rayyid's speech. Pavel looked down at the digital clock: 1454.

Throwing down the headset, he went to Kelly. She was still tapping at the computer keys.

"There's only six minutes!" he urged.

Kelly smiled up at him. "Relax. Don't you want to see what happens in Tripoli?"

"But we've got to get out of here!"

"We will. Lots of time."

"But you're not finished . . ."

"I finished up the main task twenty minutes ago. Now I'm planting bugs in their system that'll take them months to find and de-bug. I also patched into their comm system and sent a message to my father, via satellite. Let him know what you told me about Hassan."

"And?"

"No return message," she said. "Too risky."

"Too risky? For whom?"

But Kelly looked past him and said, "Hey, Rayyid's going to push the button. Come on, I wouldn't miss this for anything."

The two of them went to the screen displaying the TV broadcast. Rayyid had worked himself into a fine oratorical frenzy; the BBC translator was having a hard time keeping up with him:

". . . and this will prove to the world that Libyan technology and the will of the Libyan people is the equal of any nation on Earth! For we are a powerful nation, feared by our enemies! Let the nations of the world watch with awe as we enter a new era of prosperity! Let our enemies gnash their teeth with envy

as the water of life flows—at my command!''

He punched the big red button on the dais with his closed fist and the camera pulled back to the elaborate fountain in the center of the square.

Water spurted from it and the crowd went *Ahh!* The water leaped high into the air, sparkled briefly in the fierce afternoon sun, and then faltered and stopped.

The crowd murmured apprehensively. From somewhere deep in the concrete building where he stood, Pavel could hear the dull thunderous roar of gigantic pumps laboring.

Rayyid waved a hand at the crowd, as if to tell them not to worry, and smacked the red button again.

A dribble of water at the fountain's openings, where streams should have shot twenty meters into the air. Then even that stopped.

Rayyid pounded the button, his face contorted with anger. Nothing.

Pavel heard the pumps whining and screeching now.

''What did you do?'' he asked.

''Reversed 'em,'' she replied sweetly. ''They'll burn themselves out in another couple of minutes. It'll take weeks before they find the instructions in the programming. Drive 'em nuts!'' She laughed.

The digital clock said 1501.

''We've got to run,'' Pavel said.

''Yeah. They'll be battering down that door in another minute or two.'' She pulled a tiny aerosol can from her belt and quickly sprayed it over the unconscious bodies of the Japanese technicians.

Pavel boosted her up to the ventilator screen, then stood on a chair and hauled himself up into the shaft. It took a few moments to place the screen back in its mounting. Pavel could see the technicians beginning to stir. The lights on the door lock's keyboard were flashing; someone was trying to get into the room.

''Come on,'' Kelly said. ''We've got to make tracks.''

They wormed their way through the shafts and at last came out onto the rooftop, blazing hot in the high sun. Mavroulis was there, sweating and wild-eyed with the jitters.

''We've only got three minutes . . .''

Kelly grabbed his arm as they raced down the stairs toward the APV. Its engine was already rumbling, sooty diesel fumes belching from its vertical exhaust pipe.

Soldiers were dashing everywhere. Helicopters criss-crossed the air above. Orders were being shouted. Confusion ruled while the massive building seemed to vibrate as if a mini-earthquake had seized it. Black smoke was pouring from two of the four cooling towers.

They ducked inside the oven-hot vehicle and the driver gunned the engine, slamming them into the metal bulkhead before they could take their places on the padded bench. They lurched toward the gate in a spurt of sand and diesel exhaust. The compartment stank of human sweat and machine oil, and the fumes from the engine.

No one said a word as they approached the gate. The officer up front with the driver waved a laminated pass at the guards and they shot through, barely slowing in the process. The same at the outer perimeter, and then they

were out in the desert, heading back for their camp.

"Do you speak Russian?" Pavel asked Mavroulis.

"No," he said, beetling his dark brows. "Do you speak Greek?"

Casting an eye on the two soldiers on the opposite bench, Pavel asked Mavroulis, "What languages do you speak?"

"English, French, German . . . and Greek."

Pavel understood some French, but he was afraid the Libyan soldiers did, too.

Kelly pulled the pocket computer from her sweat-stained uniform. "This computer has a translator function," she said. "It's slow, but it includes most Indo-European languages."

She tapped the keys and the tiny display screen showed: NO TRANSLATOR. BUT WE CAN TALK.

The soldiers watched them tapping on the computer keys, but quickly lost interest. One of them got to his feet and opened the turret hatch. The armored compartment filled with hot sandy desert wind.

Using the computer's tiny display screen, Pavel told Mavroulis that Hassan's camp was a trap. Kelly added that she had sent the information to her father. But they had no way of knowing whether Alexander had received the transmission, or what he could do about it—if anything.

Mavroulis's thick, blunt fingers pecked at the keys: MUST GET BARKER. ONLY HE CAN FLY HOVERJET.

Kelly tapped: HOW???

WE NEED WEAPONS, Pavel typed, with one finger.

"Fine," grumbled Mavroulis. "What are you going to do, ask them?" He glanced at the bored soldier lounging opposite them.

NO VIOLENCE, Kelly typed, UNLESS UNAVOIDABLE.

Pavel took a deep breath. This was not a situation that would be resolved by delicate sensibilities or strategic arguments. This situation called for action.

"It is unavoidable," he muttered.

Kelly began typing something more, but Pavel stood up and stretched his arms as far as possible in the confines of the oven-hot compartment. His back felt all right. It only took a single step to put him in front of the soldier, who now looked up at Pavel.

One lightning-fast chop at the boy's neck and he sagged back against the armor plating, unconscious. The soldier up in the turret did not notice anything. Neither did the two men up front.

Pavel quickly took the pistol from the youngster's holster. It was a nine-millimeter Skoda, manufactured in Czechoslovakia: simple and reliable, though not very accurate at farther than fifty meters. No matter. Pavel was familiar with the gun. He felt better as he hefted it in his right hand.

Mavroulis got to his feet as Pavel reached toward the soldier standing in the turret and tapped him on the back. He ducked down and turned face-to-face with the muzzle of the pistol. Pavel smashed the gun barrel against the soldier's temple. Mavroulis caught him in his arms.

The captain turned to see what the commotion was and Pavel leveled his pistol at him.

"Stop the car," Pavel commanded.

Wide-eyed with surprise, the captain did as he was told. Pavel had him and the driver haul the two unconscious soldiers out onto the sandy track.

"You can't leave them out on the desert!" Kelly objected.

Pavel threw a pair of water cans to them. "They can walk back to the camp. It's only a few kilometers now."

Kelly looked doubtful, but Mavroulis slammed the APV's rear hatch, then hunched forward and took the driver's seat. With a grinding of gears he lurched the vehicle into motion. Pavel climbed up into the turret. Twin twenty-millimeter machine cannon and half a dozen boxes of ammunition. Now they could defend themselves.

But Kelly was still shaking her head when he ducked back into the rear compartment.

"We're hundreds of miles from anyplace safe," she said. "Hassan has at least one armored car like this one, plus who knows what else."

"We can fight," said Pavel.

"Hassan's also got Chris. And the plane. We need them both—unharmed—if we expect to get out of here."

Knowing she was right, Pavel replied merely, "It is better to be armed and prepared to fight than to go like a lamb to the slaughter."

Kelly said nothing.

Late afternoon shadows were lengthening as their vehicle topped a low ridge and Mavroulis shouted over the engine's clattering roar:

"There's the camp."

Kelly jumped up from the bench and wormed into the right-hand seat up front in the cab. Pavel stood at the hatch behind her and Mavroulis, clinging to the baking-hot hand grips on either side.

Half a dozen APVs were parked around the camouflage netting that covered the hoverjet. And several low black tents had been pitched some distance away, swaying in the hot breeze.

"Hassan's gathered quite a welcoming committee," Mavroulis growled.

"We can't fight our way out of this," said Kelly.

Pavel felt a strange hollownesss in his middle. His legs trembled. Fear! Something deep inside him was screaming at him to run away, to dig a hole and hide where none of these enemies could find him. His mouth went dry, his throat raw. He gripped the metal bars on either side of the hatch so hard that his fingernails were cutting painfully into the flesh of his palms.

Mavroulis slowed their vehicle, but kept moving ahead toward the hoverjet. A phalanx of soldiers in sand-tan fatigues fell in on either side of them. Each man was armed with an assault rifle or an armor-piercing rocket launcher.

Pavel climbed up into the turret and swivelled the guns around. A hundred rifles and antitank launchers pointed straight at him.

"You'll get us killed!" Kelly screamed at him.

He looked down at her terrified faace. "Better to let them know that we will fight. Better to die like soldiers than as prisoners of these savages."

Mavroulis slammed on the brakes and killed the engine. They were parked twenty meters from the edge of the netting that covered the hoverjet. From his perch in the turret Pavel could see that the plane was undamaged.

For agonizingly long moments no one moved or said a word. The only sounds were the pinging of the diesel's hot metal and the distant flapping of bedouin tents in the desert breeze.

Colonel Hassan stepped out from behind the ranks of his arrayed soldiers. One of the berobed Arabs was at his elbow, pointing up toward the turret.

"You are the Russian?" Hassan called.

"Yes," said Pavel.

Hassan smiled pleasantly from behind his mirrored glasses. Once again Pavel thought that he looked enough like Rayyid to be the man's brother. It is the uniform, he told himself. But still the resemblance was uncanny.

"You may come down and join us now," said Hassan. "You have done your work well. You have nothing to fear from us."

"And the others?" Pavel demanded.

Hassan's smile broadened. He shrugged his epauletted shoulders. "They will be dealt with. My bedouin friends have prepared a proper ritual for them."

Very slowly, Pavel was inching the twin guns toward Hassan. He stalled for time, trying to think of something that could break the stalemate in his own favor.

"The pilot?" he called to Hassan. "The Englishman?"

"He tried to escape. The bedouins had to restrain him—in their own way."

The colonel snapped his fingers and there was a stir from behind the ranks of soldiers. Two Arabs dragged a half-conscious Barker forward and threw him to the ground at Hassan's feet. The Englishman's legs were covered with blood; his face battered and swollen.

"It is traditional to hamstring a prisoner who tried to run away," Hassan said calmly.

Pavel heard a gasping sob from the APV's cab, below him.

"Come now," said Hassan impatiently, "come out of the vehicle and let us treat the other two infidels to their reward."

"No," said Pavel, training the guns a bit closer to the colonel's hateful smile.

The smile vanished. "What do you mean?"

"I mean that my orders are to bring these prisoners to Moscow. My superiors have their own plans for them."

Hassan's face hardened. "I was not informed of that."

"Those are my orders," Pavel insisted.

"And how do you propose to take these prisoners away from here?"

Speaking as the ideas formed themselves in his mind, Pavel replied, "You will provide a pilot to fly this aircraft to Tripoli. I will present the prisoners to the Soviet embassy there. The KGB will know what to do with them."

Hassan snorted. "Impossible! Tripoli is a battlefield now. My brother is fighting for his life against my army contingents."

So they are brothers, Pavel said to himself.

"Then fly us to Tunis or Cairo. There are Soviet embassies in either capital."

Hassan hesitated.

"You may keep the hoverjet as proof that foreign agents tampered with the aquifer system, if you like," Pavel said. With a sudden inspiration he added,

''or destroy it so that no one will be able to link you to the sabotage.''

''There must be no trace of these foreigners,'' Hassan insisted. ''No word of this operation must ever leak out.''

Pavel made himself laugh. ''The only thing that leaks out of the KGB is the blood of capitalist dogs.''

''I have no pilot here,'' Hassan said.

''Call for a helicopter from the aquifer complex,'' said Pavel, recognizing a stall. ''We will remain here.''

''You would be more comfortable outside that cramped vehicle.''

''We will remain inside.'' Pavel nudged the guns the final few millimeters so that they were pointing directly at Hassan. ''And I suggest that you remain where you are, also.''

The colonel paled momentarily, whether from sudden fear or anger, Pavel could not tell. But then he put on his smile again and reached inside his tunic for his gold cigar case. This time he had to light his own cigar; none of the soldiers or bedouins stirred from where they stood.

''Very well,'' Hassan said at last, exhaling thin gray smoke, ''I will send for a helicopter.''

He turned to the lieutenant nearest him and spoke swiftly in Arabic.

For nearly fifteen minutes they all waited: Pavel with his fingers on the triggers of the machine cannon; Mavroulis and Kelly sweating down inside the APV cab; Hassan smiling and puffing and chatting with the sycophants around him; the Libyan soldiers grouped around the APV, ready to fire into it at a word from their leader.

Barker lay on the sand, unmoving, his legs crusted with blood, his eyes swollen shut.

The sun sank lower. Shadows lengthened. The desert wind sighed.

And Pavel heard, far in the distance, the faint throbbing sound of a helicopter.

None of us can fly a helicopter, he knew. Perhaps Barker could, but he is in no condition to try. We will have to let the pilot actually fly us to Tunis and try to make a rendezvous with Alexander there.

If the pilot is actually going to fly us to Tunis, he added fearfully. If Hassan has not cooked up some deal of his own to land us in his own territory. Even if he believes my fairytale about Moscow, he could easily claim that our helicopter crashed in the desert and we were all killed. Moscow will never question him.

The helicopter materialized in the yellow desert sky, a massive ungainly metal pterodactyl hovering overhead, its engines shrieking, rotors thrumming, blowing up a miniature sandstorm as it settled slowly on its wheels. It was huge, one of the giant heavy cargo lifters built in the Soviet Union. Pavel almost smiled at the irony.

It took several tense minutes for them to get Barker aboard and strap themselves into the bucket seats lined along one wall of the helicopter's barnsized cargo bay. Hassan watched carefully, puffing his slim cigar, a satisfied little smile on his lips.

We're not going to Tunis, Pavel realized as the ship lifted off the ground. All I've done is delayed Hassan's fun by a couple of hours.

But two women in white nurse's uni-

forms came down from the flight deck and began tending to Barker. Neither of them looked Arabic; one was a blonde.

Then Cole Alexander clambered down the metal ladder from the flight deck, grinning his crooked sardonic grin at them. Kelly leaped out of her seat and wrapped her arms around her father.

"Ohmygod am I glad to see you!" she gasped.

"Likewise," Alexander said. "Good work, all of you. 'Specially you, Red. You used your head back there."

Pavel was speechless. Mavroulis leaned his head back and laughed maniacally.

"I knew it!" The Greek roared. "I knew you had a backup for us!"

Detaching himself from Kelly, Alexander squatted cross-legged on the cargo bay's metal flooring. His daughter sat beside him, facing Pavel and Mavroulis.

"I knew Hassan was a double-dealing sumbitch," Alexander said, almost apologetically, "but he was the only sumbitch we had to work with. Like my dear Uncle Max used to tell me, 'When they stick you with a lemon, make lemonade.' "

"You expected him to try to kill us?"

"No, he surprised me there. I expected him to take you prisoner and hold you hostage until his fight with Rayyid was settled."

"His brother," Pavel said.

"Yep, they're siblings." Alexander made a sour face at the thought, then went on, "The way I figure it was this: We screw up Rayyid's aquifer project. Hassan and his army people pull their *coup d'état* while the Libyan people are still stunned at Rayyid's flop with the water project. Hassan holds you four as his trump card. If he wins, you go free. If he loses, he can offer you to Rayyid in return for his own life."

Kelly said, "But instead he decided to remove all evidence of sabotage."

"He must be damned confident he'll beat Rayyid," Mavroulis muttered.

"He's probably right," Alexander said.

"But you had a backup plan for us, nevertheless," said the Greek.

Alexander's sardonic smile came out again. He looked down at his daughter, then his gray eyes locked onto Pavel's.

"Wish I'd really been that smart," he admitted. "I did have this old Russkie chopper and a medivac team ready, just in case. And when I got Kelly's message—Pavel's warning, actually—I flew this bird as close to Hassan's camp in the desert as I could."

"Damned good thing you did," Kelly said.

"Yeah, but then I was stuck. I couldn't go flying in there with the four of you surrounded by trigger-happy Libyans and fundamentalists. I needed some excuse to come chugging into their camp. Pavel provided the excuse. When Hassan radioed for a chopper to take you guys to Tunis, I got my chance."

"You see?" Mavroulis said, thrusting a blunt finger under Kelly's nose. "I told you to keep quiet and not interfere! I was right!"

Kelly nodded glumly. "You were right, Nicco."

"She wanted to shoot you when you said you were going to turn us over to KGB," Mavroulis said to Pavel. "I had to hold her down."

"You thought I would really do

that?'' Pavel's voice was weak with shock. He felt betrayed.

Kelly blushed, even under her dark makeup. ''You were damned convincing.''

''I had to be.''

Alexander interrupted. ''Damned good thing you were, Red. Otherwise my little girl here . . .'' His voice choked off. He put an arm around Kelly's shoulders and hugged her to him, as if to make absolutely certain that she was with him and safe.

''Hassan was actually going to fly us to Tunis?'' Pavel asked.

''Those were the orders he radioed,'' Alexander said. '' 'Course, they could always be countermanded once you were in the air.''

''Pavel,'' said Kelly, from the protection of her father's embrace. ''I'm sorry. You saved our lives, and I didn't trust you. I was wrong, and I'm sorry.''

Pavel nodded, his thoughts churning: I had told her that I love her, but that made no difference to her. No difference. She did not believe me.

''Well,'' said Alexander happily, ''all's well that ends well.''

''Except for Barker,'' said Mavroulis.

''He won't be able to walk for some time,'' Alexander admitted. ''But he'll be okay. If I have to donate a few tendons myself, we'll get him back on his feet.''

''What about Shamar?'' Pavel asked. His voice sounded harsh and hard, even to himself.

The others stared at him, their self-congratulatory smiles fading.

''Hassan claimed Shamar left Libya weeks ago,'' said Alexander, tightly.

''With the bombs?''

Alexander slowly shook his head. ''The bombs were not with him. He's got them stashed somewhere, but we don't know where.''

''We'll find them,'' Kelly said.

''We'll find *him*,'' her father growled.

Pavel looked into their faces. He saw smoldering hatred in Alexander's gunmetal eyes. In Kelly's he saw gratitude, perhaps even affection—but not love.

''I must return to Moscow now,'' he said. It is better, he told himself. I do not belong among these people.

But Alexander shook his head. ''You can't do that, Red. You haven't accomplished your mission. You're supposed to assassinate me, remember?''

Pavel shook his head. ''No jokes, please. I will return. . . .''

''The hell you will! You think we went through all this crap just to send you back to shoveling snow?''

''I don't understand. . . .''

Alexander took his arm from his daughter and reached out to clasp Pavel's shoulder. ''Red, my dear old Uncle Max used to tell me, 'Only a fool does anything for just one reason.' You could have fucked up this aquifer mission. You could have made Moscow very happy and gotten three of my best people killed. But you didn't.''

Pavel stared at the older man. ''You were testing me. My loyalty . . .''

''Damned right,'' Alexander said, grinning wider than ever. ''You did okay, and Moscow isn't gonna be very happy if you go home now.''

''I would be considered a failure,'' Pavel admitted.

''So stay with us! We can use a man with your skills and your smarts.''

"But Moscow . . ."

"Moscow wants you to keep an eye on me, right? I'll bet they're just as glad that Rayyid's on his way out. Hassan's the saner of the two. Besides, there's still Shamar and those damned nukes of his."

"You want me to stay?"

Mavroulis grumbled, "For a Russian, you're not so bad."

But Pavel was looking at Kelly. She glanced at her father, then turned to face Pavel.

"We want you to stay," she said, so low it was almost a whisper. "Like I told you back in the computer room—we have a lot to talk about."

Pavel would have preferred that she fling herself into his arms, but he nodded slowly at Kelly and her father. This was better than nothing. Moscow will be suspicious, he knew. I will be playing a very dangerous game; practically a double agent.

Kelly was smiling at him now. From the protection of her father's embrace.

"Very well," Pavel heard himself say. "I will stay."

"Great," said Alexander. "Now that *that's* settled, the next thing we tackle is these poachers in Rwanda. The bastards have nearly wiped out the last remaining free-living gorillas in the world. And Shamar was heading in that direction, according to my information. . . ." ■

Thomas Donaldson

THE FARTHER SHORES OF FUSION

Right now we're just on the threshold of controlling and using fusion. What will our descendants be doing with it a few centuries hence?

"For there are always hundreds of possible innovations lying dormant; sooner or later, it becomes a matter of urgency to call one of them to life."

Fernand Braudel, "The Structures of Everyday Life," *Civilization and Capitalism, 15th-18th Century* Vol. I, pp. 434-435

How will the 24th Century get its energy? What kinds of reactors will they use? What will these reactors mean for their users?

Fernand Braudel tells how in 1635, D. Schwenteer described an electric telegraph. Submarines go back to 1775. Jean Tardin in 1618 wrote about distillation of coal. Today's engineers have already invented the reactors of the future. But now they are only possible innovations, lying dormant. Sooner or later, they will come to life.

Today many countries support programs in fusion power generation. The front-runners are *Tokamak* devices and *inertial fusion*. More than physics goes into choosing these two systems. We seek devices to satisfy our immediate needs for energy. We grasp whatever devices come first. The Solar Economy of the 24th Century will have very different energy needs.

The Dimensions of the Problem

Current analyses of energy needs use

a special unit, the *quad*. One *quad* equals about 10^{21} joules. The entire Earth receives yearly about 52 quads of solar energy. All human civilization on Earth now uses about .3 quads/year. Our energy output has increased steadily over the last 400 years: from 1851 to 1950 we used a total of about 4 quads.

What could we *do* with more energy? Box 1 presents possibilities. Many science fiction stories assume regularly scheduled spaceship services to all major planets in the solar system. For interplanetary passenger transport *alone*, a Solar Civilization can easily use 1 quad/year, more than our total current energy use. We'll need even more. Ores will be uncommon in space and exhausted on Earth. We'll have to separate our materials from raw asteroid rock. We'll need more than .3 quads just to do this.

Heat pollution from energy release forces industry and power generation for *any* Solar Civilization into space. Even as little as .52 quads is 1% of the total energy received by the Earth from the Sun. Releasing .52 quads on the surface of the Earth may cause severe climatic problems. Generating and using our power off the Earth's surface avoids these problems. Large power stations will beam their power down to Earth (and other planets).

To a Solar Civilization, materials will be plentiful or rare based upon their solar abundance, not their abundance on Earth. Twenty years ago A.G.W. Cameron worked out a graph of the abundance of elements in the solar system

BOX 1: *What could we DO with more energy?*

1. *Interplanetary travel like air travel today*. Travel to Mars in 7 days needs an average velocity of 400 km/sec. If each spaceship is 50,000 metric tons mass, this means an energy of 8×10^{12} megajoules/ship. If there is one major spaceport for every 4 million people, and each spaceport launches 200 ships per day, then for a total Solar System population of 10 billion people we get a total energy expended of 1.4×10^{6} quads/year. Even 20 launches per day implies 146,000 quads/year.

   Even if transport isn't by rocket, energy cost stays the same. If we somehow capture and reuse this energy, a loss rate of only 1% implies 1460 quads/year.

2. *Materials processing*. A Solar civilization will need more energy for refining. I'll estimate how much by the energy needed to separate rock into its elements. This requires about 4000 calories/gm. If every person uses, directly and indirectly, 10 metric tons/year, then 10 billion people need 1.6 quads for refining.

Energy use at these rates is orders of magnitude beyond our own. However, even if we only burn deuterium, the Sun will go out before we run out of energy.

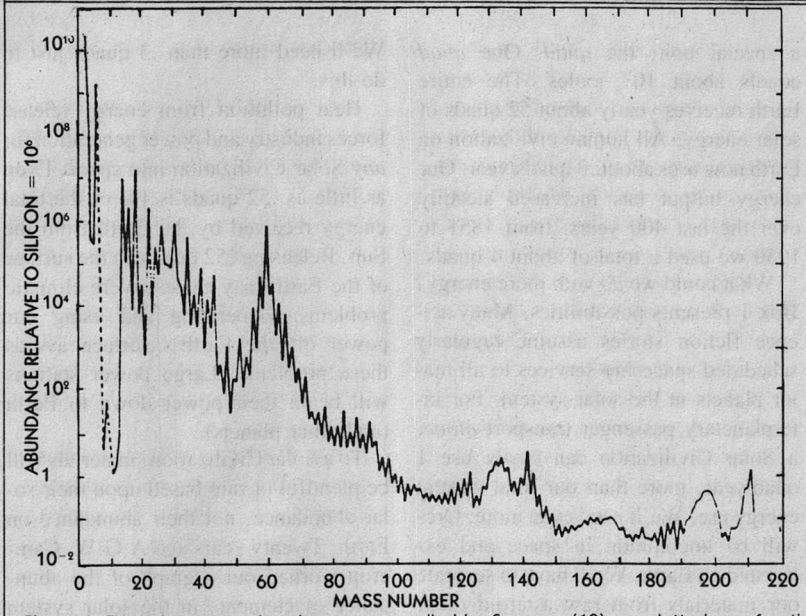


Figure 1: The solar system abundances as compiled by Cameron (10) are plotted as a function of mass number on a scale with silicon = 10^6.

By A.G.W. Cameron, "Elemental and Nuclidic Abundance in the Solar System," p. 32 of ESSAYS IN NUCLEAR ASTROPHYSICS (edited by C.A. Barnes, D.D. Clayton and D.N. Schramm) Cambridge University Press

(Figure 1). He discovered that about 80% of all atoms in the solar system are hydrogen. We see two major groups of heavy elements, the lighter elements such as carbon, oxygen, calcium, or silicon, and another less common set of elements centering about iron. We now use iron as a major structural material. But the other group is at least as important. It consists of many elements we ordinarily associate with living things. Wood consists mainly of cellulose, that is, only of carbon, hydrogen, and oxygen. These elements are at least ten times more common than iron. Calcium and silicon are at least as common as iron. Carbon, hydrogen, and oxygen are far more abundant in the outer solar system than they are on Earth.

The major structural materials of a Solar civilization will be: wood, bone, and steel, in that order. Yes, we'd make the wood and bone in highly modified form, not just grow it from trees. But chemically, we're talking about *wood*.

Furthermore, uranium is very rare. A glance at Cameron's chart convinces us. Fission reactors can't become very important power sources to a space-borne civilization. Hydrogen fusion, either in reactors or in the Sun, is the only viable source of power.

Nuclear engineers in a Solar civilization must face very different problems from nuclear engineers now. Let's see how their "ideal" power sources differ:

*NONPOLLUTING. Currently ideal fusion power must produce low levels of radioactive wastes. Many kinds of fusion power reactors produce high levels of neutrons. Others make copious *gamma radiation*. Reactor materials become radioactive. Radioactive pollution can't be a problem to a spaceborne civilization. Wastes can be sent on orbits out of the solar system or into the Sun. They can also be stored in orbit.

*ADVANCED FUELS. An "advanced fuel" power reactor burns nonpolluting fuels. Such fuels produce lower levels of neutrons. Two such fuels are ^{3}He-D and ^{11}B-H. Both ^{3}He and Boron are rare elements. Deuterium is about 16 times more common than ^{3}He. Boron is orders of magnitude more rare than either. Boron therefore doesn't look like a good fuel. However, we'll see that thought which has gone into finding ways to make p^{11}B reactors is far from wasted.

*HIGH POWER DENSITY. Currently, power density (power generated per cubic meter) directly relates to capital cost per megawatt. Any currently acceptable fusion power reactor must compete economically with fission and chemical reactors. But fusion is at a disadvantage. Fusion power reactors consist of plasma in a container. All their power comes through the reactor walls. Fission power reactors can draw power from their entire volume. Since any material wall can withstand only limited amounts of power, fusion reactors must work extremely well to match the power density of fission.

Every current power source on the Earth uses the Earth itself as its sink for waste heat. Designers don't have to worry about waste heat. But waste heat is *the* major form of pollution in space. In space we'll need radiators with areas increasing in proportion to the reactor's output power. Power density *will not* be important. Power output per unit area, though, will be a very important issue.

The true home of fusion reactors is in space. They easily surpass solar power in power output per square meter of surface. They need radiator areas only 20% of the collector areas for solar power plants of the same output, even assuming 100% efficient solar conversion [1].

*EFFICIENCY. On Earth we have no way to release heat at temperatures lower than the lowest Earth temperature. This limits efficiency of our heat engines. In space, outlet temperatures can be far less. At Pluto's distance from the Sun, simple engineering can reach efficiencies up to 95%. Such high efficiencies do require far larger radiators than present power plants, and corresponding capital costs. But it is not an option available on Earth.

Energy Transport

How we make energy is fundamental. But how we move it around is likely to cause the most *visible* impact. Trans-

former substations and high tension lines are now so common that they're invisible. Yet visitors from 300 years ago would probably find them overwhelming parts of the landscape.

Solar Civilizations transport energy at least three ways. First, transporting the hydrogen or deuterium fuel. Second, large power stations can produce concentrated fuels (such as ^{3}He) for transport. Finally, microwave beams can transmit energy substantially intact over distances of several AU. Box 2 sets out the relative merits of these three methods.

Box 2 tells us the most efficient form of transport in space is the transport of bulk hydrogen. This favors *small* power stations rather than large ones. Each station would be as close as possible to industries using its power. Engineers will try to maximize efficiency of smaller and smaller power stations. But for fixed technology, large power stations will always be more efficient than small. "Urban centers" will grow up around large power plants. Each city could contain many O'Neill cylinders or other space habitats, all physically connected. Very large, slow ships with small crews would bring hydrogen to its users.

When waterwheels were the main

BOX 2: *Options for energy transport*

1. *Transport of hydrogen fuel.* The energy needed is the change in kinetic energy to move an object from one orbit to another. Moving 1 gram of hydrogen from Pluto's orbit to Earth requires a velocity change of about 15km/sec and hence a kinetic energy change of 1.12×10^{12} ergs. Burning 1 gram of hydrogen in a Bethe cycle reactor releases a total energy of 6.4×10^{17} ergs. This means that only .001% of energy released has to go for transport.

2. *Transport of processed fuel.* The major problem here is energy loss through inefficiencies of processing. For instance, we could burn D + D to produce ^{3}He. Even if we attained 99% efficiency, we would lose 1000 times the energy lost by transporting fuel directly to its users. ^{3}He particularly may prove an important rocket fuel. Creating it is not an efficient source of energy.

3. *Microwave beams.* For microwaves with wavelength of 3 cm, we can transmit and capture 84% of the radiation over a distance of 1 AU with antennas about 100 km in diameter. The formula relating antenna size, wavelength, and distance of transmission is:

   d * D = 2.44 * L * s

   where d is the receiving antenna diameter, D is the sending antenna diameter, L is the wavelength and s the distance. Transmission over great distances is possible.

   A major use of microwave transmission is to avoid heat pollution in confined volumes (like planet surfaces).

power source towns grew up around waterfalls. The power station will be so important that the habitat itself may take its name from it.

Fuels and Reactions

Only three fuels are abundant enough. The most abundant, of course, is ordinary hydrogen. The next most abundant is deuterium, which is about as common as silicon. Finally ^{3}He is about 1% as common as deuterium. Reactions we'd use to burn deuterium and ^{3}He are already very well studied. Box 3 describes these reactions. Box 3 also tells about power economy. If D-D reactors become major power sources they'll also become major sources of ^{3}He and Tritium. Hence D + D, D + T, and ^{3}He + D reactors will go together.

But what about ordinary hydrogen?

First, deuterium contains lots of energy. Jupiter's deuterium alone contains about 9×10^{14} quads of energy. Fuel

BOX 3: *Some reactions we could use*

Only major reaction products are shown.

Deuterium reactions:

$D + D \longrightarrow T + p + 4.0$ Mev

$D + D \longrightarrow {}^3He + n + 3.25$ Mev

$^3He + D \longrightarrow {}^4He + p + 18.2$ Mev

$D + T \longrightarrow {}^4He + n + 17.6$ Mev

Nuclear engineers are looking at these for advanced fuel reactors now.

Boron reaction:

$p + {}^{11}B \longrightarrow 3\ {}^4He + 8.7$ Mev

Because boron is cosmically so rare, it's unlikely this reaction will be used.

Hydrogen burning:

$p + p \longrightarrow D + 1.44$ Mev (the proton-proton chain)

This reaction, and burning the deuterium resulting, is a major solar reaction. Unfortunately it's very slow.

Hydrogen burning (the Bethe cycle):

$P + {}^{12}C \longrightarrow {}^{13}N + 2.369$ Mev

${}^{13}N \longrightarrow {}^{13}C + 1.22$ Mev

$P + {}^{13}C \longrightarrow {}^{14}N + 8.06$ Mev

$P + {}^{14}N \longrightarrow {}^{15}O + 7.35$ Mev

${}^{15}O \longrightarrow {}^{15}N + 2.7$ Mev

$P + {}^{15}N \longrightarrow {}^{12}C + 5.28$ Mev

The Bethe cycle is the only way I know in which we could burn hydrogen ourselves.

exhaustion just isn't going to force interest in hydrogen fusion. Still, hydrogen is 6,000 times more common than deuterium. Mining it from Jupiter simply needs a large scoop. Mining deuterium from Jupiter requires separating it from hydrogen with which it is mixed. The primary reason to burn ordinary hydrogen is that it is cheaper.

Hydrogen will be the "advanced fuel" of a space civilization.

What reactions could we use? If hot and dense enough, protons react directly with one another. Most of the Sun's power comes from that reaction. But it's far too slow for us. We need to attempt the Bethe cycle (see Box 3).

Some Bethe cycle reactions are quite clean. The final reaction, $^{15}N + p -> {}^{12}C$, involves emission of a single energetic alpha particle. But all of the others make copious gamma rays. Intermediate isotopes like ^{13}N and ^{15}O are radioactive. They also create an engineering problem, since their half lives are several minutes. We'll need at least 4 different reactors to carry out the cycle. The $^{15}N + p$ reaction may become a major fuel source for space travel. Because the others produce so much gamma radiation and need time for their products to decay, they're good for static power reactors only. On the other hand, Bethe cycle reactions make relatively few *neutrons*.

Wood and Bone: Advanced Materials for Fusion

Economic power production in space depends on high *power production per square meter*. I'll call this factor *area density*. Some design problems go away if the scale is large enough. But we can't solve the problem of area density by scale alone.

Reactor walls must withstand extremely hostile environments. High levels of gamma radiation mean high temperatures from the heat generated. High temperatures cause creep (slow movement) of reactor materials. Neutrons form helium by transmutation, making voids and cracks, walls sputter from reaction debris. Reactor walls must also contain conductors and insulators. Their electrical properties must resist many hours of this environment.

All reactor power passes through these walls. Current materials can withstand about 1 MW per square meter for long periods. This erodes the walls about 1 cm/year. To increase area density, we must increase these survivability figures.

Stainless steels are currently the best materials for reactor walls. But we want to know the *ultimate limits* of materials rather than our current best. To find them, I'm not going to discuss metallurgy; I'll discuss materials existing in nature.

Current materials survive hostile reactor environments *passively*. We try to find materials so good that even after years of corrosion they still remain the same. This approach has fundamental limits. But there is another way. We can make materials survive *actively*, by self-renewal.

We already know many self-renewing materials. We call them *living things*. Living tissues differ radically

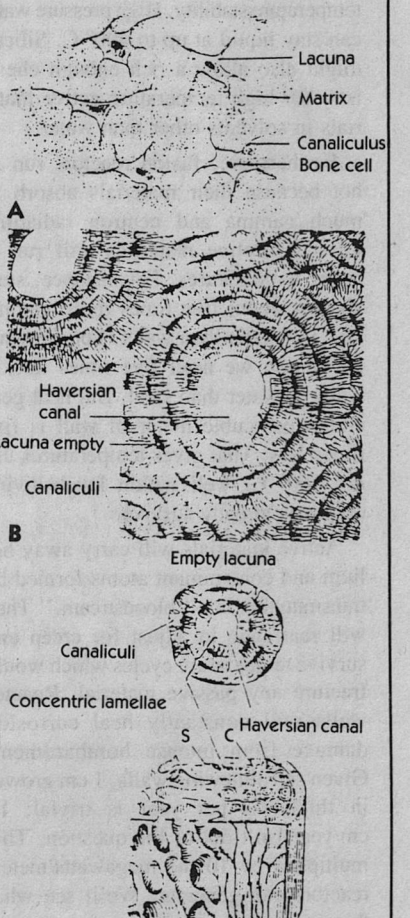
from our normal materials. They are wet. They have extensive vascular systems to constantly carry away broken down tissues and replace them with new tissues. Self renewing materials needn't depend on *water*, but they will need a liquid medium. Reactor walls demand high temperature stability, which most biological materials currently lack. On the other hand, biological materials consist of lighter elements H, C, N, O, very common in nature.

Let's give these speculations concrete form. We'll look at BONE. Bone consists of an interwoven matrix of collagen and hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$). Special cells (osteoblasts) grow more bone in response to stress and damage. Other cells (osteoclasts) can absorb bone to reshape it. Passageways contain blood vessels to bring in new structural materials and remove wastes, on a microscopic scale, to every bone crystal. As a composite material, its microstructure maximizes load-bearing ability in exactly those directions where the bone feels greatest stress. Figure 2 is an illustration of bone.

In 1986 the only active materials we know are living things. They prove that active materials *can exist*. But we must solve two problems: *high radiation resistance* and *high temperature resistance*.

Radiation resistance is easy: some bacteria *(Micrococcus radiodurans)* survive in nuclear reactors. They continuously repair radiation damage. High temperature is harder. Reactor materials may have to withstand up to 500° C. That's too much for active cooling to

Figure 2: Bone
Active, continuously self-repairing materials, with microstructure on molecular scales, *exist*. To show what's possible, here is a diagram of bone.



5.10 Bone: A, at high magnification; B, at lower magnification; C, spongy (S) and compact (C). (From King and Showers, *Human Anatomy and Physiology*, 5th Ed., W.B. Saunders Co., Philadelphia, 1963.)

help. However, some bacteria may normally thrive at the sea bottom in high pressure, 250° C water [2]. Their biochemistry uses many crosslinks for high temperature stability. High pressure water can stay liquid at up to 400° C. Silicon might also allow a rich enough chemistry for high temperature active materials in solvents other than water.

Furthermore, fusion reactors run so hot because their materials absorb so much gamma and neutron radiation. Less absorptive materials will run at lower temperatures. For instance, steel absorbs about five times more gamma rays per meter than water. For the same absorption we need five times thicker walls of water than steel. But heat generated per cubic meter of wall is five times less. That gives temperatures under 100° C, well within levels living creatures already survive.

Active materials will carry away helium and contaminant atoms formed by transmutation in a "bloodstream." They will rearrange to adjust for creep and survive temperature cycles which would fracture any passive material. Reactor walls will constantly heal corrosion damage from intense bombardment. Given self-renewing walls, 1 cm growth in thickness per year is trivial; 10 cm/year isn't out of the question. This multiplies by 10 the megawatts/meter^2 reactors can generate. We'll see what this means later.

Active materials can make other reactor parts too. Self-repairing electrodes could suppress sparking due to materials breakdown. Active insulators would retain their characteristics. We could use conductors themselves made of organic materials (like *polyacetylene*). Because H, C, N, O, materials allow a great variety of molecular structures, we can even hope for organic high temperature superconductors.

The idea of active materials with microstructure has grown slowly over many years. K. Eric Drexler in his book *(The Engines Of Creation)* gives a very good account of this topic, which he calls *nanotechnology*.

Conventional and Almost Conventional Reactors

Most current work on fusion reactors tries to solve contemporary problems. The leading reactor design in 1986 is the Tokamak. No one doubts Tokamaks will run, but the field of *possible* fusion reactor designs is far broader than Tokamaks. In fact, many authors have generated a fantastic variety of ingenious designs. But first, what can mainline fusion do?

Mainline fusion relies on the *Lawson criterion*. This states that fusion power production will occur if the product of density n and time of confinement t at a temperature T exceeds a fixed value. *Mainline* fusion seeks ways to keep a hot plasma with density n for a time t long enough. The threshold value n*t and temperature T of this "hot" plasma depends on the reaction. Current mainline reactors search for solutions in two ways:

1. High density methods. The leading method here is *inertial con-*

finement fusion. But some methods try to compress a plasma by one million gauss magnetic fields for brief periods.

2. Low density methods. Most forms of magnetic confinement fusion fall into this class.

Each method has its own problems. Low density methods are hard to carry out in practice because of the many ways in which hot plasmas can lose all their energy, especially when confined in magnetic fields. Once the plasma loses its energy, of course, it cools and the reaction goes away. It is hard even to find a way to heat the plasma hot enough in the first place. For high density methods the biggest problem is just getting a density great enough.

To generate power by low density methods we must solve three major problems. First, in a hot plasma the electrons collide with the nuclei. This causes them to radiate. Since density is low, the light passes through and the plasma cools. This process is called *Bremsstrahlung*. Second, electrons moving in a magnetic field are *accelerated*. They will therefore give off *synchrotron radiation*. Finally, impurities in the plasma cause it to radiate. This again drains away heat.

To make plasma hot enough to burn DT is very much within technological reach. But the DT reaction happens at relatively low temperatures. We need plasma 100 times hotter to burn DD. We need it even hotter for advanced reactions like $p^{12}C$.

Are there low density methods equal to this task? Yes, but perhaps only at the cost of great size. Even Tokamaks can burn pure deuterium if scaled large enough. Tokamaks 20 to 30 meters in radius (compared to 1 to 2 meters now), making 2,000 megawatts of power, could easily burn deuterium. Energy for a solar civilization is already available. Our question is not whether but how.

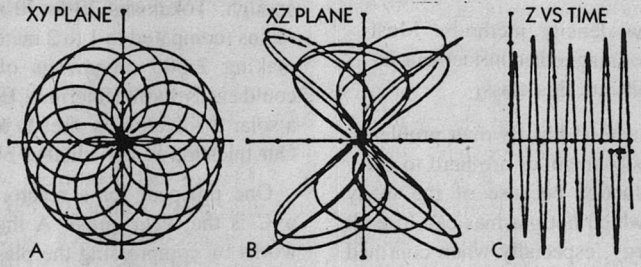
One prospect for a reactor burning $p^{12}C$ is the *theta pinch*. A theta pinch works by compressing the plasma with a sudden magnetic field. It also requires a very long thin reactor. Using standard scaling equations, theta pinch reactors several hundred kilometers in length could sustain $p^{12}C$ reactions. Other proposals are *mirror* reactors and the *multipole* reactor, which will create a magnetic "well" to hold reacting hydrogen. Unfortunately, relatively few studies of multipole reactors have been made [3]. Two even less studied alternatives are electrostatic confinement and confinement by high energy microwaves in a superconducting cavity [4], [5].

Evading the Lawson Criterion

Protons (hydrogen nuclei) repel one another. To cause fusion we must overcome this repulsion. The Lawson criterion only applies to attempts to use *high temperatures* to do so.

The *migma reactor* is another way. To force hydrogen atoms to fuse, they must collide at high velocity. Migma reactors are special accelerators maintaining constantly colliding beams of

Figure 3: The migma reactor
This figure shows the orbits of particles in a migma reactor field. The configuration forces particles to pass through the center, where they collide at high velocity but not high temperature.



From an article by B. Maglich, *Atomkernenergie*, Munich, p. 100, vol. 32

hydrogen (see Figure 3). "Migma" (from Greek for mixture) stands for the mixture of orbits these colliding beams follow. To keep them going, we have to constantly put in energy. The reactor makes power if we put in less energy than we get out.

Since energy to drive the fusion must come from the reactor itself, migma reactors can't lose too much energy due to inefficiency. They need an energy conversion efficiency between 50% and 70%. The classical migma reactor is intended to burn *boron* and *hydrogen*. This reaction produces charged particles only. We can convert charged particles to electric power at high efficiency. High efficiency conversion of gamma rays would let us burn $p^{12}C$. We'll see how we might do this later.

Secondly, we can try *catalysis* to bring the reactants together. One subatomic particle, the muon, can cause deuterium and tritium to come close enough to fuse, releasing energy. The reaction is very like chemical catalysis. Recently nuclear catalysis has looked more and more practical [6]. Unfortunately muons don't catalyze any other reactions. Still, we might find other particles, as yet unknown, to make power from other kinds of fusion.

Explosive Devices

Explosive devices are outlawed by treaty. However this treaty cannot last forever. Furthermore, compared to the energy to accelerate a spaceship to 1% of the velocity of light, thermonuclear bombs seem trivial. One way or other we'll have to get over our current attitudes to nuclear explosives.

Let's consider practicalities of fusion energy production by large thermonuclear bombs. Certainly it's easy to start such an explosion. Furthermore, even with uranium detonators large bombs

BOX 4: *Very large reactors*

Solar civilizations will need lots of energy. This need makes very large reactors practical.

For 99% efficiency in a proton burning reactor we can try to convert all the gamma rays into heat energy using a plasma. To do this, we surround the fuel with shielding. But too much shielding and its temperature isn't high enough. One safe figure is about .003 cm of shielding for 1 cm of fuel. I estimate we can get complete capture by compressing a 10 cm radius pellet with a .03 cm shield by a factor of 1000. These pellets contain about 400 grams of hydrogen. Since burning 1 gram of hydrogen produces 6.4×10^{17} ergs, a pellet yields 2.7×10^{20} ergs. If the reactor explodes a pellet every 10 seconds, it makes .004 quads/year.

With current materials withstanding 1 MW of energy per square meter, radius is 660 meters. Continuously self-repairing materials could withstand 10 MW/m^2 giving a radius of 330 meters. Conceivably they could withstand 100 MW/m^2 for a 66 meter radius reactor.

Compared to energy needs of a Solar civilization, .004 quad reactors are actually quite reasonable.

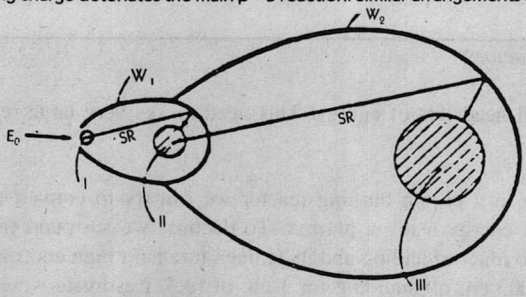
will release far more energy than uranium contains alone. They may even prove practical for spacebound civilizations, for which uranium will be a very rare metal. And efficiencies go up for large reactors. Box 4 sets out calculations on size of reactors exploding charges of 400 grams hydrogen, about 10 kilotons.

These figures are for deuterium reactors. How can we ignite $p^{12}C$? Perhaps more than anyone else, one physicist, Friedwardt Winterberg, has published many highly original ideas on thermonuclear explosives. He concentrates on *inertial confinement fusion*, how to cause fusion in milligram masses of hydrogen. But he also has highly original ideas on large bombs

Whether we do it on a small or a large scale, the principal problem to *advanced* reactions is how to make high enough compression and temperature. Here are some solutions:

1. Use compression and heating from one nuclear explosion to cause another. Winterberg presents a method to make $p^{11}B$ reactions take place with a series of staged nuclear explosions. Even though the first explosion isn't dense and hot enough, the next is better. The last pellet is dense and hot enough to

Figure 3A: shows an arrangement to detonate $p^1\ ^1B$ reactions with a T + D reaction. Blast from the priming charge detonates the main $p^1\ ^1B$ reaction. Similar arrangements should work for $p^1\ ^2C$.



F. Winterberg, "The Physical Principles of Thermonuclear Explosive Devices," *Fusion Energy Foundation*, p. 93, 1981

burn $p^{11}B$ (see Figure 3A). If we can do this with $p^{11}B$ reactions we can do it with $p^{12}C$ reactions too.

2. Special shapes of explosives can cause higher implosion velocities and therefore higher compressions. With properly shaped charges we could even cause thermonuclear reactions using chemical ignition alone! (Cf. Figure 3B).

Other scientists also propose interesting ideas to make inertial confinement work. Heinz Hora suggests using *antimatter* to compress and heat a fuel pellet. We would focus beams of antiprotons onto hydrogen pellets and the antiprotons would annihilate some of the hydrogen. This reaction would heat and compress the hydrogen fuel and start fusion. No one seems to have studied the potential of antimatter fusion in detail. Box 5 sets out calculations on its practicality.

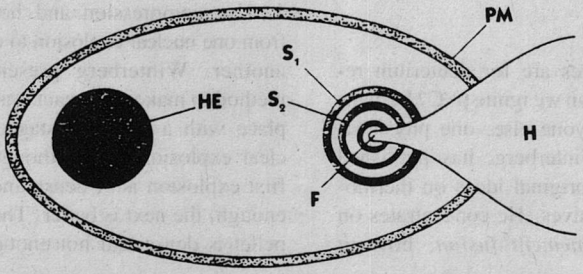
Energy Conversion Methods

Current power stations are *heat engines*. This means that they first create heat, then convert this heat into elec-

Figure 3B: Chemical ignition and the $p^1\ ^1B$ reaction

These diagrams illustrate Winterberg's ideas. Chemical explosive compresses multiple shells onto a thermonuclear fuse, which detonates a much larger charge of thermonuclear fuel.

The reaction works on principles of shaped charges. The explosive at one focus of the ellipse creates a detonation wave which compresses the multiple shells. High temperature black body radiation created by compression detonates the thermonuclear fuel.



From an article by F. Winterberg, *Atomkernenergie*, Munich, p. 85, vol. 32

BOX 5: *Practicality of antimatter fusion*

It costs energy to make antimatter. A 1 mg fuel pellet can produce 100 MJ of energy and requires 1 MJ energy for compression. If we deliver this energy by means of antimatter, we need a total efficiency of more than 1% for converting energy to antimatter.

DG Growe (JBIS 36 (1983) 507-508) presents one method using lasers which can theoretically convert up to 95% of the lasing energy into proton-antiproton pairs. Including the laser efficiency, we might hope for 10% total efficiency.

tricity.

Heat engines work like waterwheels. We can't get any more energy from a waterwheel than the difference between the original water height (the "head" of water) and its height after falling. Similarly, heat engines can't extract any more energy than the difference between their exhaust temperature (the radiator temperature) and their reactor temperature. Current power stations usually recover only 30% to 40% of their heat energy in electricity. The rest is waste. Space-based power stations would need enough radiator to dispose of 60% to 70% of the energy created.

We can try for higher efficiency by using the heat of the fusion reactor more directly. Since, after all, the reactor is at millions of degrees C, even heat engines ought to work with almost 100% efficiency (except for our lack of clever engineering).

The major way to use the heat of the fusion reactor directly is a magnetic piston. At millions of degrees C, hydrogen in a fusion reactor is stripped into separate protons and electrons. It becomes a *plasma* at high pressure. We can get energy from a high pressure gas by letting it expand against a piston. Because it is so hot, we can only hold the plasma in a magnetic field. But we can get energy from it by letting it expand against this magnetic field. The plasma pushes against the magnetic field, compressing it just like (far cooler!) gases compress a piston. We can make electricity from this compression. Fully worked out, patented methods to do this already exist [7].

Large enough reactors capture all their gamma and neutron radiation in high temperature plasma. We can use magnetic pistons to take energy from these plasmas. Fusion reactors can therefore increase efficiency with size, up to over 99%. For ordinary hydrogen fusion such efficiency requires reactors at least 10,000 times the power output of current power stations.

Smaller reactors which make electricity from heat energy will lose lots of their output in waste heat. But a fusion reactor first makes *gamma and neutron radiation*, not heat. Another way to try for high efficiency is to convert this radiation to electricity before it becomes heat.

We can directly convert gamma rays to electricity by using a physical process called *Compton scattering*. HIgh energy gamma rays will strike electrons, removing them from their corresponding atoms, losing energy, and scattering away from the atom at an angle. L. Wood and T. Weaver at Lawrence Livermore have proposed a design for multiple layers of material which would use this scattering to turn the gamma rays

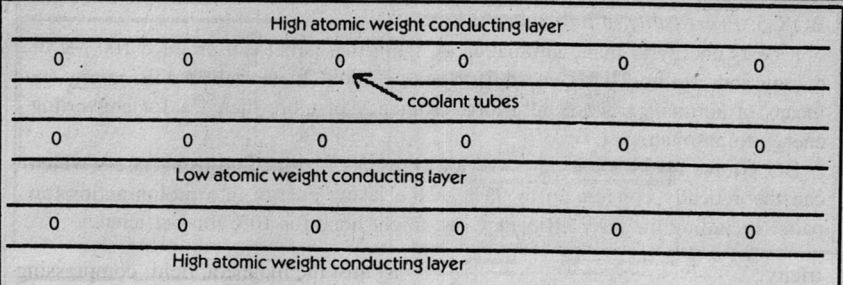


Figure 5A: Compton generators (primitive):
This diagram shows the Compton effect generator proposed by Wood and Weaver. The generator contains multiple thin layers of high atomic weight metal interleaved with layers of low atomic weight conductor. The Compton effect knocks electrons off the high atomic weight films. The low atomic weight conducting films capture the electrons. The potential difference generates power.

into electric power (see Figure 5A). Their calculated efficiency is 30% [8].

Secondly, we can try for high efficiency conversion of heat energy. Both gamma and neutron radiation easily pass through walls made of low atomic weight materials. They can then heat an inert gas outside. We can extract energy mechanically from this hot gas. One proposal by R.T. Taussig [9] consists of a chamber of hot working gas (2000 to 3000 degrees C) heated by gamma rays. The heated gas expands, compressing cooler gas of lower atomic weight. This mechanical process extracts energy with up to 75% efficiency (see Figure 6).

Active and microstructured materials have an undefined but very large potential for high efficiency conversion. Currently, most reactors use large masses of inert shielding to convert gamma and neutron radiation to low temperature heat. They then convert this heat into electric power with heat engines, which cannot operate at high efficiency because they exploit only a relatively small heat difference. However, when gamma radiation strikes matter it first makes free electrons and ionized molecules. These ionized molecules (called *free radicals*) are very toxic. Most life forms have extensive biochemical systems to make these free radicals into harmless chemicals. We can imagine biochemicals which convert these free radicals into chemically stored energy. Photosynthesis can convert (much lower frequency) light rays into chemical energy (ATP) with an efficiency of almost 40%. *Chlorophyll* transfers the energy of light into high energy electrons. A complex series of chemical reactions convert the energy of these electrons into stored chemical energy. Active materials might work like the Compton generator of Wood and Weaver but on a molecular scale.

If gamma rays have very high energy (> 1 Mev) they lose energy through another process, called *pair production*, instead of through Compton scattering. Pair production occurs when high energy gamma rays turn into a positron and an electron. The Wood and Weaver generator won't work with very high

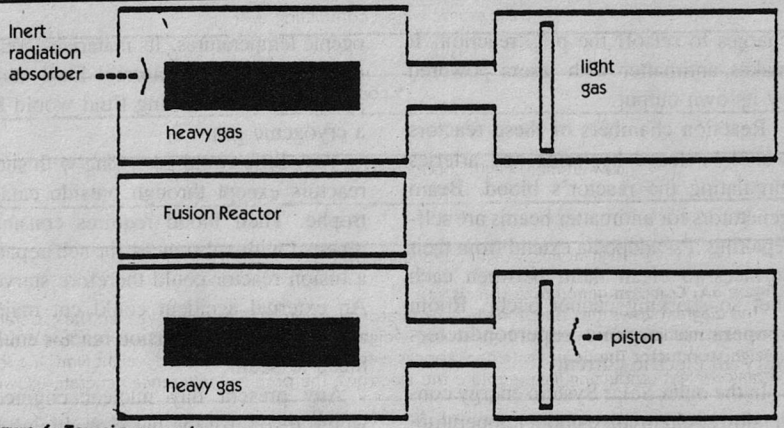


Figure 6: Taussig generator

Fusion reactor walls consist of low atomic weight organic conductors. Gamma rays pass through into a chamber lined with carbon and filled with inert high atomic weight gas like xenon. The heated xenon expands against a piston or membrane, compressing a second gas (helium). We extract energy from the compressed helium.

The diagram is schematic only, intended to explain how a Taussig generator works without giving an actual design. In [9] Dawson reports that Taussig developed a working model. His model verifies 75% efficiency of conversion.

energy gamma rays, but active materials might generate electricity from pair production too. An advanced gamma generator would operate in a wet mode, making electricity from free radical reactions on a molecular level rather than the gross mechanical level of the primitive Compton generator (See Figure 5B).

Power Reactors of the 24th Century

No more than today, of course, will we get our power all from the same source. So we'll have many different kinds of power reactors for different uses.

We could have migma reactors made of active materials. They burn $p^{11}C$. *Organic superconducting magnets* drive the colliding beams. The magnets absorb few gamma rays. They stay relatively cool even though high gamma ray flux passes through them. The reactor walls are laced by a very fine network of arteries and veins and maintained by a bloodlike substance. The gamma rays heat a cavity full of ionized gas and metal heating rods. The rods absorb gamma rays and heat up the surrounding gas. The expanding gas makes electricity. The conversion chamber lining is nonliving, but secreted by cells which constantly renew it much like seashells.

We can now imagine an inertial confinement reactor hundreds of meters in diameter burning $p^{12}C$. Its walls continually renew themselves and explodes a charge of $p^{12}C$ every second. Ignition happens through a sequence of successive explosions, started by chemical ignition of a T + D trigger. Another much smaller inertial reactor uses antimatter

charges to set off the $p^{12}C$ reaction. It makes antimatter with lasers powered by its own output.

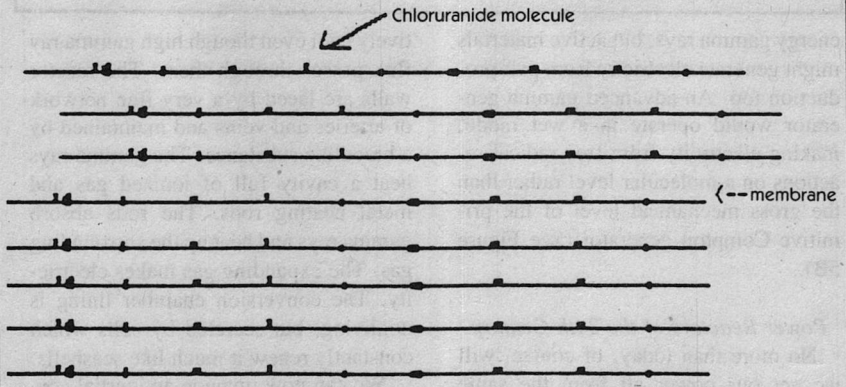
Reaction chambers of these reactors would be laced by veins and arteries circulating the reactor's blood. Beam generators for antimatter beams are self-repairing. Pseudopodia extend from their surfaces to clean them between each shot so sparking cannot occur. Room temperature organic superconductors carry all electric current.

In the outer Solar System energy conversion could involve outlet temperature as low as 120 degrees K. Radiators would be very large compared to the "hot" radiators of inner planets. Power conversion machinery works at cryogenic temperatures. Its materials would melt or vaporize at normal Earth temperatures. The working fluid would be a cryogenic gas.

Very little could go wrong with such reactors except through outside catastrophe. Their blood requires constant renewal with substances for self repair; a fusion reactor could therefore starve. An external accident could cut major arteries or veins. A fusion reactor could bleed to death.

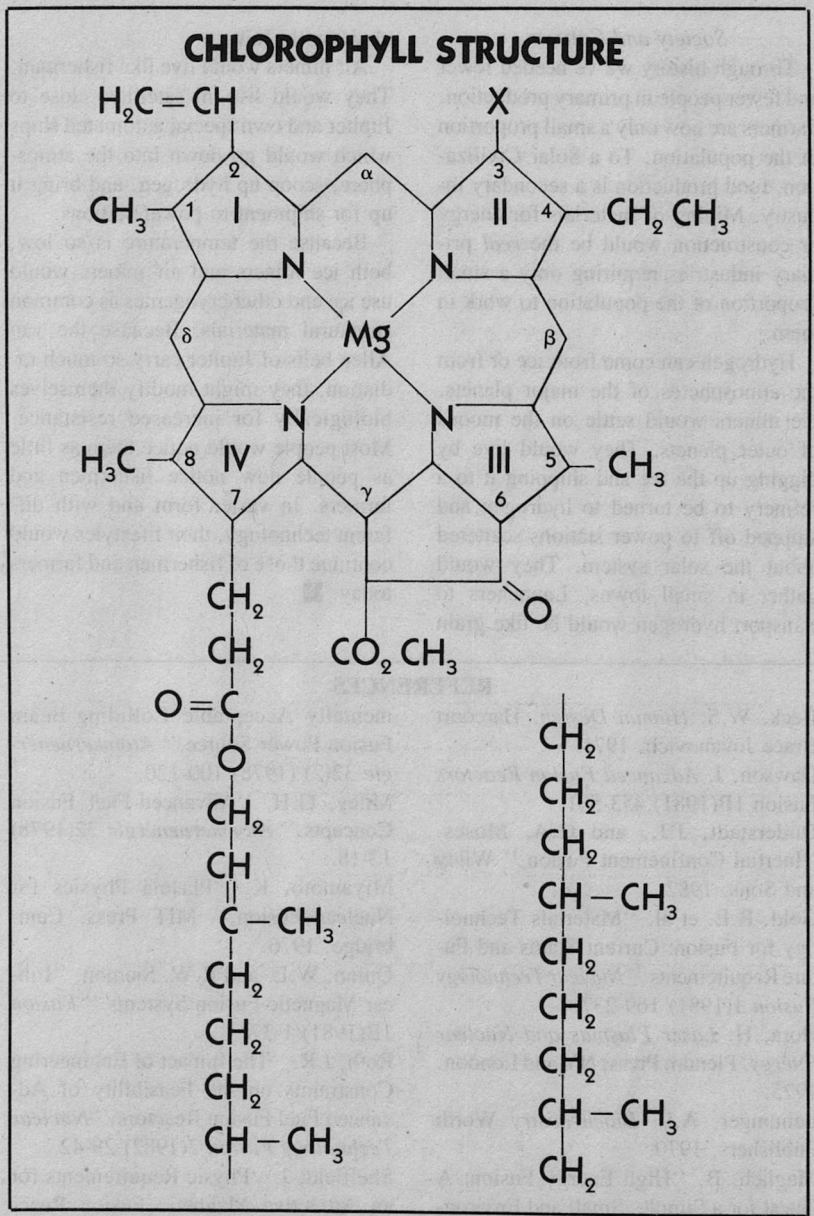
Any present day nuclear engineer would recognize the basic principles of 24th Century fusion reactors but find their large scale and the sophistication of their materials fascinating.

* * *



A gammaplast consists of many membranes each containing chloruranide molecules.

Figure 5B: Compton generators (advanced):
An advanced Compton generator would work by extracting energy from free radical reactions. Without knowing exactly how to do this, we can make suggestions. Collectors would consist of many layers of membrane ("gammaplasts"). On the membranes would be molecules ("chloruranide"), like chlorophyll, except that they would center about uranium rather than Mg. Biochemicals resembling NADP would capture freed electrons. Once captured, reactions like those of photosynthesis extract their energy.
The diagram shows the chemical structure of chlorophyll and a speculative structure for a gammaplast.


CHLOROPHYLL STRUCTURE
H2C=CH
X
CH3
CH2 CH3
Mg
H3C
CH3
CH2
CH2
CO2 CH3
O=C
O
CH2
CH
C−CH3
CH2
CH2
CH2
CH−CH3
CH2
CH2
CH2
CH2
CH−CH3
CH2

Society and Culture

Through history we've needed fewer and fewer people in primary production. Farmers are now only a small proportion of the population. To a Solar Civilization, food production is a secondary industry. Mining of materials for energy or construction would be the *real* primary industries, requiring only a small proportion of the population to work in them.

Hydrogen can come from ice or from the atmospheres of the major planets. Ice miners would settle on the moons of outer planets. They would live by digging up the ice and shipping it to a refinery to be turned to hydrogen and shipped off to power stations scattered about the solar system. They would gather in small towns. Launchers to transport hydrogen would be like grain elevators in Iowa.

Air miners would live like fishermen. They would live in satellites close to Jupiter and own special automated ships which would go down into the atmosphere, scoop up hydrogen, and bring it up for shipment to power stations.

Because the temperature is so low, both ice miners and air miners would use ice and other cryogenics as common structural materials. Because the van Allen belts of Jupiter carry so much radiation, they might modify themselves biologically for increased resistance. Most people would notice them as little as people now notice fishermen and farmers. In vaster form and with different technology, their lifestyles would continue those of fishermen and farmers today. ■

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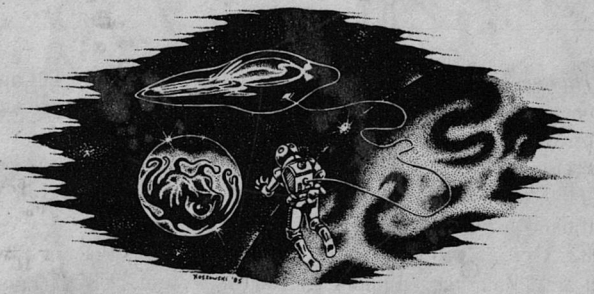


●The most distant object one can see in the bright light of day is the sun. But in the dark of night one can see stars which are millions of times further away. Remember *that* the next time your own private world turns black.

Anonymous

DEFENSIVE ONLY

Timothy Zahn

It's become almost axiomatic that some kinds of advertising claims are invariably and inevitably exaggerated. But suppose they aren't . . .

Bob Walters

The party had degenerated into an insufferable blather of strato-crust gossip, and behind his artificial face Wilstun Oismer was beginning to sweat. So far his masquerade was holding up, but with only a vague notion of what petty intrigues and adulteries the Five Hundred were up to these days, this was potentially slippery ground. It was time to give the party a gentle nudge; and he was casting about for an innocuous way to bring the Panakarian Defensor into the conversation when old man Grisbane did so himself.

"Ah, yes," somone decked out in a ridiculous Tigeleian fur spoke up. "That's the black box your people dug up on Ramiris III six months ago, isn't it?"

"Yes, indeed," Grisbane nodded, looking pleased with himself. "Dug up, translated, and poised to be the start of a radical new approach to personal and general protection."

An appreciative murmur ran around the room. There was nothing these fat parasites liked better, Oismer reflected cynically, than to have their accomplishments oohed at by the rest of the fat parasites. "*Personal* protection, as well, you say?" he asked carefully. "You mean the Defensor is small enough—?"

"I must say, Gris," one of the other guests cut him off brusquely, "that the whole concept of a 'defensive only' weapon strikes me as ludicrous. Anything that can be used *de*fensively can also be used *off*ensively. That's basic military logic."

"That's what all *my* experts say, too," Grisbane agreed, looking insufferably smug. "But the archaelogists have found records listing other equally outrageous Pankie claims that have later been borne out, so for now I'm quite willing to assume that they may indeed have come up with a purely defensive device. And as soon as my people can locate a working Trilspi power unit I'll prove it."

The scoffer shook his head, with equal smugness. "You're getting painfully idealistic in your old age, I must say. Look at the facts, man. The suppressor field—remember how that was hailed as the end to nuclear threat? And then someone found out that it was also ideal for damping a starship's drive pile while you pirated the thing?"

"Or go back to the old fixed-place mine," another man—whose earlier conversation had clearly showed he fancied himself a historian—chimed in, steepling his fingers over his drink. "They were supposed to do nothing but destroy oncoming tanks and troops, another so-called pure defense. The problem being that you could send in agents to plant them on your opponent's side of the border, which immediately turned them into terrorist offensive weapons."

"Or what about the standard force barrier?" the person in the Tigelian fur shrugged. "You have any *idea* how many homes and value depots have been robbed by someone encased in one of those? And if the force barrier can be used that way, *anything* can."

Oismer certainly hoped so. There was little reason otherwise for him to have crashed this party. "What does this thing look like, anyway?" he spoke up. "The size of a flitter, or something a single man could carry?"

"Oh, the latter, certainly," Grisbane

said. "Vodkish," he said to his glass, releasing it. It floated off toward the bar; with his hands now free, Grisbane began slicing off rectangular pieces of air. "It's about *so* by *so* by *so*, with a handle grip on one side and the slot for its Trilspi power unit next to it. Three kilos or so—easily a one-person device."

Oismer held his breath. If someone else didn't make the obvious suggestion, he would have to.

Someone else did. "Have you got it here?" one of the overdressed women asked.

"'Oh, yes, Gris—*do* let us see it," another woman exclaimed.

Grisbane pretended to hesitate as the urgings became a chorus, but to Oismer it was obvious how much he wanted to show off his new toy. "Well . . . all right," he said at last. His drink had returned; settling it above the armrest of his chair, he got to his feet. "I'll be back in a minute."

Oismer gave him a ten-second lead. Then, as the room's conversation shifted to doings on Genendowi Major, he eased backwards through the kitchen door he'd been careful to place himself in front of. Jogging silently through the room, he emerged into a deserted hallway just behind the esclate to the upper floors. Grisbane was about halfway up, fiddling with his coder pass. "Gris?" Oismer called quietly.

The other turned to look, and brought the esclate to a halt. "Yes, Binks, what is it?"

"I need to talk to you right away," Oismer told him. "May I come up?"

"Of course." Grisbane did something to his coder and the sensor at the esclate's lower end flickered off. Oismer climbed on, and the two men met at the top.

"First of all, Mr. Grisbane," Oismer said, shifting to his own voice, "I have to tell you my real name is Cal Moranis—InterStar. We asked Mr. Binkworth to allow me to come in his stead tonight because we needed to talk privately with you on a vitally important matter."

Grisbane's expression had gone from shocked to surprised and all the way to appraising by the time Oismer finished his speech. "InterStar, eh? You're interested in the Defensor, I take it?"

"Yes, sir, we are," Oismer nodded, reminding himself not to get cocky. Grisbane might be a fop, but he wasn't stupid. "The conversation downstairs just now in many ways mirrored the Bureau's thoughts on this matter. Any defensive weapon can indeed be used offensively, and we obviously don't want anything like that falling into the wrong hands."

"No, of course not," Grisbane said, his eyes searching Oismer's artificial face and noting where the connections around mouth and eyes were. "Amazing job, that disguise. I'd have sworn in a court of law that you really were Binks."

"Mr. Binkworth allowed himself to be used as a model for the mask," Oismer shrugged. Not that Binkworth had had much choice, being freshly dead at the time. "But the specific reason I'm here tonight, Mr. Grisbane, is that we have reason to believe the Defensor may in fact have already been stolen from you."

"What?" Grisbane's eyes narrowed. "Impossible. The security here is im-

possible to break—the space/shifted vault alone is totally impenetrable without the proper codes."

"I hope so, sir, I really do. But I have orders to check it out for myself."

"Yes, yes, I understand. Well, come on, then—the vault's in the room next to my study."

Two armed guards were also in the room, a fact that could have made things very awkward indeed. But Oismer's reading on Grisbane was that the man had a standard rich fop's mentality, and part of that mentality was the suspicion that even the best lackeys could flip on you if the rewards were great enough. That evaluation turned out to be right; without any hesitation Oismer could detect, Grisbane ordered the guards outside into the hallway while he opened the safe.

It was a complicated procedure, made even more so by the horrendously expensive space/shifted outer skin. Another invention, Oismer remembered as he watched Grisbane work, that had once been hailed as a purely defensive device. The kudos had died down about the time two differently phased space/shift generators were fired up together and left a small town scattered about the surrounding landscape.

"There," Grisbane muttered as the multicolored haze faded and the vault door swung ponderously open. "Let me see . . . no, Agent Moranis, there it is—safe and clean."

"Looks like it," Oismer nodded. "I'd like to take a closer look, though, if you don't mind bringing it out here. I have a list of characteristics Customs recorded when you first registered it."

"No trouble. I was going to bring it downstairs, anyway." Grisbane stepped into the vault, the force barrier opening and then closing as he passed; and a moment later he reemerged, carrying the faded gray box carefully in both hands. "Here we go."

"Set it down on the table there, please," Oismer said, pulling a readcard from his coat pocket with one hand and surreptitiously loosening his neck scarf with the other. Grisbane complied . . . and stepping up behind him, Oismer looped his scarf around the other's throat and pulled.

Grisbane gasped, clutching futilely at the garrote squeezing the life out of him. Oismer held on—and abruptly the clamor of alarms split the air.

Damn. Oismer gave the scarf one last vicious tug and let the unconscious man drop to the floor. He'd hoped Grisbane's body-keyed sensor net wouldn't be functional here, as close as it was to the space/shift generator. But he'd been wrong, and now the only thing standing between him and the guards outside was the armored door to the hallway . . . the armored door, and the as-yet untested Panakarian science sitting on the table beside him.

A muffled *crugg* sounded from the door: the guards had turned their flaysers against it. A minute at the most and they'd be swarming all over him. Pulling out his computer, Oismer broke open the back and from its power pack niche drew a small tube that looked like a paste dispenser with dimples. Grisbane's eyes would have bulged to see it: one of the bare handful of operational Trilspi power units in existence. It had cost another eight or nine lives to obtain—Oismer couldn't remember ex-

actly how many—but it would be well worth the price if this worked out. The slot in the Defensor was right where Grisbane had indicated, and with only a little resistance the power unit slid neatly into it, disappearing deep into the Defensor's vitals. It would become an integral part of the device now, absorbed into it and generating a slipfield that would keep it powered for years.

A second *crugg,* and the door began to bulge inward. Oismer curled his fingers around the Defensor's handle and looked for the controls. Only one seemed to exist: a rocker-type switch within thumb reach of the grip. Taking a deep breath, Oismer pressed it . . . and at the same instant the door exploded into shards and a dozen guards swarmed into the room.

Swarmed in like ghosts through mist. Oismer stared at the indistinct shapes, heart thudding in his throat as he tried to figure out just what the hell had happened. The guards—the whole room, for that matter—had taken on the character of a soft-focus, gray-on-white, silent holovid. A new kind of force barrier, perhaps . . . except that force barriers usually didn't behave this way. Oismer was still puzzling at it when the first guard raised his flayser and fired.

The beam, also gray-on-white, flicked out toward him . . . but without sparking the characteristic flash of force barrier absorption. The guard's face lit up with reflected light, and Oismer turned his head in time to see a section of the wall peel away before the beam.

He looked back . . . and slowly it dawned on him just what he had here. The Defensor didn't create a force barrier or a suppressor field or anything else of that sort; rather, it apparently had shifted him bodily to an ethereal plane where weapons simply couldn't touch him.

Weapons or anything else. He laughed as two of the guards attempted a running tackle and shot through him without so much as a wisp of feeling to mark their passage. "So much for you," he said aloud, the words oddly comforting amid the eerie silence. "Now let's see how hard it is to get out of here."

It wasn't nearly as difficult as he'd feared it might be. Decoupled from material reality, his feet were still somehow able to propel him along a path that more or less corresponded to where the floor was. He passed through the gaggle of guards—some of them still trying the whole while to stop him—down the hallway and to the esclate. The sensor field didn't seem to notice as he went on through it, and the next thing he knew he was walking firmly through the air over the descending steps. A little experimentation showed that tilting the Defensor box forward angled his path by the same amount; ramping his way down to the first floor, he headed through the walls toward the kitchen and the nearest exit. For a moment he considered dropping in on the guests, wondering how many of Grisbane's unspillable glasses would be spilled in the panic. But he resisted the temptation. Business before pleasure, and at the moment his business required him to disappear into the night with his prize before Grisbane's guards were able to regroup enough to explain this coherently to the planetary authorities.

The night had turned windy, it seemed, judging from the way the ghostly trees

were swaying. Oismer headed for the parking drive where his specially-equipped car awaited him, getting an odd satisfaction in walking unnoticed through Grisbane's elaborate system of alarm beams on the way. All his life such things had been obstacles, headaches that always had to be overcome if he was to get what he wanted. Now, thanks to the Panakarians, they would never bother him again.

He smiled at the thought. *Defensive only*, indeed. To be able to go anywhere he chose, with no one and nothing able to stop him—he would be the greatest thief and smuggler the galaxy had ever known. *Defensive only*. Idly, he wondered if the Panakarian race had survived long enough to recognize the extent of their naivete.

He'd reached the drive now. His car was second from the end, it's effete exterior masking its true power and capabilities. Even if Grisbane's guards organized in time to block the exit down the road, it would do them no good. Oismer was as good as gone, and with his "perfect defense" he was about to become master of the galaxy. Smiling with anticipation, he stepped to his car door and pressed the Defensor's rocker switch.

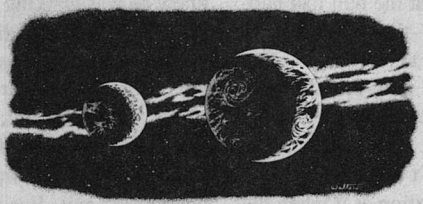
Nothing happened.

He pushed it again, and again. "Come on—*work*, damn you," he snarled at it. "You worked perfectly before—what the hell's wrong now?"

The box didn't reply, and the switch still didn't seem to do anything . . . and then suddenly he understood.

The Defensor was working exactly as it was supposed to . . . and the Panakarians perhaps hadn't been so naive after all.

"Oh, God," Oismer whispered. ■



●There may well be of the order of a million highly-developed civilizations in the universe, all at different degrees of progress or formation. That man will not attempt to contact the nearest of these is to me unthinkable. The only questions are when and how.

Dr. Bernard M. Oliver

on gaming

Matthew J. Costello

At last summer's game conventions, much of the excitement was created, as usual, by a game that wasn't there. (In gaming, as in other adult pursuits, 50 percent of the fun is in anticipation.) The game was considered one of the prime licenses in the SF world, and it had been rumored to have been a hotly pursued license. I heard of at least three companies that tried to obtain the prize, the right to design and market a series of games based on the *Star Wars* films of George Lucas.

And while *Star Wars* may have had its day (we did grow a little tired of it all by the end, didn't we?), there's no doubt that the *Star Wars* saga could be a potent force in gaming.

The eventual winner in that derby was West End Games. Reportedly won over by the clever design proposal (and with appropriate financial inducements), Lucasfilms has authorized West End to produce a line of board games, role-playing games, and supplements built around the rebellion against the evil Empire.

By the time this column appears, the Force will be with you.

West End also plans on reaching out to the non-gamers through a series of hardcover background books. These will be available in bookstores and, like the assorted books of *Star Trek*, should prove to be catnip to hardcore *Star Wars* fans.

(I did get, by the way, an advanced look at the *Star Wars* role playing game, courtesy of Eric Goldberg. Like all West End designs, it was going to be nothing less than state-of-the-art, a team effort that would be well worthy of its subject. The game's use of the Force is extremely clever, and losing the character to the "Dark Side" is a a real possibility.)

But the conventions also offered a look at what another company might have done with the *Star Wars* license.

FASA Corp. (P.O. Box 6930, Chicago, IL 60680) is renowned for turning its *Battletech* into a major game product all by itself. It started out as *Battledroids*, but after some rumbling over the name from the George Lucas camp, it mutated into *Battletech*, a game of battling robots. Eventually, there were supplements that added special rules (such as *Aerotech* and *Citytech*), a line of novels, lead miniatures, and a comic book. It became such a hot game that Activision recently acquired the rights to produce computer versions of the *Battletech* line.

Now, FASA has released *Interceptor*, the first in its *Renegade Legion* series, and it is perhaps no mistake that it recalls the *Star Wars* films (which themselves were built on the long tradition of Space Opera starting with the blonde, blue-eyed Flash Gordon).

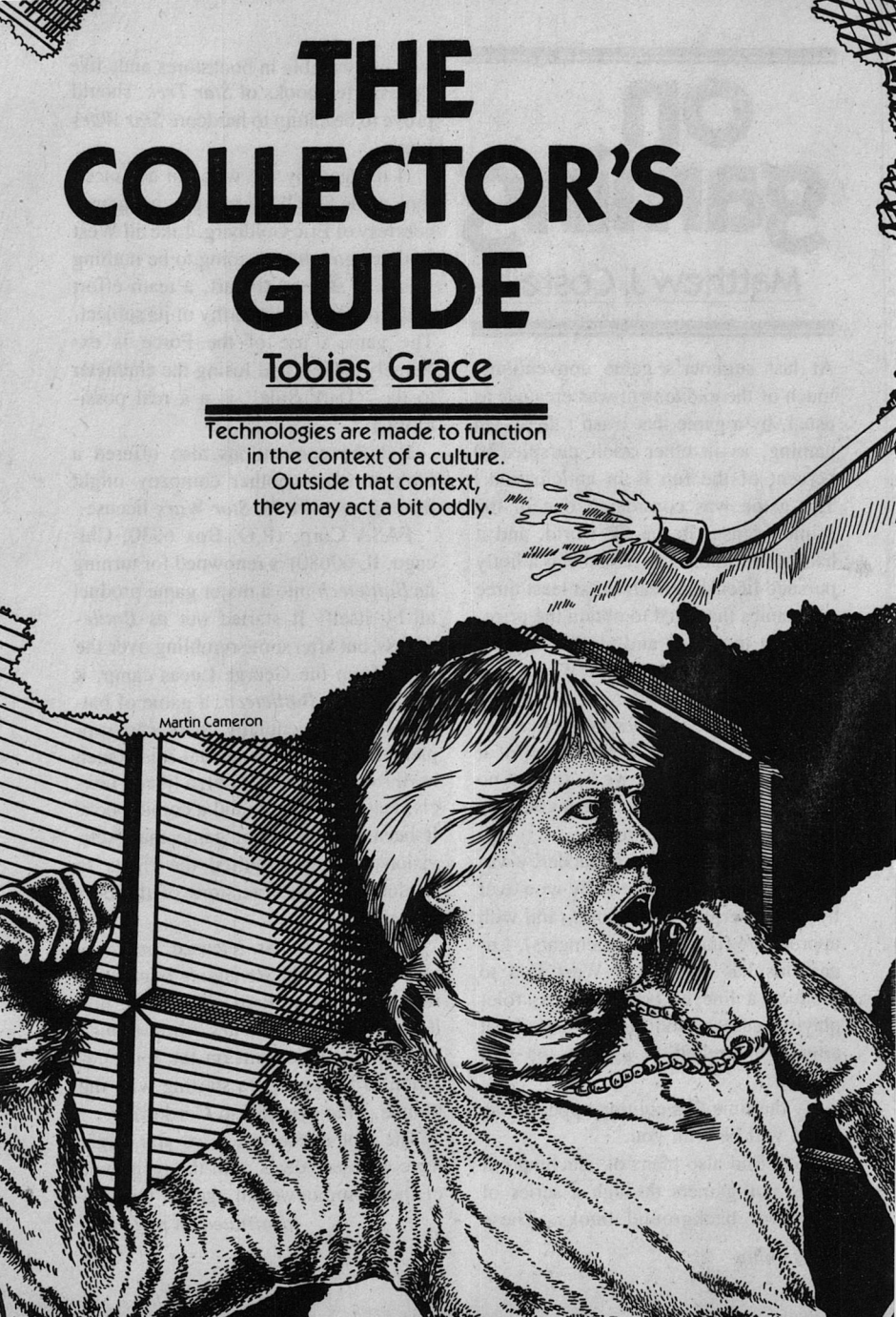
The plot of the series, as you might have guessed, deals with the resistance of the Commonwealth against the Ter-

(continued on page 185)

THE COLLECTOR'S GUIDE

Tobias Grace

Technologies are made to function in the context of a culture. Outside that context, they may act a bit oddly.



SYON HALL CORP
EYER-EYIER
NO STEP
STEP

Syonhall House, after all,
Isn't a house, hasn't a hall,
Nobody lives there, no one at all,
But they'll be home if you come to call.
They will meet you and greet you and take you to tea,
And then they will eat you as quick as can be.
(Traditional children's rhyme on Capria 6—Syon's World)

It wasn't anything like a real castle, of course. Real castles were built for heroic defence. Syonhall House was merely built for office space. Real castles have moats and battlements, crenellations and portcullises. Syonhall was simply a twenty story tower block of black glass and bronze-toned aluminum. It was like a million other such office towers on a thousand other worlds, except in one respect; it was not in a city. It stood alone, a good many miles from any other habitation, half way up a mountainside in the frozen north of a cold world. Except in the rhyme, it was almost never called Syonhall House. Everyone referred to it as 'The Castle,' when they referred to it at all, which was as seldom as possible.

No one sets out to build a nightmare, but the line between dreams and nightmares is crossed so easily. It was certainly that way with the Syonhall Corporation. They had envisioned a city clinging to this mountainside, close to one of the planet's few good sources of hydroelectricity. The city would be the world headquarters of a vast industrial network, producing something or other. It had all been centuries ago and no one remembered anymore what the product of this Golconda was supposed to be. What had begun with such bright hopes withered quickly. There were financial problems back home, a world half a galaxy away. They persevered however, and shipped in the building prefabricated. It was to have been a tangible symbol of corporate progress, something to point out to the investors. Instead, it became a money pit. What had been presumed to be a solid rock base turned out to be shifting and insubstantial. The severity of the weather took a greater toll than had been allowed for. Hostile natives unexpectedly manifested themselves. New labor contracts were forced on management at the midpoint.

By the time the building was finished, the corporation was exhausted, its leaders totally involved in a scramble for self preservation. The great work had become a white elephant, to be let go at bargain rates to creditors who had no use for it. It was forgotten. As century followed century, it stood solitary and incorruptible. A complete arcology, drawing energy from both the sun and the planet's thermal core, it maintained itself perfectly for a long time. For year after year, it cut its own lawn during the brief summer, and trimmed its gardens. It cleared the area of snow during the long winters. It kept its glass clean and its hinges oiled. It was temperature controlled and dust free. Its dining rooms made food available and its security systems noted and filed every intrusion of the local fauna, taking appropriate action according to its programs.

Eventually, after a great many centuries, the building began to tire. Possibly its sense of purpose began to fail, as it waited endlessly to serve masters who would never return. It was, after all, in many ways a more complex sys-

tem than a living thing and it might be said to have verged on sentience at some level. The observable facts, however, were more mundane; parts wore out which could not be fabricated by the building's systems. It had been designed to be self-maintaining, but not in isolation forever. At last, it began to husband its resources. Floors were shut down and allowed to decay. Services were curtailed. From the outside, it still looked much the same. The steel letters of the building's name still gleamed above the entrance. Its lawns and shrubs were still in order, (for some reason, the builders had assigned a high priority to landscaping). Inside though, cold winds stirred clouds of dust as they blew through broken glass in the darkness, and mechanical servitors, themselves unrepaired, fumbled with half remembered tasks.

Fifty or sixty miles distant, in a valley stretching away from the base of the building's mountain, was a human village. There had been humans on Capria 6 long before the Syonhall Corporation arrived. No one knew how or when the first humans came and no one particularly cared. Outside of what was known as the "Main Concourse" of human worlds, there were many such unknown and unvisited pockets of habitation. Some descended from isolationists of one sort or another. Others came from the survivors of shipwrecks. Some were founded by criminals and some by refugees. In the end, most such settlements descended to a primitive level, adapting to their new homes as best they could and forgetting, slowly, the rest of the universe.

So it had been with the people of the village. In fact, the bitter environment of this world had driven them further down than most such groups. Once, long ago, their ancestors had built buildings on other worlds which dwarfed Syonhall House. Now, they stared at it in wonder and avoided it as a thing built by magic.

The winters were long and hard on this world, and never did everyone in the village survive them. The people were used to this and expected it. The last four winters, however, had been particularly brutal, and this present one was worse than certain winters of legend. The snows fell endlessly and drifted to the eaves of the houses. Winds screamed around the gables and down chimneys, rattling shutters and doors. Old people and children huddled on hearth seats, tending fires and telling tales of better times. Hunters could not go abroad and food ran dangerously low.

One evening, in the very depth of this winter, an event occurred without precedent. Shortly after the evening meal, a great rumbling was heard in the sky. Rushing out into the falling snow, the people could dimly see a great cluster of lights overhead. It moved away in the direction of the castle, and the people went back indoors, muttering and making signs against ill omens.

The next day, the villagers arose to find they had visitors. The snow had stopped during the night and, in the bright, clear morning light, they saw three figures standing quietly in the village square. Next to them was a stack of large, white boxes. The figures were hooded and wore long, white robes with sleeves closed at the ends so that no

hands showed. Reflective silver masks covered the face openings of the hoods. At their feet, the robes were gathered and bloused into heavy white boots. They stood absolutely still, waiting.

By alleyways and back doors, the senior people of the village quickly made their ways to their chief's house where, after considerable argument, it was finally decided that there was really nothing to be done, after all, but to go outside and greet their guests. After some preparation and the donning of best furs, the chief and a party of elders stepped into the square and stood facing the visitors. One of the visitors made some slight adjustment to a small box he, she, or it wore on a chain around the neck, and began to speak, the voice issuing from the box.

"All appropriate greetings are extended," said the box in flat, metallic tones. "We are travelers."

"Dennish," said another's box, "Dennish travelers. We are from another world. We are Dennish."

"Far world," said the third box.

"Travelers and collectors," the first went on.

"We buy," said the second.

"Always buy," the first agreed, "to take without buy is death, by our law."

"Give always good price," said the third.

"Fair," said the first.

"Always fair," said the second.

"Boxes here are gifts," said the first. "Food, safe for you. You have been analyzed."

"Good," said the second, "we give, no cost, for your time."

The chief, a red eyed, suspicious old man, once fat but now reduced by winter to sagging bags of empty skin, stood unsure, confused. His eyes darted between the visitors and he licked his lips repeatedly.

"We buy," the first visitor repeated, "buy."

"What you want t'buy?" asked the chief at last.

"Something," said the first, "this, that. We collect, seek knowledge, all things."

"Precious little knowledge here," the chief snorted.

"All knowledge precious," said the second.

"Artifact," said the first, "want artifact. Buy, good price."

"*What* artifact," said the chief, showing some exasperation.

"What you call 'castle'," the first answered.

"Yes, castle," agreed the second. "We buy, take away whole thing. Give much food."

Neither the chief nor anyone else in the village had ever considered the castle as theirs to sell. The mention of "much food," however, was a more than adequate stimulus to their powers of rationalization. What they didn't know, of course, was that the Dennish collectors didn't care who owned it. As long as they made a deal for it with someone, honor was satisfied. If they had wanted to buy the village, and had arranged a transaction for it with a fish in an ocean a thousand miles away, their code would have considered it a binding contract.

Regardless of codes and contracts, the chief immediately perceived that this was his village's lucky day. The Dennish pushed forward the boxes and some

of the villagers began opening them. Within were neatly stacked bricks of enriched protein. One or two of the more adventurous tried nibbling a brick and quickly pronounced it delicious. There were enough bricks in the gift boxes to sustain the entire village for at least two months. The chief began to haggle.

At first he refused to even consider parting with such a treasure as the castle. The Dennish were not impressed. They had bought rugs, on another world, from the descendents of Armenians, and knew all there was to know about haggling. A philosophical observer might have found in the next hour's discussions a microcosm of universal commerce; one party offering to sell that which it does not own, in exchange for what the other party in truth considers worthless, and both lamenting greatly their sacrifice. Eventually, they settled on an additional thirty boxes of protein bricks.

For the villagers, this was wealth undreamed of. It meant that none of the weaker children need die of malnutrition in the long, cold months still ahead. It meant that old Ah-Jonay would see another spring, and tell his fireside tales to one more generation of children. It meant that Er-Racel, even older and very feeble now, might linger long enough to pass on amidst the warmth of summer, perhaps even teaching the secrets of her renowned preserves to one or two more young ones. In a quiet village, tied eternally to the land and the seasons, these things, these possibilities, are beyond price.

The Dennish, knowing the needs of the people they dealt with, allowed enough time for all these implications to fully register in the minds of the villagers. Then, they produced several impressively engrossed documents for the chief to sign.

"Also one thing more," said the first.

"Another thing, requirement," said the second.

"Guide-reader," said the first.

"To read, words, signs, everything," said the second.

"Need for castle," said the third, "to read things, inside."

"But you speak our language," said the chief, confused.

"Speak yes, box does this, not read," said the first.

"Could translate," said the second, "break code, take long time."

"Long time," said the third, "much better have reader, for signs, instructions."

"All things, read screens, computers," added the first.

"Com-pu-ters? Don't understand," said the chief.

"You have people can read? Yes?" asked the first, "Own language?"

"Course we do!" The chief spoke with some show of offence taken. "Course we can read! What d'you take us for? Swamp runners? At least ten or twelve in our village can read. Why, we must have up'ard of twenty books here. Some very old ones too."

"Good, good," said the first, "then reader must go with us. Save much trouble. Very important."

There was a long, painful silence in the square as the old men looked first at each other and then at the other villagers. They needed the food. This was unspoken but foremost in the minds of

every person present. This was an opportunity which could not be missed. A trip to the castle, however, to actually go inside the place, was beyond anything they could simply order someone to do. There had been adventurous souls, from time to time over the centuries, who had been drawn to explore the mystery of that strange tower. None had returned, and the people of the village had learned to curb their curiosity. In the absence of fact, imagination had peopled the tower with every sort of horrible monster and black magician. The stories told of how it was inhabited by a race of giant insects, who waited endlessly to trap the unwary traveler who came too close, feeding their victims to the wicked sorcerers who lived at the top of the tower.

There was really only one candidate to accompany the Dennish, and everyone knew it. At seventeen, it was already obvious that Ah-Jay was not going to be much practical use to the village. To begin with, he was an orphan. His parents had died in a fire when he was still very young. This meant that there was no one depending on his support in their old age. Even more important, Ah-Jay was a terrible hunter and a worse farmer. He almost never ate meat and seemed more interested in watching the animals than catching them. When he was tried at farming, he spent his time endlessly experimenting with mulch, or hand cross-pollination. The results were often two or three spectacular rows of corn when what the village needed was an entire field of the more ordinary sort of growth. Everyone knew, without discussing it, that Ah-Jay could be spared from the communities' struggle for existence. Most important; Ah-Jay could read. He was, in fact, probably the best reader in the village, and had even gone so far as to make a note book and do some labored writing of his own, mostly notes on his observations and experiments. To the villagers, this was very close to magic in itself. It occurred to some that this might even give him an advantage over other candidates for the job, if it came to dealing with magicians.

There was one further consideration; Ah-Jay wanted very much to go. In this he was unique in the village. Any of the others would have gladly sacrificed almost anything to avoid the duty. Accordingly, very little discussion was necessary and within a few minutes, Ah-Jay had thrown some necessities in a pack and was going with the visitors into the forest. Embarrassed at how easily they had done this, the villagers did not follow him with their eyes. Neither did Ah-Jay look back.

As they entered the forest, Ah-Jay asked the visitors if they had truly come from the stars.

"Not stars," said the first, "Stars are big fires. No one lives on stars. Come from planet."

"But how?" asked Ah-Jay, "how did you travel from another planet?"

"In vehicle," said the first.

"Small vehicle," said the second.

"Bigger than some things," said the first.

"But smaller than others," said the third.

Ah-Jay began to suspect that conversation with his fellow travelers was going to be unrewarding. They walked

on in silence for some time before he tried again.

"How many of you are there, anyway?" he asked.

"Three," said the first. "Self and these others here."

"No," said Ah-Jay with some frustration, "I mean *altogether*."

"Altogether or separated, is still three," said the first.

"The whole can not exceed sum of parts," said the second.

"No, no," said Ah-Jay, "I mean, are there more people like you somewhere else?"

"All living creatures share certain similarities," said the first, "reproduce, consume fuel, pursue objectives."

Ah-Jay spent some time mastering his annoyance and attempting to formulate his questions with a greater precision.

"Did you three," he asked at last, very carefully, "travel from your planet, in your vehicle-which-is-smaller-than-some-things-and-larger-than-others, in the company of others of your race?"

"All are part of the oneness," said the first.

"All who have gone before and all who are and all who shall be, join eternally, merged in the great consciousness," amplified the second.

"Selah," said the third.

Ah-Jay stopped asking questions.

After they had been walking for perhaps an hour, they came to a large, newly made clearing. On one side of the open space, a huge pile of uprooted trees rested, as though swept over by a giant's broom. The forest floor had been fused into black glass and on it, in the center, rested an object which Ah-Jay found both frightening and intriguing. It appeared to be a large capsule of shiny metal, resting on three bent legs and having a glass bubble on its stubby head. A short flight of steps led from the ground up to a hatch. The object was somewhat larger than the village hall, but lacked a suitable ornamentation of carvings and statuary in Ah-Jay's eyes.

"This will be a magnificent temple indeed, when you finish it," said Ah-Jay, determined to be polite.

"Is finished," said the first. "Is vehicle, not temple."

Ah-Jay permitted himself a smile of superiority at the idea of a vehicle without wheels. It had begun to seem that these strangers might not be as superior as he had at first thought. He decided to keep his suggestions to himself for now, however. There could be some advantage to be gained at a later date. He followed the three strangers up the steps and into the vehicle. Within, he found himself in a small room, the walls of which were covered with tiny lights, ranks of buttons and inscriptions, none of which made any sense to him at all. One of the visitors indicated a sort of armchair in which he seated himself and, following their example, fastened a harness over his shoulders and around his waist. Another of the Dennish began doing things with the buttons and suddenly, Ah-Jay was terrified by a great roaring noise and a terrible vibration which shook the entire structure. He glanced out through the glass bubble and saw the forest dwindling below them and passed out with shock and fear.

When he regained consciousness, the structure was no longer vibrating or making noise. He was greatly relieved

to look out and see trees once again in their normal position, and the forest floor securely beneath the structure's legs. The others had already unstrapped and seemed to be awaiting him. Ah-Jay was far from any sense of security however. In one awful flash, he realized what fate had befallen him. These three were no mere visitors and their tales of other planets were obvious nonsense. They thought him primitive and stupid, he knew, but he had recognized them now for what they were. He should have known it the instant he saw this structure in the clearing, but it was shiny and metal and he had never pictured it that way. There could be no mistaking it though, once the connection was made. Ah-Jay had finally remembered the favorite tale of his childhood, the very ancient story of Baba Yaga the witch and her cottage with its legs like a giant chicken's, which could leap forests and rivers on its mistress's command. He had been taken by witches and would surely meet a terrible fate unless he was very careful, very clever and very lucky.

Silent and nervously shaking just a little, Ah-Jay unfastened the harness and followed the three outside. Almost the first thing he saw, rising from a position several hundred feet above them on the mountainside, was Syonhall House. Ah-Jay knew of it of course, and had heard descriptions, but was quite unprepared to think of anything that big as a made object, much less a man made object. The idea that it was placed there by wizards seemed entirely reasonable.

As they slowly climbed up the base of the mountain, making a difficult way around boulders and over cracks and chasms, Ah-Jay determined to remain very alert for the slightest sign of a trap. He fully expected that he was being led to a cooking pot in which he was scheduled to be the main course. His was not the only alertness on the mountain. Deep within the great building above them, sensors were reporting a warm blooded presence coming closer. A pattern quickly formed on the security scans as three cold blooded presences were also detected. The four were moving in concert and displayed no identity tags. The analysis was hostile intent. At another procedural level, the presences were evaluated as being a total of almost three hundred pounds of protein. The building formulated its own protein for service in its dining rooms, but was always alert for fresh supplies from outside sources. For that reason, there were no mice in the building, and no small animals disturbed the perfection of its lawn.

The lawn was, in fact, the first odd thing Ah-Jay noticed. He had never seen such an expanse of grass at such meticulously short and identical heights. He could imagine neither the purpose to it, nor the method whereby it was kept so green and free of snow. He wiped his feet carefully before stepping onto it, much as he would have at home, after the parlor floor had been scrubbed. The Dennish paid no attention to such niceties, and walked on ahead, carrying instruments of several types. With these they seemed, to Ah-Jay, to be conjuring. They waved wands in all directions as they went, and listened to the rapid clicking noises issuing from the instruments. Ah-Jay presumed they were casting protective spells, or countering the building's defensive ones.

Suddenly, as they neared the building's main entrance, a panel in the foundation slid back and a monster issued forth. It wore an armor of metal covering it entirely and moved on twin, studded belts. Ah-Jay knew from its shape that it could not be a man. It was too short and had a narrow center segment no thicker than his wrist. As it came, it began to extrude arms and weapons from its sides. The Dennish, seeming unimpressed, merely pointed a wand at it and at once it was enveloped in what seemed to be a ball of lightning. The monster turned aside and, smoke pouring from within, smashed itself against a tree and lay still. This was the first demonstration of the stranger's power to destroy that Ah-Jay had witnessed and he was suitably impressed.

Nothing had ever before made such short work of one of the building's protein gatherers. This did not impress the building. It was not programmed for subjective reaction. It did, however, confirm its hostility analysis and upgraded its response level. A plaque beside the entrance lit up and began to flash and a siren sounded. The wailing of the siren startled Ah-Jay, who interpreted it as a keening for the dead monster. The first Dennish pointed to the plaque and indicated that Ah-Jay should read it aloud. The boy stepped closer and began to puzzle at the letters. They were in clear, block form, but each glowed as though written in fire.

"Authorized Personnel Only! Display Your Identity Disc! Unauthorized Entry May Result In Serious Danger!"

Though Ah-Jay could pronounce the syllables, the message made little sense to him. He understood the part about serious danger however. Evidently the Dennish understood it also.

"Standard cautionary," said the first.

"Normal prudence adequate," said the third.

Ah-Jay was about to suggest that he should keep watch by the door when a noise caused him to turn and see two more monsters rushing up the steps in their direction. Ah-Jay may not have been the quickest or the strongest young man in his village, but in this case he had no trouble with rapid response. He shoved the three strangers aside and leapt for the doors. They were locked. He jumped narrowly aside as one of the monsters crashed headlong into the door next to him. Instantly there was a flash and a strong smell of ozone as the monster's circuits were fried by a heavy current of electricity, activated by the breaching of the entrance.

One of the Dennish had dispatched the other monster and the four adventurers stood briefly surveying the remains. One of the strangers took his wand and began a detailed examination of the doorway and the vestibule beyond.

"Area clear," he pronounced. "Trap door beyond vestibule. Must go around. Otherwise safe."

The Dennish were an advanced and intelligent race. They had a broad experience of other cultures and ways of thought, combined with quick reflexes and a keen sense of danger. They were not omniscient however, and the tower's builders were just a little bit more clever than the Dennish had given them credit for. The inspection had not revealed the hidden gas jets. No sooner had the four stepped into the vestiblue than a gate

slid down behind them and a series of jets located in the bosses of the area's ornate crown molding began issuing clouds of a heavy, sweetish vapor. Fortunately, the gate had struck the body of the monster which still lay in the entrance, leaving a space of about a foot and a half open at the floor. Ah-Jay did not have to be told that the gas was dangerous. He hit the floor and rolled outside immediately. Two of the Dennish were close behind him but the third had caught the strap of one of his instruments on a wall fixture he'd been investigating. He had time for only two quick pulls before the first tentacles of gas drifted past his face shield. Instantly he stiffened, coughed several times and fell forward.

"Toxic," said the first Dennish.

"Effective," said the second.

"Look," said Ah-Jay, "maybe you'd like to think over this whole business about buying this place, huh? I think we could arrange to take it off your hands. Give you a good price."

"No. We are collectors," said the first, "difficulties only increase value of prize."

Once the gas had cleared out of the vestibule, they cautiously reentered. The lobby they found themselves in was modest by the standards of the builders and bland by the taste of the Dennish. To Ah-Jay, however, it was grand beyond imagining. He stared open-mouthed at the polished stone walls, the great chandelier and the stately, artificial palm trees clustered in the corners. There were elegant seating groups casually placed, but when the young man touched one of the chairs, its upholstery crumbled at once to dust. The Dennish signaled for him to decipher the lobby directory and he began a labored process of first figuring out the words, and then trying to get the Dennish to explain them. They were about half way down the sign when Ah-Jay paused to ask them an unrelated question.

"How can you possibly take this building away in your little magic cottage? You could put the whole cottage in this room alone."

"Vehicle not cargo vessel," said the first Dennish. "Will signal appropriate ship to come."

"How can you signal to another planet?" asked Ah-Jay. "A bonfire won't work, even if it's real big."

"Large red button on second console to right of main screen is signal activator. Write message on screen by pressing buttons on console. When message complete, press red button. Message sent. Will be received. You will do this, and wait for reply, when we are ready to signal. We remain here and work on decoding systems. We are now one individual short so both of us must stay here."

"You will go, send signal, get reply," said the other Dennish. "Not yet. We find systems center first. You read."

Ah-Jay was an exceptionally bright young man. He knew that playing with buttons had nothing to do with sending messages, especially to other planets. It really was not difficult for him to figure out that, once his usefulness here was ended, they would send him back to the magic cottage for one reason only, to become part of the larder. He knew that if he went back in there while the witches were still alive, it would not let him leave until they returned to make

him into sausage. The old stories were quite clear on such points.

The Dennish were uninterested in any of the directories' information until Ah-Jay reached a line which read "Central Computer Facility, Systems Control, Data Bank." The sign said it was located on sublevel B. The second Dennish stepped toward a blank door in the central wall and pushed a button on the right hand side. Instantly, the door slid open revealing a very small room beyond. He stepped into the room and began to press other buttons when, suddenly, there was a loud creak, a dry tearing sound and several crashes. The small room abruptly dropped out of sight with the Dennish in it. There was a terrible crash and a choking cloud of dust where the room had been.

"Building may be even older than it seems," said the remaining Dennish. "Cable broke. Find Stairway."

Now terrified of disaster at every step, Ah-Jay led the last Dennish down a service stairway they had found behind a door near the elevator. The unlit stairway, deep in decades of dust, was a startling contrast to the well kept lobby, and they went slowly. Suddenly, just as they passed the first sub-level, a bank of lights flashed on, temporarily blinding them, and a sweet but firm female voice was heard;

"This access is for emergency use only. Please use the nearest elevator."

The message was repeated several times. Ah-Jay dropped to his knees at once and began to pray loudly. The Dennish prodded him with its wand.

"No danger here," he said, "voice deaf to your supplications."

"But she said we shouldn't be here!" said Ah-Jay.

"Also said to use elevator. Observe quality of this advice in view of recent tragedy. Let us continue."

Of course, it can never be adequately emphasized, or repeated frequently enough, that nothing lasts forever. It is an unfortunate fact which is too frequently ignored in the making of plans. In this case, the universal tendency toward entropy was well exemplified by the state of the insulation on the wiring of the stairway's emergency lights. Since this area had been abandoned for some time, the extremes of temperature and the dietary preferences of certain local insects had speeded the rate of decay. The sudden activation of the units after so long a dormant period generated a heat that the insulation no longer had the integrity to deal with. Just as the Dennish walked under the bank of lights, there was a small explosion, a burst of brilliant, sparkling white light, and arcs of lightning in all directions. A heavy section of six lights dropped down on one wire, swayed for less than a second and, wrapped in flame, abruptly dropped to the floor. Unfortunately, the Dennish was in the way.

Ah-Jay could only press himself against the wall and gibber in fear as he watched the sudden incineration of the last remaining alien. His first thought was to run back up the stairway, but this was prevented by a new terror. He had gone no more than three steps when he was confronted by another whirring, clanking monster. This new apparition was descending the stairs with speed, its long thick tentacles extended, spray-

ing a white foam in all directions. A revolving red light on its head added to the fearsomeness of the overall effect. Ah-Jay turned and, skirting the smoldering Dennish as widely as possible, entered sublevel B and ran down the main corridor as fast as the dark permitted. It was very evident that the Dennish had brought about its own demise by ignoring the orders of the voice. He could only assume that the voice was that of an enchantress, probably *the* enchantress. This was obviously her castle and her orders would be ignored at dreadful peril. Ah-Jay was absolutely filled with a will to accommodate. If she wanted him to use an elevator, he certainly would. If she wanted him to ride an elevator until doomsday, he would ask no questions. Only show him an elevator, he pleaded, and he was on it at once. He threw open doors at random, hoping to find one. He wasn't sure just what an elevator was, but he inferred from the Dennish's last remark that it had something to do with the small room which had disappeared from off the lobby. He desperately hoped that behind one of these doors, he would find a similar small room and that within such a room, he would find something called an elevator.

The fourth set of doors he threw open revealed not an elevator but a very large room with a floor that sloped down toward a wall with a large, rectangular white area in its center. There were ordered rows of seats filling the floor area, enough for at least 150 people. As soon as the doors opened, the room was flooded with light from hidden sources and music of a stirring, martial type filled the air. Ah-Jay had never seen troops march off to war, but he found the music exciting nonetheless. Perhaps it stimulated a racial memory. Suddenly, the large white space on the wall changed. It glowed with shifting colors and sparkling, three dimensional letters spelling 'Syonhall' appeared. Then, he heard the voice once more, seeming to come from all corners of the room.

"Thank you for taking your valuable time to join with us here today, and thank you very much for your interest in the Syonhall Corporation."

Ah-Jay stood frozen, his heart beating so loudly that he was sure its vibration would betray him. The perfectly modulated feminine tones seemed to cast a web of magic, holding him immobile. He understood at last that he was being welcomed.

"This must be it," he thought, "the heart of the castle. I've penetrated to it. And this is the voice of the enchantress. I've passed her tests, met her challenges and I'm *here!*"

Ah-Jay knew of course, that enchantresses have an unsavory reputation, as a group. Most frequently, they are hags in magic disguise. They are also known for a certain callousness toward castoff lovers, occasionally turning them into pigs and so on. While this is a disposition that would thrill a divorce lawyer, Ah-Jay found it reasonable to be cautious.

"Once, centuries ago," the voice was going on, "Mankind was confined to one small planet . . . "

The picture on the wall changed, fading out before Ah-Jay's unbelieving eyes. The new scene showed a world of vast, teeming cities, which the boy realized at once could not be this one.

"But we went forth, pursued the dream and conquered the stars!"

The picture now showed things somewhat like the magic cottage leaving the crowded planet and entering a great darkness set with countless points of starlight.

"We have peopled thousands of worlds and become a great race!"

Just at that moment, a synapse or two connected in Ah-Jay's brain and a Great Realization occured.

"That's *people* she's talking about," was the message that flashed through his mind, "us, my race! *We're* great? *We* conquered the stars? What happened to it all?"

As is so often the case, the dawning of understanding had simply led to more difficult questions.

"But what about us as individuals," the voice asked, becoming sweetly sad. "Have we become great in our own personal and professional lives? Have we accepted the challenge of the unknown? Have we dared to claim a greater destiny?" The voice was strident and meaningful now. "Are we willing to strive *beyond* the limits imposed by others? To set our own goals and impose our *own* standard of greatness?" The voice was on a rising note. "Do we *dare* to be *great?*" it thundered.

Ah-Jay had sunk to his knees in front of the spectacular display of fireworks now on screen.

"This is the challenge that awaits each and every one of you as new Syonhall Corporation distributors." The voice had changed back to the tones of sweet reason. "As representatives of Syonhall's total and proven line of tested home care products, manufactured right here on our own planet, only you, yourself, will be able to determine the limits of your yearly income. Have you ever dreamed of an income in five figures, six, even *seven?* Its possible if *you* decide to go for it."

Ah-Jay's people didn't use money, but he certainly comprehended the general concept of wealth beyond his wildest dreams. This has never been one of mankind's more difficult ideas to grasp, and it conveys surprisingly well even in fairly primitive societies.

"And now," the voice trilled with a note of pure joy that caused Ah-Jay's heart to leap, "now, I take great pride and great pleasure in presenting you each with the golden key to the kind of bright tomorrow you've decided for yourself that you want. Here it is; your own Syonhall Corporation Distributor's Sample Kit!"

A panel beneath the picture screen slid open and a low trolley rolled out stacked with 200 identical cases, each covered in imitation pink leather.

"Now lets open our cases," said the voice, suiting the action on screen to the word, "And examine the contents carefully."

For the next half hour, the voice took Ah-Jay step by step through the mysteries of various spot removers, soaps, shampoos, and accessory items. The tone, at first hushed and reverential, gradually built until it reached a ringing crescendo of victory over the filth of the universe. Ah-Jay arose from his trance-like state some minutes after the finale, and wandered out of the presentation room a reborn man. He had become a man with a vision, a new meaning and a guaranteed method. He figured the

magic cottage was safe, now that the witches were dead, so he moved in with his sample kit. He practiced until he felt he was ready, then he put the kit in a back pack and set off to the villages. Not many days went by before he discovered a flaw in his reasoning; none of his fellow inhabitants of this world had carpets to shampoo. Even more important, the absence of currency made assembling a fortune a matter of the acquisition of chickens, goats and so on. This can pose problems when you are traveling alone. At last, he returned to the magic cottage, much more tired but no richer. Still hopeful, he recalled the Dennish's instructions regarding sending messages into space. He coded out an aggressive pitch regarding some of the product line's finer points, and waited. Weeks passed and no one came. Regardless of how good a carpet shampoo is, no one of any race is going to be willing to cross the universe for it, in spite of the claims of advertisers.

By now, Ah-Jay had reached a low point. He was even begining to question the validity of his faith. It was at this point that inspiration came at last. Ah-Jay suddenly realized that, though the voice had been right, the product was wrong. He at once coded out the following message in the way the Dennish had instructed him;

Important Historic Bldg.
Twenty floor, human built, glass/metal structure, functioning, one owner, very old, all systems, fp, view, very collectible, needs some work, motivated seller.

A week later, three Dennish walked out of the woods and negotiations began. After a very favorable deal had been concluded, the Dennish went alone to inspect the property. They did not return. Two days later, three more Dennish appeared. The results were similar. At the end of two weeks, Ah-Jay had become a very wealthy man, as protein blocks are counted.

He had only sent the message out once so, eventually, customers stopped coming. He took the opportunity to rest, and returned to his home village to distribute largess and marry his childhood sweetheart. Together, they added a wing on the magic cottage, planted a garden, evolved countless ways to prepare protein blocks, and had four children. Periodically, Ah-Jay would send out the same message, always with the same results. He never did discover why the Dennish collected things like Syonhall House.

After many comfortable years however, he did discover one or two things about Dennish ideas of justice. They were not pleasant discoveries, since the Dennish are by nature both a clever and a vindictive people. Nonetheless, he left behind a large and prosperous family who greatly mourned him and honored his memory for generations. ■

● There is no knowledge that is not power.

Ralph Waldo Emerson


LOW HURDLE
J. O. Jeppson
The step from one kind of being to another doesn't have to be dramatic to be profound.
Hank Jankus
I AM ROBOT 220
I AM USEFUL AROUND THE HOUSE, WITH CHILDREN AND PETS, AND I DO NOT RUST. PLEASE ASK ME ABOUT MY FUNCTIONS.

A robot sat under the oddly blue waterfall next to a plastic sign reading "I am Robot Two-Twenty. I am useful around the house, with children and pets, and I do not rust. Please ask me about my functions."

The WeNeverClose indoor shopping mall was busy all day long and well into the evening but not many people asked Two-Twenty any questions. Humanoid household robots were commonplace, and this one was just like all the others except that he was supposed to be completely waterproof.

The blue water splashing on his head and shoulders seemed to iridesce as the drops ran down the fleximetal covering his body. Unless someone asked him to demonstrate an action—to show that his arms and legs hadn't rusted into immobility—he was motionless except for occasional blinking. All robots with human-imitative eyes could blink to clean the lenses.

"Aren't you bored sitting under that falling water all day and night?" asked a small boy who had temporarily escaped from his robot nanny.

"No, young master."

"What do you think about?"

"Nothing."

The little boy shrugged and wandered off, oblivious to the fact that Two-Twenty had not added the conventional "young master" or "sir" when he answered the last time.

—I forgot, thought Two-Twenty. Something must be wrong.

No robot was particularly bright, but Two-Twenty's model could use cognitive reasoning better than most. He shut his eyes in order to concentrate more effectively.

—I forgot because I was preoccupied with the realization that I had lied to the young master. I did not mean to lie. I always answer "nothing" when anyone asks me what I think about, because I seldom do think about anything. I calculate the weight and speed of the falling drops sometimes, and count the number of people who pass by per hour, and I check my internal clock with the slant of sunbeams through the glass roof as the day passes, but that is usually all my mind does. This time was different.

For the first time since he had been activated, Two-Twenty's emotive circuits went into full operation.

—I am experiencing a strange, uncomfortable mental sensation that I deduce is probably guilt. Data built into my memory bank indicates that this is the normal reaction of a robot brain cognizant of the fact that it has made a mistake. It was a *mistake*. I did not lie deliberately. I was just thinking about something . . . something . . .

"Well? Have you deactivated? Rusted through?" said a voice that sounded rusty itself.

Two-Twenty opened his eyes. Standing before the waterfall was an elderly human female, holding a full shopping bag.

"I am intact, master. I am waterproof." Even as he said it, Two-Twenty realized that he had lied again. That's what he had been thinking about when the child questioned him. About the fact that he was not, after all, waterproof.

"How long have you been sitting in that rather scummy water full of blue dye?"

"One month, master."

"Humph! I'm glad I'm not you. You

may be incapable of rusting but if you stay there long enough you're going to be covered with scum. You'd better tell the manager it's already growing around your right eye. Looks as if some kid put eye shadow on you. I'd tell the manager myself but I have to get an air taxi before they're all taken." She walked away lugging her shopping bag.

Two-Twenty touched his right eyelid with his right finger. The human was correct. The finger now had a blue smudge that the falling water washed away only when he rubbed it hard.

—That was the lie. Although I am not rusting, and the organic matter clinging to my right eyesocket is not damaging my fleximetal skin, nevertheless I am not waterproof. I now detect that the right eyesocket is imperfect. Water has penetrated . . .

—No, not water. I was misled because all organic matter is composed of a high percentage of water. The tiny crack in the back of my right eyesocket has been penetrated by some of the organic matter living in the recirculated water falling on me. Microorganisms are now living inside my body, changing and spilling out onto the outer socket and lid . . .

Two-Twenty watched the crowd of people hurrying through the shopping mall. It was the end of the day and most of the people would be leaving. None of them looked at him as he carefully wiped the blue scum from his right eye.

—I do not have enough data in my memory bank to tell what kind of organic creatures are living in the waterfall, except that they are mindless and as small as a single cell, perhaps even as small as bacteria. I know that organic life can change, and the change can be passed to the next generation.

Two-Twenty remembered that dying is part of organic life, occasionally even for those organisms that reproduce primarily through fission or exchange of substance. His emotive centers surged as he overworked his internal sensors.

—There are creatures dying inside my brain but dead matter is not accumulating so they must be eaten by the living. I have never thought before of what living organic creatures have to do. Even the humans who come to this shopping mall have to eat . . . and eventually die. But humans change so slowly, unlike the creatures inside my head.

The sky above the glass roof of the shopping mall was now dark, and there were few people left, but the inside lighting increased in strength. Concealed spotlights changed color as they swung back and forth to create a cascade of brilliance over the wet robot.

—The water is much more iridescent than it has ever been. It is also more opaque, because the organic matter in it is thicker. Inside me, the microorganisms grow and spread along the electronic pathways that control all the parts of my body. Should I tell the manager when he returns in the morning? He will tell the robotics company who sold me to the shopping mall.

Two-Twenty closed his eyes again and focused on data from his internal sensors. He decided to review what he would tell the manager and the robotics expert.

—Organic matter has penetrated a flaw in my right eye socket. Now microorganisms live along my electronic

circuits and bask in the energy field that surrounds the microbubbles of my brain. The organisms are changing rapidly, perhaps more rapidly than they are in the waterfall. They have many mutations and reproduce frequently, yet my brain has not deactivated, and they have not altered my functioning. . . .

—I am not certain about that. Perhaps I am not certain about anything now. Perhaps my sensors are lying to me. I must protect my own existence, so I must report what has happened. Should I rise and leave the waterfall and wait by the manager's office? Everyone was so sure that I was waterproof that they did not give me an emergency number to call in case of trouble. What should I do?

Two-Twenty did nothing. He sat quietly under the waterfall while midnight came and went, the shopping mall lights dimmed slightly, and Earth's moon passed over the glass roof like a blotched spotlight someone had forgotten to turn off. A patrolling cop turned out two vagrants who tried to sleep inside the mall and then went up to inspect the other four stories. Two-Twenty saw no other human until daybreak.

One of the human cooks for the nearby restaurant entered the mall and walked by Two-Twenty's waterfall just as the full lights turned on. He glanced at the robot.

"Hello, Two-Twenty." Usually no one ever said hello.

"Hello," said Two-Twenty.

"What happened to your body?" asked the cook. "It positively glistens with all sorts of colors."

"It is the water," said Two-Twenty, "and the . . ."

But the cook had vanished into the restaurant and he was alone again.

—I must report that my brain has been invaded. But if I do, then the robotics repair service will do whatever must be done to destroy the microorganisms and close up the opening. At the worst they will deactivate me, clean out my body, and restart my brain. I will not have any memories of the past. I will not be the same individual.

Two-Twenty's emotive circuits gyrated. —I cannot refuse to report on the grounds that it will endanger the existence of the individual I now am. I am not important as an individual. This body and brain are valuable and I have permanent orders to protect them, not my individuality.

—Very well. I will report and lose my individuality.

He raised his head and watched the spray of water droplets reflect and refract the view of the pale blue sky beyond the glass roof. Each drop seemed different, individual.

—I must report. Soon. Is there any other reason why my emotive circuits indicate that reporting my condition is not a good thing?

The scum splashed against his feet and seemed to glow intensely in the growing daylight. People hurried into the shopping mall to open stores and booths and eating places.

—If I report, and if they destroy the organisms infecting me, they will be destroying living creatures. Humans —any living creatures—always destroy others that live. They cannot help it. That is what it is to be organic, to be alive. But I am a robot, and I am supposed to keep life from harm. I have never had the chance to do this. Until now.

He saw the manager of the shopping mall walking by.

"Mr. Snellenton!"

"Yes, Two-Twenty?" Snellenton stopped and ate the doughnut he was holding while he looked at the robot.

"It was a long night," said Two-Twenty.

"Really? I suppose it always is. What did you think about?" Snellenton finished the doughnut and began to walk away without waiting for an answer.

Two-Twenty stood up and watched the people go by. None of them noticed him. Nobody else asked him what he was thinking, but this time he knew the answer. He climbed carefully out of the shallow pool at the bottom of the waterfall and walked toward the back door of the mall.

There was a nature preserve near by, with water in case the microorganisms needed it, and plenty of sunlight. His own energy supply, a permanent fusipack, would last for centuries.

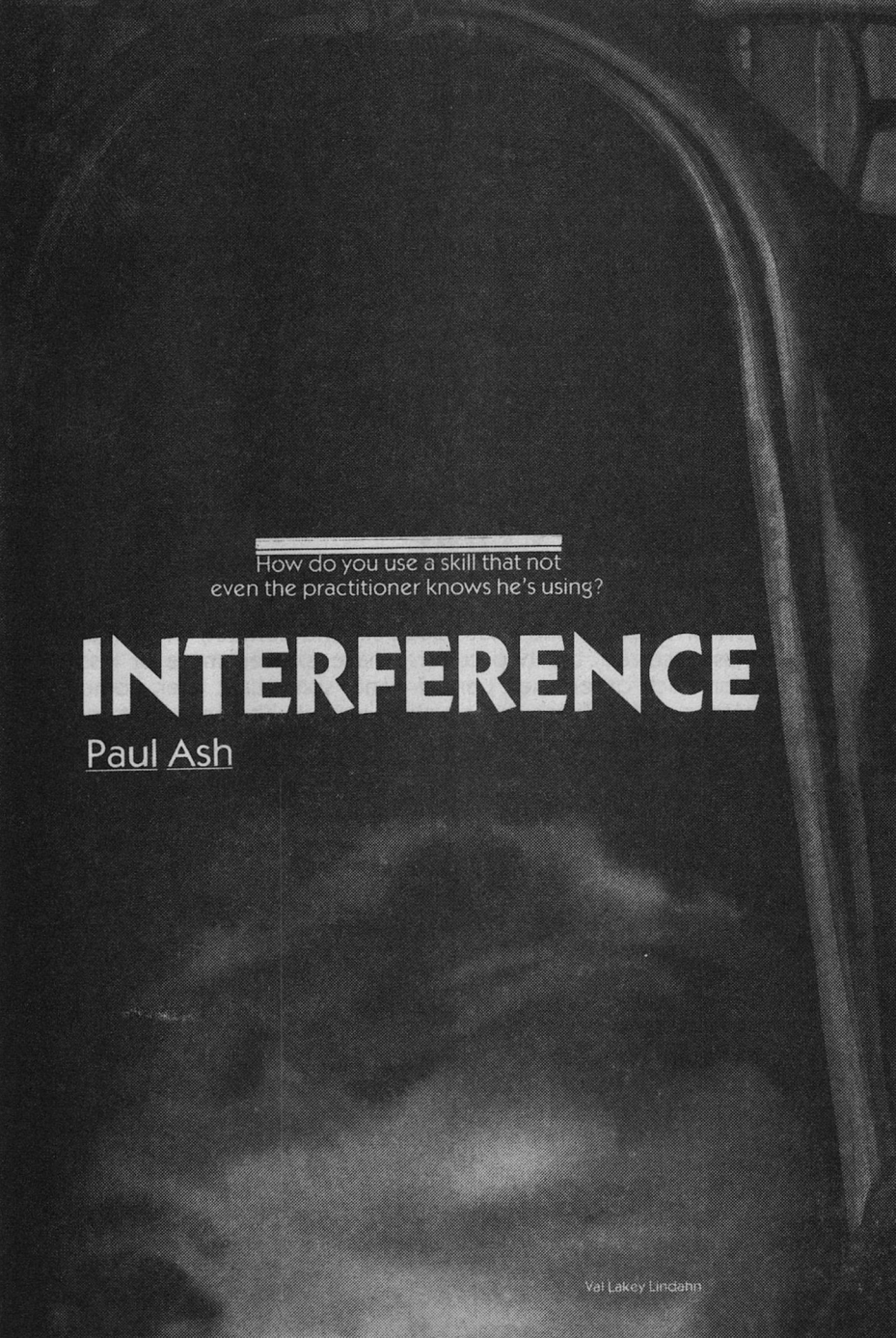
—I am thinking all the time now, thought Two-Twenty.

—I am thinking about being alive. ■

IN TIMES TO COME

There have been plenty of science fiction stories about first contact—the first meeting between human beings and extraterrestrials of one sort or another. But what about *second* contact, when first contact has occurred, the two cultures have exerted more or less influence on each other, then parted—and, some time later, come back together again? That's the situation in W. R. Thompson's April cover story; Earth has been visited, and the aliens have left their mark. As in many cases of contact between "superior" and "inferior" cultures on Earth, our culture has not fared well—it has, to put it bluntly, collapsed. But why? Is it the result of an evil outside influence—or does the collapse merely reflect a pre-existing weakness in our culture itself? If the latter is the case—or even if enough people *think* it is—the resulting cultural sickness could make recovery quite difficult. Thompson's story about what happens when the aliens return is likely to make you rethink some commonly held assumptions about how dangerous contact with an advanced extraterrestrial civilization would be—and why. (And why *did* the aliens come back, anyway?)

Next month we'll also have Part I of an intriguing and possibly important two-part fact article by Michael F. Flynn, called "An Introdution to Psychohistory." Chances are you remember psychohistory from Isaac Asimov's *Foundation* stories, and quite probably regard it as an interesting but farfetched science fictional speculation. But it seems there are several lines of research already going on, one or more of which may be early steps toward the development of a real science of psychohistory. Flynn's article may be the first to bring them all together and suggest what their significance might be when taken together.



How do you use a skill that not even the practitioner knows he's using?

INTERFERENCE

Paul Ash

Val Lakey Lindahn

On Wednesday night the local TriV station in Rockwell Deep always ran a Standup unless there was a big game on, so on most Thursdays Johnny Washington had something to complain about. He was the Class Genius of my year in Level II High School, and complaining was one of the things he did best.

At Recess on that particular Thursday he was in good form. Last years's Annual Assessments had just been published (the general announcement is held back for three months so that anyone who doesn't want their name included has time to object) so the Standup on the night before had been on some subject like Can We Afford To Let Our Best And Brightest Kids Go To Space?

"There they were," he was saying "a bunch of mixed mediocrities, all perfectly ready to Stand Up And Be Counted on what to do with kids assessed at 160 points and over. Did it occur to any of them that a person whose brains could be considered a National Asset might be better able to decide how to use them than a bunch who probably classified within three points of the National Average, either way?"

I agreed with him all right. In my opinion if they introduce legislation to stop the very bright ones from doing what they want to, just because somebody feels they would be more useful doing something else, some of them will probably decide not to be any use at all. Very bright kids can be even more ornery than the rest (see Johnny, for instance, though he isn't within twenty points of the category we were talking about).

I'm a good deal further from it than that. All I can claim is that I am the only person in three generations of my family who got into high school. I came close to graduating, too; in fact I would have done, practically for certain, but for what happened next.

The flashscreen in the Canteen beeped for attention, then lit up with an announcement:

THE SENIOR CLASS WILL TAKE PART IN A PERSONALITY CLASSIFICATION EXERCISE AT 1400 TOMORROW IN ROOM 127. (PARTICIPATION VOLUNTARY)

I said, "What on Earth or under it is a Personality Classification Exercise?"

"They had one last year," said my friend Lisa. "That was the thing Jane Schlegel called the Dope Test, because it was so stupid. Don't you remember?"

I did, then. Jane Schlegel was the Class Genius in the year before mine. The name was so appropriate that the other two high schools in Rockwell Deep (Level I and III. The one on Level IV was closed years ago) took it up as well.

"Wasn't there some sort of suggestion that if you turned out to have the right kind of personality the Government would give you a real job?" I reflected.

Lisa looked wise. "Well, sure, that idea kind of floated into the air when they were asking the seniors to 'participate', but nobody heard anything about it afterwards. A boy I know in Level I High said that some postgraduate with a lot of pull must have organized it, to get something he could write a thesis about."

Nobody was all that keen to play guinea-pig again, but we'd all done it often enough to know that all you lose is a little time. . . . The Voluntary bit

turned out to mean that you could get out of "participating" if you could talk a parent into writing a letter about it. Nobody thought it was worth the trouble. The Exercise only took about forty minutes, it was the start of the semester when nothing much was happening, and there was no strain to it—the results didn't count against your Annual Assessment or anything else that mattered. Certainly it was no tax on the brain, unless you tried to figure out why on Earth or under it anyone wanted to set it in the first place.

Johnny Washington, upholding his position as Class Genius, did at least come up with a more colorful explanation than last year's. He said Subversive Forces had organized it to overthrow the Education System by discrediting Multiple Choice Questions once for all.

Well, maybe MCQs *were* invented by lazy teachers so all the marking could be done by computers, and maybe they *do* only test your memory for facts when what ought to count is how you put them together, but usually, up to a point, MCQs do have a *point*, I mean one answer in the five is the right one and you stand a better chance of picking it out if you paid attention in class. But in the Dope Test there *were* no right answers; all the questions were on matters of opinion, or taste; and what's more, they were on subjects hardly anybody would bother to *have* opinions about, or tastes either.

Like: *Which would you choose for purposes of interior decoration:*

Ivory White?
Off-White?
Magnolia White?
Brilliant White?
Oyster White?

(With nothing to say what *kind* of interior you are decorating, or what other colors are being used; let alone that nobody, but *nobody* is decorating interiors in *any* sort of white this year (see Mom's favorite Home Beautiful program on TriV).

Or: *Whose writings do you consider to have the greatest relevance to the present day:*

Marcus Aurelius?
Fenelon?
Chesterfield?
Matthew Arnold?
Boethius?

Mention *any* of those in general conversation and watch your friends say *"Who?"*

One or two questions were factual, in a way, like:

Which of these family names occurs most often in the population of the world as a whole:

Chin?
Garcia?
Jones?
Petrov?
Schmidt?

I guess you *could* actually find a true answer to that, by querying the eight Bureaus of Regional Population and adding together the answers—always supposing the eight directors would waste machine-time on it.

After we applauded his wit Johnny was still scowling, so we knew he had another Great Thought coming, and presently it hatched. "I'll tell you how to classify the personality of whoever designed that test—it's *split*." We asked "Why?"

"Because whoever picked the questions was a Grade A moron, but whoever designed the hardware was more than half bright—except for letting it be wasted like that."

The Dope Test did not use printed questionnaires—not even the kind used for the Annual Assessments, printed before your very eyes with questions chosen randomly from a memory bank holding half a million. Instead we had each been given a flat plate like a computer screen, with an electro-stylus and an earplug. The questions appeared on the plate one at a time, and you just pressed the stylus against the answer of your choice. That must have registered by radio; the plate itself was not wired to anything. A new question appeared every sixty seconds—unless somebody was late answering the one before. Davey London tried to skip one, just from cussedness, and held us all up; the new question wouldn't come from the main computer—wherever *that* was, not in the room with us—until it had registered an answer from every single plate. Afterwards, Davey said his earplug had made a noise—he couldn't describe it, except to say he never wanted to hear it again—until he pressed his stylus against an answer at random, when it stopped.

The answers were not in line or column but in a pentagon, and they moved —five seconds in one spot, then round to the next, and so on, so that your choice was not influenced by whichever came first in line. Very neat.

The whole setup must also have been very expensive, and for what? We chewed it over and decided that the test had been designed by some psychologist who was more than usually psychological; not very original, but the best we could do.

The rest of the afternoon was free, so I walked home—Yes, that means what you think it does; my home was in Rockwell Deep. Mom and I had been living at No. 27 East III/14th Street for three years and whatever you may have heard it was *perfectly* on key. Most of Rockwell Deep is on key, come to that. The only sour spot is IVth Level, and not all of that—only what used to be the most fashionable part, with the big expensive units. Twenty years ago, when it suddenly got fashionable again to live Topside, it was the people from that section who got up and left—for the Rockies, or the Grand Canyon, or even Antarctica—anyway, nobody who could afford the rent of those units wanted to live in them anymore. So after a while some of them were bought and split up into offices for small businesses—some of which turned out to be crooked—or made into the sort of lodging-house that is always losing its license through overcrowding. And then when the Space Gate was set up only ten miles away, squatters moved into the rest.

(Just what they get out of it I don't understand. Rockwell Deep is close enough so they can go and poke their noses through the wire when there's a landing or a launching, maybe a dozen times a year; but it happens so far away that all you see is a big cloud of dust with something bright in the middle. You see much more on TriV.)

But IIIrd Level and the two above it were never depopulated. Half the families have lived there for a hundred, two hundred, maybe three hundred years;

but newcomers are made welcome. Mom was invited to join the Street Committee the year we moved in. The Committees see to retouching the murals every year, and keeping the mid-street garden strip blooming, and every fourth week the street is closed to traffic on Saturday night and we have a dance.

To tell the truth, it's more fun than the ten years we lived in Chetwood. That used to be a village, Topside, until Rockwell High grew all round it. If your grandparents weren't born there the people treat you politely, except some of the kids, but you'll never be an *inhabitant*.

Dad bought the house there when I was five. It took him most of a year, before Mom and I moved in, to make sure it wouldn't fall down, and another five to do all he thought it needed, but when he finished it was on key right up the scale.

Most of the time I liked living Topside; trees, birds, changing seasons . . . it's something you ought to experience . . . anyway I was still going to school in the Deep City, so I got all the benefits of modern civilization as well. If Mom missed them she never would have said. Only when we had to come back to Rockwell Deep, in spite of all the trouble and worry I knew she had that feeling of coming home. . . .

However, when I got back that afternoon I thought she seemed a bit down, so I told her all about the Dope Test. I thought I made it pretty funny.

"Tina, dear," said Mom gently, "I don't think you're being quite fair. If this exercise was as pointless as you seem to think, the Authorities would never have allowed school time to be wasted on it."

I had forgotten how Mom is about Authorities. She believes that all of them, especially the ones concerned with my education, are composed entirely of very wise, careful people who go into everything in depth, so that whatever they decide is bound to be all for the best. I guess she finds it reassuring, so I don't argue.

I didn't think of that at the time, though, so I made some smart-ass kind of answer and Mom tried to find some really good points in that Exercise, or even just one, and couldn't; and got as cross as she ever gets.

Anyway it took her mind off what was bothering her, to the point where she forgot the letter she had hidden in her library book and let it drop out.

The envelope fell face up. I wondered who we knew who used such a fancy voice-writer—the letters were so curly you could hardly read them. Then Mom made a grab for it and dropped it again and this time if fell with the return address on top.

Mom would assess the full four octaves for mothering, and housekeeping, and several other things, but there are times when she is just not too bright. Like the first time she picked a husband—even if she was only seventeen. Not that I ever met him—he left three years before I was born—but people who did say that he was just like Big Fred.

Mom says when I was little I adored Big Fred, and he was nice to me and let me follow him around, even though he was ten years older. I don't remember that. What I *do* remember is seeing

him go through Dad's handbag, when I was seven. I had been told so many times that nobody ever, but *ever,* puts a hand into someone else's handbag, unless maybe to find out who was the owner if it turned up lost, that I felt all muddled. I couldn't believe I had really seen that, although I knew I had. When Dad threw Fred out about six months later I kind of thought that was the reason.

Actually it was just that Big Fred had turned eighteen. Dad said now he was legally adult he must either find himself a job or sign up for Statutory Right of Employment and give Mom half his pay for board and lodging.

Dad never took SRE in his life. He was born Topside, in a little place so remote that the Disruption was something they only heard about; partly I guess because the place was too poor to loot. Life there just kept going on, based on self-sufficiency in essentials plus a little trade when they had a good year, while the Deep Cities were dug and most of Topside went up in revolutions and counterrevolutions with just plain riots in between. The Time of Settlement didn't make that much difference to them, either. All along there had been a few restless young ones who left home to see the world, and once in a while one of them would come back and tell stories that started the others' feet itching. After the Settlement, a few letters got through from those who didn't come back.

It was a letter that made Dad restless enough to get up and go; from a second cousin of his mother's. He never actually caught up with him, but people who knew him gave Dad a bit of help, in the way of board and lodging in exchange for odd jobs, and that was what gave him his idea. He wouldn't register for SRE because he knew he didn't have any qualifications for the interesting jobs—his mother taught him to read and write and figure prices and costs, but that was all the schooling he had. So he would have got one of the make-work occupations that *could* be done by a man and a machine, but actually keep twenty or thirty reasonably busy, in company, and with somewhere to go outside their own units. The work isn't useless; they *are* making a contribution to society, and can take pride in that; many of them do. Dad saw the point of it all right, but it wasn't what he wanted himself.

He saw that with people pouring out of the Deep Cities to live Topside, they were getting a whole new lot of problems. Those who had stayed Topside all along grew up knowing how to handle their solar generators and recycling systems and gardening equipment, and how to prepare for snow and gales and droughts and fallen leaves; and the ones who left the wealthy parts of the Deep Cities for the swank new locations could hire someone to take care of all that. But those who came Topside later, especially the ones who bought old houses because they were cheap (or chic, or cute) found themselves with a whole lot of problems they didn't know how to tackle.

Having grown up Topside, in a place where there was no money for new equipment, Dad knew just about every way things *could* go wrong, and how to fix them when they did. So he set up as a professional DIY. He would take on almost any job that one man could

do without heavy machinery, even clearing blocked drains; but he specialized in solar and recycling systems. As soon as he got known he had all the work he could handle.

All the time he was working topside he had lodgings in Rockwell Deep. I think he wanted to try something as unlike home as possible. But after he married my mother his one idea was to give her a house Topside. He did it, too, in the end. He carried Fred as a passenger, too, as long as there was no alternative, but he wasn't going to do it forever.

Fred said that if he was going to be forced into drudgery six hours a day, four days a week, the money was damned well *his*. He moved into Bachelors' Barracks, where the basic charge is 60% of basic SRE pay, and that was the last we heard of him for nearly five years.

About two years after Fred left, Dad died. He came home rather late—it was the time of year for cleaning solar panels—and sat down to rest before supper. Mom left him undisturbed for most of an hour, then tried to wake him . . . The doctor got round with a resuscitator in three minutes, but it was much too late.

Big Fred didn't come to the funeral.

About three years later he roused Mom and me by banging on the door in the middle of the night.

I never really understood what it was that he had done. It was not the police who were after him, but it could have been an employer, or a bookie, or business associates, or the Mob. All I know for certain is that that was why Mom sold the house. She had the income from Dad's Insurance, but couldn't cash the principal—maybe Dad was thinking of Big Fred when he arranged it that way—but the house was hers, free and clear. Paying off whoever it was did not take the whole selling price; there was enough to buy the lease of a unit in Rockwell Deep, where accommodation is cheap, and to put some in a trust for my education. That was fixed so she couldn't touch it; maybe *she* was thinking of Fred. He had been her baby boy and she never forgot it, but he'd certainly gone a long way since then.

He wrote to her once or twice a year, just a line or two; he had never asked her for money again, but the letters reminded her to worry about him. I'd seen this latest one already, so she gave it me to read. It was just how was she, he was doing fine, his latest employer really understood the value of his services and he had the use of some very high-class equipment (I guess that explained the curly script). But nothing to do with Big Fred was ever really good news.

A week later I was sent for to see the Principal. My conscience had nothing on it that he was apt to know about so I thought this was just one more talk about my future career. As it turned out that was true, but not in the way I expected. He told me that my Personality, as revealed by the Classification Exercise, had turned out to be of interest to a potential employer, who would like me to take some further tests and was prepared to pay me ten Credits to do so.

By that time I had forgotten all about the Dope Test and it took me a moment to understand what he was talking about. When I did I nearly fell through

the floor, except it is solid rock, of course, and six feet thick.

The further tests were to take place at the Council Offices on Level III. The Principal said he didn't feel I needed an escort so close to home, and I assured him I didn't; Rockwell Deep is a lot safer than any houses above ground, except for parts of Level IV.

The office was one of the big ones used for meetings of up to ten or twelve people, but apparently the test was going to be solo—on my side, I mean. There were two of *them,* a man facing the door in an office chair with instrumented arms, and a woman in some sort of headset sitting at a table with her back to me and operating a computer terminal.

I said "I'm Tina Harrison."

The man nodded. He looked just like a thousand other men, except that somehow I got the idea he had put quite a lot of work into looking that way, blurring his character and blunting the sharp edges of his personality—

"Please sit down, Miss Harrison. My name is Stride."

His voice was like the rest of him —quite all right as voices go but with not much color, and I suspected that had been deliberately taken out of it.

"Thank you for coming," he went on. "Here is your attendance fee." He handed over an envelope thin enough so I could see the outline of the note inside.

"I won't ask you to do any more formal tests, for the moment," he went on. "The results we already have are sufficiently informative about those aspects of your personality. Instead I'd like you to talk to me for a few minutes."

"What about?" I said.

"Oh . . . tell me about your school. Is it a good one, do you think?"

I had just made a discovery; that I didn't much care to have people evaluating my personality, or even aspects of it, from that nonsense in the Dope Test. In fact I didn't care to have my personality classified, period. I didn't want it put into somebody's computer, tagged so as to be available on demand. I didn't want to go on with this at all.

Unfortunately I had just accepted Cr.10 to do so. Of course I could hand it back; but how was I going to explain that? Not just to Stride; I'd have to account for it to the Principal if I backed out.

Well, there were other ways to play it . . .

I told him about Level II High. I gave him, word for word, the first three paragraphs of last year's School Magazine; all about Academic Records and Social and Artistic Activities and Integration with the Community. . . . So let him try and classify my personality from *that.*

He stopped me at the beginning of the fourth paragraph and said "How about sports? I suppose that schools in the Deep Cities are at something of a disadvantage; they can hardly have space to play the usual games."

Sports has absolutely no bearing on my personality; I never hit a ball straight in my life. . . . I switched to the School Prospectus. "On the contrary, Mr. Stride. There are two basketball cards and five for tendon, and the school studio is quite big enough for football or baseboard or—"

I stopped, feeling that something had

gone wrong, and he said quickly "Excellent. Do you have anywhere to swim?"

I began to wonder if he was thinking of sending his own kids to Level II High. I said, "The school has its own swimming boat—I mean base—so we have the opportunity to shin all the year round. In summer we go Topside to swan—slim—I mean there's a big laid—lane—residence—I mean—*what are you doing to me?"*

I started to get up. Stride patted the air in front of him rather hurriedly, half getting up himself.

"It's perfectly all right, Miss Harrison. You're doing fine."

I yelled, "Liar!—" and the sound of my own voice shouting that at a strange grown-up shocked me into being quiet. I sat down and tried to keep from trembling. When I felt my voice was steady enough I said, "I don't know what you did, but it made me use all the wrong words—and that is *not* part of my personality."

"No, no, of course it isn't. That was what we call an Interference Test. It tests sensitivity to . . . er . . . to certain influences. You seem to be highly responsive."

I glared at him. "You might have warned me!" I wondered what "certain influences" were and whether I could sue him if I developed a permanent stutter.

"I'm afraid that would invalidate the test," Stride said. "However, we've finished with that aspect. Hilda, the subliminal apparatus, please."

The woman rose and handed me a glassy plate like the one we had for the Dope Test. When she had her back to Stride she looked me straight in the eye and winked, very quickly. Maybe it was just a trick to make me feel better, but it did.

"Now this one I *can* explain beforehand without influencing the result," said Stride. "I suppose you've heard of subliminal perception?"

"When you see something too quick to take it in, consciously, but you remember it anyhow?"

"Exactly."

I arranged my mouth to look prim. "I thought that was illegal."

"It is illegal to use subliminal stimuli to influence people without their knowledge; as in advertising, or political propaganda," answered Stride patiently. "I assure you there is nothing illegal in testing subliminal perception if the subject consents."

Well, I knew that—anyway I guessed it. I was just trying to needle him. I should have known you can't get back at grownups that way, they just go patient on you.

. . . Stride was already talking about this other test and I'd missed the start. Well, if I got it wrong to hell with it. As soon as it was over I was going straight home and he could find another personality to classify.

". . . about three minutes," Stride was saying. "To give the memory time to percolate." He flashed me a quick grin as though there had been a joke somewhere. "Then I shall ask you to write down as many of the words as you can; but don't start until I give the word. Ready, Miss Harrison?"

It was a good thing I didn't care how the test came out, I thought; because I didn't catch a single word. They winked

on all over the plate at all angles; one after another I supposed, but so fast I couldn't even be sure of that.

I caught myself thinking it wasn't fair—I could have read them if they'd been right way up—which was silly.

Stride said, "When the time comes to write them down, just use the stylus as a pen. Use block letters. When you've written one word, wait until it fades before you start on the next one. Any questions, Miss Harrison?"

Yes, I had a lot of them. Such as why they were looking for somebody whose mental processes were easily interfered with and who could be influenced by subliminal perception . . . That seemed really sinister. On the other hand they couldn't *make* me take a job however they had classified my personality—I didn't *think* they could—

"Ready, Hilda?" Stride again. I wondered what the woman had to be ready for—to put the computer in receiving mode, maybe? Would she see the words on her screen or would they go straight into the computer?

So far nothing could be happening because I hadn't thought of anything to write—

A word popped into my head: BRIMSTONE.

Could that possibly be one of the words I had seen? I didn't remember that any of them looked so long. . . . Well, I wasn't trying to pass the test, so it didn't matter whether it was correct or not. I wrote it down.

Suddenly I realized that I could get the whole thing over just by doing a bit of free associating and writing the results down. From BRIMSTONE I could go to . . . well, TREACLE. Or PITCHFORKS. And nobody would know that I'd done it on purpose, it would look as though the associations had turned out to be stronger than the subliminal memory. . . . I was just going to write PITCHFORKS when I remembered that I had to wait for the first word to fade. BRIMSTONE was still on the plate. Irritating. I couldn't think why they used plates with such a long lag-time . . . At last it winked out. I put the stylus to the plate—

DIAMOND.

It was clear and sharp and insistent in my mind. . . . Evidence of subliminal perception, or—? If I was *really* all that susceptible maybe I ought to know about it. . . . I wrote it down.

IRON. The time-lag didn't seem so lengthy on that one.

BLACKLEAD. What was it, a list of the common names of elemental substances?

SILICON

TIN

Yes, definitely elements. What came next? Copper? Silver? Gold—?

WAGON.

What brought that in? *Two* lists? Or was it all some nonsense cooked up by my subconscious without reference to anything else? It didn't *feel* like that. I know the sort of things my subconscious mind turns out when it has nothing better to do—

The next word was SPRING.

CATERPILLAR

CATKIN

CAT

Word association—? If so what was this next one—half-remembered—stuck on the tip of my mind's tongue —AS-

TRO—Astrology? Astronomy? Astrodome?—

ASTROGATION. It was a relief to write it down. I stuck the stylus back into its clip. That was the finish. If I remembered any more words I would just forget them again.

Stride said "That's all." He looked across at the woman's back, waiting.

I found I was waiting, too. There's something about tests: even when it doesn't matter I want to know how I've done. She went on fiddling for half a minute, then swivelled round in her chair and gave Stride a thumbs-up. He let out a long sigh, and his face reorganized itself around a great big grin.

"What score?" he asked.

"Eleven and a half."

"Wow!—What do you mean, a half?"

"She put WAGON instead of CART."

"A half? Should be three-quarters at least. Make it the full dozen, Hilda; after all, anything over seven is bingo. . . ." He sobered abruptly and turned to me.

"Miss Harrison, I'm sure you realized a long time ago that these tests have nothing to do with personality in the broad sense. That was merely camouflage."

I hadn't realized anything of the sort—I'd simply got a rather murky impression of the type of personality they were testing for. It was a relief to know that was irrelevant, or was it?—Camouflage? What was so wrong with the truth?

Stride was going on, "It would have caused altogether too much excitement if we'd told the truth—and too much disappointment for the vast majority who test out negative. Miss Harrison, what do you understand by the initials See Ell Dee?"

I was going to say "Nothing!" when I suddenly saw them in my mind's eye, the way they appeared in about two dozen Fac programs a couple of years ago—C(L-D).

I said, slowly, "Communications . . . Long-Distance?"

"Exactly."

My voice shot up to cracking point. "But that's—Space!"

"The latest section of the Space Services, and by far the most difficult to recruit for, because the basic qualification is so rare. Miss Harrison, would you like to train for C(L-D)?"

After the first four months of training we got two weeks' leave, and I decided to spend it at home.

The Personnel Officer tried to convince me that I would do better to invite Mom to join me at a resort somewhere; but I told her going home was a calculated risk, taken to get information I couldn't get any other way.

Mom wrote every week and told me everything was fine. . . . If she was being ostracized by the whole neighborhood and had the bailiffs in, Mom would never have worried me by admitting that everything was anything *but* fine. What's more she could probably have kept it up through two weeks in a hotel; and I was not about to break the rules of decent behavior, not to mention the rules of the C(L-D) Corps, by trying to get pickup on my own Mother. (Anyway I had realized early in training that Mom must have a good, tight seal —people with lots of experience in controlling their feelings often do.)

But if I saw her at home I was bound to find out if anything was wrong, in a couple of days at most; so I went.

And in a couple of *hours* at most I realized that Mom had simply been telling the truth. She was having the time of her life; invited to everything that was happening, friends dropping in every day, and at least three definite prospects working up to a proposal of marriage —one widowed, one divorced and one a hardened bachelor going soft at the edges. In fact everything about Mom's social life was perfectly on key except for one item: and the sour note was *me*.

Plenty of people had warned me about it, starting with Stride at that first interview. He told me, straight, that if I let anyone at all know I had been picked for training as a C(L-D) I would regret it. The profession was highly unpopular.

"That can't be true," I protested. "Two years back I remember everybody talking about what a good thing it was."

"Oh, sure." He leaned back, looking sad and cynical. "Everybody agrees that the formation of the Communications (Long-Distance) Corps was a very good thing. Now that it's possible for expeditions to send reports back and to exchange information among themselves, the efficiency of planetary survey teams has just about doubled, which means that the chances of finding an inhabitable planet have just about doubled, too. But approving of that is one thing. Finding that one of your own neighbors has been invited to join the Corps is something else altogether.

"Miss Harrison—Tina—" he leaned towards me across the desk—"whether you decide to join C(L-D) or not" (I wondered whether anyone had ever really refused that offer) "you'd better understand this. C(L-D)s are highly unpopular as *people,* for two reasons. I won't call them *good* reasons, but they pack a hell of a punch.

"One is fear. Everyone knows that C(L-D)s are telepaths. Some of our Public Relations people wanted to use another term for it, but the Commander decided it wouldn't help. Unfortunately, to the average person that seems to mean that a C(L-D) can sneak into his head and find out all the things he particularly doesn't want anyone to know."

He lifted a hand as I started to speak. "I know, you wouldn't do that and anyway you *can't*. That's true of ninety-five percent at least of our recruits. One or two may be capable of something of the sort, under some circumstances; but *all* of them are strictly forbidden to try. In twenty years' time, if the PR people do a good job, we may have a generation of citizens who understand that; but for the moment the man on the street—and the woman and the girl and the boy on the street—are afraid any time they meet a C(L-D) that he or she is going to make it a first priority to dig their nastiest secrets out of their subconscious; and nothing we can say will make them think otherwise.

"The second reason is envy. Do you remember what you said, when I asked if you wanted to train as a C(L-D)?"

I nodded. It had just popped out, because I was so surprised: *"But my last Assessment was only twelve points up on the National Average!"*

"You thought the Space Service was

recruited only from people at the top end of the Assessments, mental and physical. Well, there's some truth in that. The Service gets applications from enormously more people than it could ever accomodate, and most of them are pretty high in the Assessments, because the rest mostly figure they haven't a chance and don't try. So the Service gets to pick and choose; and if superfit, superstable geniuses are available they naturally get chosen for a lot of the posts, because those qualities are useful in Space work.

"However, the general public has picked up the impression that recruitment into the Service is a kind of reward for general merit, and that isn't true. We recruit the kind of people *we need.* There are several slots where quite different qualities are more important—C(L-D) is just the latest, and the most difficult to fill. The basic ability is so rare that we'll take just about anybody who has it, provided they can walk and talk—

"No, I'm wrong. There's one girl in a wheelchair. I don't suppose being dumb would be too much of a barrier; there's always sign language. We've got a couple of trainees who grade as morons—high on that scale, but morons.

"A lot of people resent that. They seem to feel C(L-D)s have cheated somehow, getting into the Service when their Assessments are not particularly high. No sense to it, but the feeling can run very strong. A few C(L-D)s have been roughed up because of it and just about all of them who let it become generally known that they were joining the Corps have been the target for abusive phone calls and that sort of nuisance. They didn't enjoy what happened to their personal relationships, either. Many of them found they hadn't a friend left. Even their parents turned against them, in some cases—including a few who had been absolutely confident they could rely on Mom and Dad, however anyone else might react.

"So take my advice; don't talk to *anyone* before you make up your own mind. And if you decide *against* joining C(L-D), never tell *anyone* you were invited to do so; not your best friend or your lover or your husband or your children. And if you *do* decide to join—well, your Mother will have to be told, obviously. We'll fix up a cover story for everybody else."

He even hinted he'd be glad to stand by when I was telling Mom, if I liked. I didn't like. I told her the next morning—I felt I had to wait that long, to make it look as though I'd thought things over. (I didn't sleep much the night before, but I wasn't exactly *thinking. . . .*) Anyway, Mom took it quite calmly, and was pleased, for me. She wasn't even very much surprised—it seemed I took the words out of her mouth so often she'd wondered about it, especially after all the publicity about C(L-D) Corps a couple of years back.

Afterwards I called Stride and he came round with his cover story ideas, but Mom turned them down.

It wasn't just that she disliked telling lies, but—as she explained to him—it makes life very complicated to have to remember what you can tell people and what you can't. (I guess she had enough of that when Fred's father was around.) There would have to be an announcement of some sort, to explain why I left

the School four months short of graduation; and she proposed that once I was safely away at training camp a small notice should be sent to the local newsfax, telling the truth.

Stride wasn't happy.

"Mrs. Harrison, you may not have realized that the public reaction could affect *you,* too. Abusive phone calls."

Mom shook her head.

"It's nice of you to worry, Mr. Stride, but truly you don't have to. After all, this *is* Rockwell Deep."

He looked a bit blank.

"I know the Deep Cities have a long tradition of orderly behavior, Mrs. Harrison, but—"

"Oh, I'm not relying on that," said Mom. "—Well, where my neighbors and friends are concerned, yes; but a good many rather *unpredictable* people have moved in nowadays, especially in Fourth Level. But our phone system is very up-to-date: all calls are traceable, either to a private phone or to somebody's credit card. As for anything else, you have to remember the Deep Cities were dug during the Disruption, when people Topside hardly dared go out of doors because of muggers and burglars and riots and demonstrations and that. Every one of our streets has a surveillance system built in. If anyone came and daubed graffiti on *my* house, or hung about outside to throw things, like they did to those poor people you were telling me about, the police would be there in seconds—and the records would be there in the data banks, for evidence.

"As for breaking in—"

Stride grinned. "Yes, Mrs. Harrison, I noticed your front door." (It's a sliding sheet of polished rock nine inches thick; standard construction along our street.) "—All right, I'll accept that you know what you're doing."

He looked a bit surprised, all the same. Mom does not look like the kind of person who studies up on her local police system. Actually, Captain Brown of the local precinct is a friend of hers—they met on one of Mom's committees, and exchanged knitting patterns or something, and nowadays they take tea or coffee in each other's dwelling units almost every week.

Captain Brown dropped in the day after I came home on leave, and seemed to take me pretty much in her stride. Mom had made several other friends at the precinct and they didn't seem much disturbed, either, at having a C(L-D) around—I suppose police conditioning meant *their* consciences were in pretty good order. Not like Mom's bachelor suitor, who dropped in without invitation and nearly threw a fit at meeting me. (I wouldn't have tried to get pickup on the reason even if I had known how, but I hoped Mom would notice and take warning—I didn't like him much in any case).

However, once I'd said Hello I usually remembered an engagement elsewhere when one of Mom's friends came to call. As for *my* friends, I didn't really have any. The sort of letters I got from people I had thought *were* my friends had taught me not to try to look them up while I was on leave. Lisa would have been all right—Lisa's curiosity is much the biggest part of her and she would have wanted to hear all about it if I'd been an axe-murderer just home after psycho-correction; but she was

away getting Work Experience before going to college.

There are plenty of things in Rockwell Deep you can do on your own, from taking a floater round the street murals—some of them are top-class Art and the rest are always changing—to visiting three live theatres and eleven Solidromes. The fourth day of my leave I went up and took a look at the fountain in Flying Horse Square, which I hadn't seen during the three years since Mom and I moved into III/24th Street. I walked home thinking I'd go see it, in the future, whenever I came back.

When I walked into the living room, there was Big Fred.

I heard his laugh from the other side of the door, so I did have some warning. When I came in he surged up with a yell of "Tina! Little Sis!" and wrapped himself around me. Mom was there, so I didn't shove him away.

Mom's living room is quite large, as they go on Third Level—big enough to seat eight or nine people comfortably; but he seemed to overflow it. Mom had told me that he got called Big Fred when he was quite small, to distinguish him from his father, because he threw a tantrum if they called him *Little* Fred; but he had grown to fit the name. He was high, wide and thick—not fat, exactly, more sort of cylindrical.

Fred had got a job—private, I mean, not SRE. He stood in front of our see-through window (yes, houses in Rockwell Deep do have them; there's plenty to look at out in the street) and told us that only suckers stayed on SRE, where you had to keep their rotten hours even though the work could have been done by pressing one button and going home. He didn't tell us what this job was, but evidently it paid well. His clothes were good cloth, well sewn, and said so, loudly.

Mom sat on the sofa and beamed proudly and uneasily at her two chicks, hoping they wouldn't peck one another; and I determined not to get into a fight whatever Big Fred did.

He switched from unemployment to talking in a loud, unfocused way about how he'd been dropping in a lot lately (Mom had told me she'd seen him twice since I went away) to make sure she wasn't lonely while her little girl was off playing with the Space boys, and how families ought to keep up with one another, not so?

I said sedately, "I shall always be interested to hear from you—Freddie."

He shot me a look, half startled and half nasty, then decided to laugh again.

"Hahahahahaha! No, what I mean is, here we both are, for once, so we ought to see something of one another. Tell you what, I'll squire you round a bit, Little Sis. How about coming to the races with me tomorrow?"

I said, "No, thanks."

Out of the tail of my eye I saw Mom's look of disappointment, so I added hurriedly, "I've *been* to the races, Fred. With Dad. I was bored stiff. *Hours* hanging around waiting for something to happen and then when it did it was behind a lot of people and I didn't see a thing. And it rained."

Fred gave his usual bray. "Hahaha! Tina, it won't be like that, give you my word. My boss has a box at the races and he lets me take guests. It's real plush. Sees over all the heads. You'll love it."

"No," I said. "I'm not interested in racing. I'll go with you to the sollies or the theatre or the Saturday night hop—I think 12th Street is holding it this week. I'll even stretch a point and go with you to a ball game, if there is one. If you can't afford the tickets we'll go Dutch, but I will *not* go to the races. With you or anyone."

He looked at me for a moment without moving any part of his face. I felt just as glad that I'd been trained to keep a good, tight seal against other people's stray thoughts. Then he said "Sollies, eh? Have to find out what's on. I'll call you."

Mom was so relieved she jumped up and kissed him. Then she kissed me. Then she went to get coffee and cake, and I had seen enough of Fred, so I went to help her. In the kitchen it occurred to me that *she* ought to come to the sollies too, but she said she had some committee work to catch up on and would rather not.

Fred ate the cake, but didn't remember to say how good it was until I gave him a lead. Very soon he got up and said he had a little job to do for the Boss Man and after all that was what he got paid for, hahaha! and he left.

I thought that would be the end of it, but he rang next morning.

"That you, Little Sis? Say, about the sollies. There's one of those old classics you rave about, at the place on II/11th Avenue. Last day today. I've got tickets. Pick you up at Mom's place at 1400, on key?"

The only thing that stopped me being thoroughly taken aback was, he'd got it wrong. I do *not* rave about the so-called classics, preferring modern expertise to primitive quaintness. However, I couldn't turn him down without upsetting Mom. I said weakly, "Right up the scale. But you needn't bother with picking me up—"

"Oh, hey, no trouble. Got the use of the Boss's floater. Only the best for my Little Sis, not so?"

Grinding your teeth damages the enamel.

"You can't pick me up here," I said, slowly and distinctly, "because I shall be somewhere else. Mom has a committee meeting here and I am going out to do some shopping and get a sandwich lunch. I will meet you at the Sollidrome at 1410. Thank you."

I switched off.

When I tapped the local What'son? I found Fred's call was not so out of character as it had seemed. The so-called classic was "Eruption of Everest" and the only classical thing about it was its daftness—why pick on Everest when there are hundreds of perfectly genuine volcanoes around? And I don't like disasteramas. I'd heard that the one saving grace of this one was that you could *see* that all the figures stuck in the red-hot lava were really plastic. Even so, I didn't care to watch them melt. Also, it wasn't the last day. So Fred was giving up the races unnecessarily in order to take me to a show I didn't want to see. Typical, I thought.

(I should have thought harder. When did Fred ever give up anything he personally wanted, except to get something he wanted even more?)

I did my shopping on Level I, where I was not likely to run into anybody I knew; found a good sandwich bar and

made a note of the name (there aren't many that make their own mayonnaise) and set off to meet Fred punctually in front of the Sollidrome.

I was walking along II/27th Street, which joins II/11th Avenue just to the right of the Sollidrome, when a long shiny floater came parallel to me and hovered. Fred leaned out of it and grabbed my wrist.

"Give you a lift, Sis. Come on."

I started to say it wasn't worth it—I could walk to the Sollidrome in less time than it would take to open the door, step in, sit, open the door and get out again—when he reared up, wrapped his arm around my waist and hauled me over the side of the floater on to the back seat. He then stifled my protests by jamming my face against the shoulder of his jacket, while polarized side-screens slid quietly up and hid us from view.

All kinds of things happened inside my head. One was a great wash of sheer astonishment; This *happens? Fred does this to me?* But what *for?*

Another was a nasty cold burst of fright—images from historical sollies—hostages? ransom? sex-slave? sadist-fodder?

The third was quite indescribable. . . . I knew *something* happened in the underneath of my mind, where thoughts are shaped before they push up to the part where I get to know about them; and it was pretty forceful; but I didn't know what it was, because the pushing-up never happened. Maybe there was too much going on in the top, conscious part of my mind already. Apart from the surprise, and the fright, the main item was trying to find something I could do to Fred; he was so much stronger than me that it was humiliating. I bucked as hard as I could, while feeling with my heels for his shins, but he didn't seem to notice: I was just wasting energy. . . . Also oxygen. All of a sudden I started to wonder where my next breath was coming from: Fred's jacket shoulder was covering my nose as well as my mouth.

I managed to wrench my head sideways and got a gulp of air. I guess Fred thought I was going to use it for screaming—I hadn't got round to that idea yet—because he stuck his hand over my mouth. That *really* gave me an idea. I bit him.

Fred yelled a lot louder than I could have done. He put his other hand against the side of my face and pushed. My teeth lost their grip and I shot sideways, and my head met the far corner of the seat so hard that I felt it had been pushed corner-shaped.

Meanwhile a quite separate layer of my mind had noted the floater making two right-angled turns, taking us into the Avenue past the Sollidrome and then out again into II/28th Street. A few seconds after that it came to a halt and settled to the roadway.

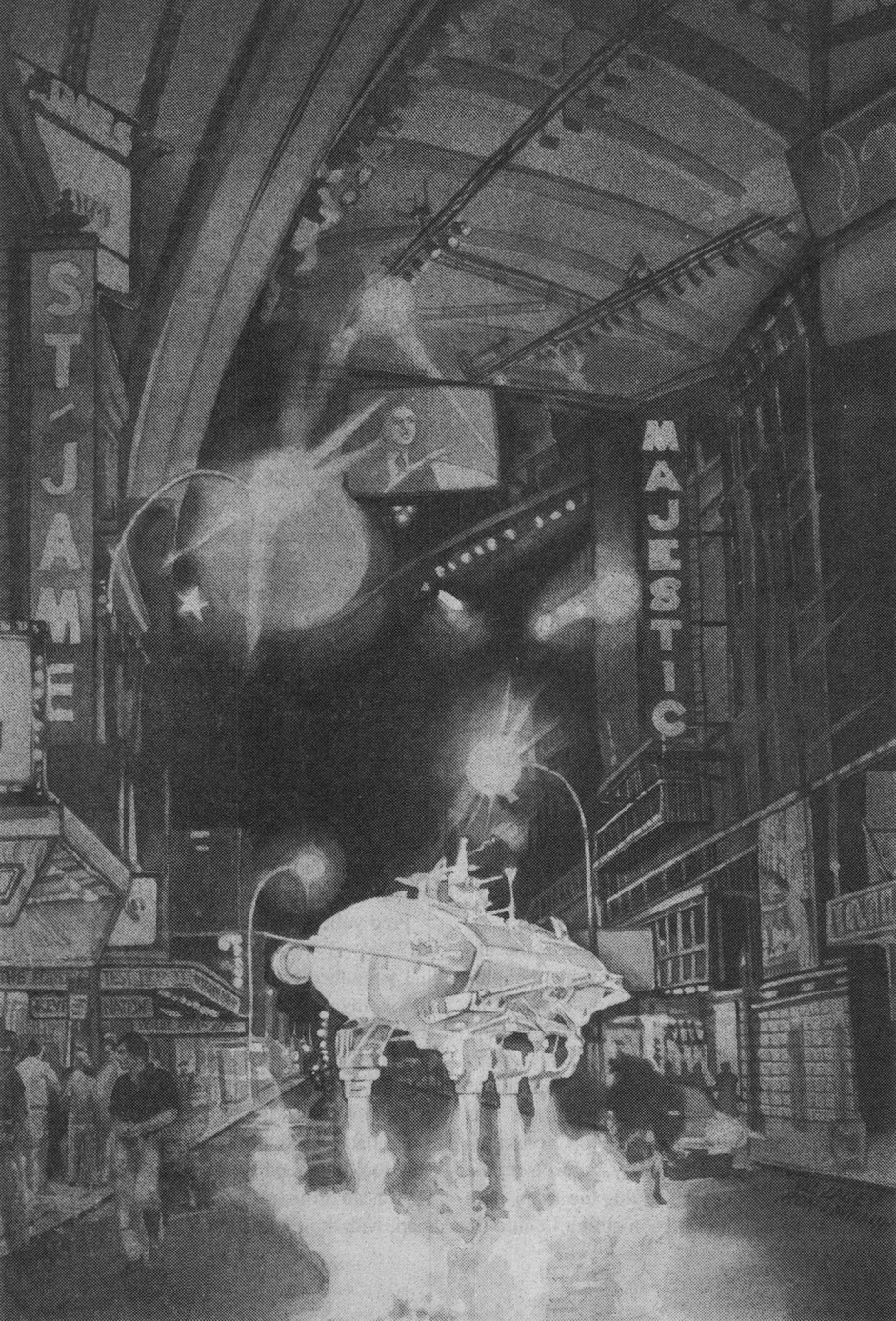
Fred yelled, "What are you stopping for?"

I wrenched myself out of the corner, shook my head back into shape, and shouted "What are you clowns playing at?"

Fred lifted his hand. I ducked.

The driver said, "No, Fred."

He had turned around in his seat and was looking steadily at the pair of us. He was an ordinary, rather tired-looking man, with those radiating wrinkles round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the eyes that people get when they spend a lot of time Topside.

Fred said, "Aw—"

"Leaves marks," the driver said. "The Man wouldn't care for that."

He turned to me. "Miss Harrison, I need to talk to you for a few minutes. After that, if you like, you can get out and go—"

"The hell she can!" shouted Fred.

The driver looked at him again. Then he turned back to me.

"If you like, you can get out and go home. But if you do, say good-bye to your big brother. You won't be seeing him again."

I started to say it was the best news I'd heard all week, and turned to Fred to make sure he got the force of that. The look on his face stopped me. He had gone a nasty sort of off-color and his mouth hung open.

Before I could ask what was wrong with him a head popped over the side-screen and addressed me.

"Need any help, miss? . . . Miss Harrison, isn't it?"

One of Mom's friends from the precinct; one of the three men who wanted to marry her, in fact; a uniformed Sergeant, coming up to fifty. I'd never thought him handsome before.

I took a deep breath . . . and let it go again. Evidently Fred's little bit of kidnapping had shown up on the surveillance cameras—and, just as it was supposed to, the computer had noted the unusual activity and drawn the attention of a police-person at the precinct; who had played it back and notified a patrolling officer; who had come to investigate, I guess through one of the short-cut passages that run through this rock between certain dwelling-units and are kept shut except in emergencies.

Anyway, it was evident that I was safe enough where I was. That being so, I thought I'd better go into the question of *why* I wouldn't be seeing Fred again if I got out of the car; before I actually did so.

To the Sergeant I said, "Do you know any way to teach my brother that practical jokes aren't funny?"

He looked us over, in no hurry.

"I might think of one," he said.

"I might ask you to teach it to me. Not right now, though."

He examined my face reflectively. ". . . Any time, Miss Harrison. If you need any help, just shout. I'll be along."

He turned and sauntered along the street. Not very far along; twenty yards or so. Then he turned and stood watching us. The butt of his stunner seemed prominent and his hand was not far away from it.

The driver said, "As you see, Miss Harrison, you're quite safe. You don't even have to listen. But it would be a kindness to Fred."

I said, "You went through this—this—You snatched me off the street, just to say a few words and let me go?"

He shook his head. "That wasn't the idea, no. Fred and I are off to the races; we're hoping you'll come along."

Fred was sucking his finger where I'd bitten it. "I tried to do it nice," he grumbled around it, "but you couldn't cooperate; not you."

I suppose I should have known. I mean, if Fred was oiling around Mom and me it wasn't just from family feeling, and if he invited me to the races it wasn't because he cared whether I

enjoyed myself; and if he seemed to agree to an alternative plan—

I turned my shoulder to him and said to the driver, "*Why* do you want me there?"

"Not me, Miss Harrison. You're being invited to meet The Man."

I heard the capital letters all right—he hammed them up—but I ignored them.

"I've met a lot of men," I said. "I met one just now."

"Ah, but this one's special. This is the one that owns your brother Fred."

Fred said indignantly "He *employs* me. He's been good to me. This is his car—"

"And he lets you have the use of his box," I said irritably. "You told me yesterday. I didn't want to go then and I don't want to go now. Give me a reason why I should."

Fred looked at the driver, and he answered; "Because of your brother, here. He's in trouble."

"He always is," I said. Fred made a protesting noise. The driver ignored it.

"Well, you'd know about that. Right now he's in trouble with The Man." He paused, chewed his lip a bit and decided to explain. "What happened, he was put in charge of some money and he was conned into giving it to the wrong man. He says. As a rule, there'd be only one end to that. The Man, though, he sort of likes Fred." The driver looked at my brother in a wondering sort of way. "So he decided there was something Fred could do for him that was maybe as valuable as the money. He put it to Fred that if he could deliver on that, the money could be forgotten."

I knew the answer, but it didn't make sense; "Deliver *what? . . . Me?*"

The driver reassured me. "Nothing personal, Miss Harrison. The Man just wants to see your act."

"My what?"

"Your act. Your schtick. The thing you do."

Fred said crossly, "He wants you to read some minds for him, that's all."

Jumping Jesus (Sorry, Mom). Well, I suppose I should have known . . .

Words rushed up from my subconscious. *But I don't read minds . . . that isn't what I do at all . . .* I bit them off. The driver wouldn't believe them, and it wouldn't help if he did; what mattered was The Man . . . And if *he* believed that I couldn't read minds, presumably he'd just go ahead and order Fred—

I stopped to wonder whether the driver had really meant what I thought he'd meant; and whether, if so, he was bluffing. A year earlier I would have been sure he was bluffing, because nobody could murder a person in Rockwell Deep and get away with it. But since Mom got pally with Captain Brown I'd heard a few things. For instance, a couple of times police probing illegal borings on Fourth Level had come across little caches of mummified corpses, sealed off in cavities of the rock. And although the carriage of garbage and manufactured goods to the surface was entirely automated and there was supposed to be no way to tamper with it, three or four times packages had been found to contain corpses—unidentified.

So if The Man really intended to have Fred killed he could probably do it; and the only way for him to be safe would be to hole up in Mom's dwelling unit

and never go out of doors. . . . But, judging by today, he would go Topside any time The Man ordered him to, and there was no surveillance up there. . . .

So if I wanted my half-brother to stay alive—

Did I?

Well, yes. I mean, I didn't like him and never had, so long as I could remember; and he practically stole the house my father made for Mom and me; and at least ninety-nine percent of all the people I ever met would be more of a loss; but I didn't want it to be my fault, or default, if he went missing. Anyway, Mom would be upset.

Leaving just one question; *could* I keep him alive? Which meant, probably; could I convince The Man that I was reading minds for him?

So I'm a telepath. But the definition of telepathy is *The passage of information from one mind to another without being channelled through the physical senses*—which does *not* equate with "reading minds."

Take the Dope Test—I didn't *read* anything, except the instructions. I looked at a list of five words and picked one. Meanwhile somebody else—maybe Hilda, I never found out—was looking at *one* of those words, picked at random by the computer and displayed. More times than you'd expect on a random basis, the word I picked was the one she was looking at. So information got transferred, somehow—but I wasn't *reading* it. I didn't even know anyone else was involved.

The other C(L-D)s I've talked to all say the same. Thoughts pass through your mind. Some of them may have started in somebody else's. You can't tell. They *feel* just the same as the ones you think on your own. The only way to tell if one person is picking up thoughts from another is to set up a deliberate test—like the one Stride used on me, having Hilda think the wrong words at me while I was talking about sports facilities.

(I still get cross when I think about that. He said that test took a lot of hard work to think up and was very tricky to coordinate. Serves him right.)

A lot of C(L-D) training is concerned with setting up distinctions between "Message" thoughts and the C(L-D)s own. For one thing, everybody in the Corps has a call-sign, usually a sort of rebus on their names. (Mine is a big Viking—Vikings "harried" people —holding a small boy by the hand —"Son" —"Harrison"—you see? It doesn't come over as a picture—just the idea.)

Also we learn to put messages in a sort of code—mostly backing up the more abstract words with concrete-type associations. E.g., numbers are all associated with particular classes of objects; one (Spaceship) two (Twins) three (Oranges) four (Books) five (Flags) and so on. This helps to make sure you receive the number correctly and it also helps to indicate that it really is a message and not just some passing fancy of your own.

What distinguishes telepaths is the pickup; *anybody* can send. In fact the theory is that everybody *does* send, all the time, (unless they have learned to seal it off) but mostly nobody picks it up. A sender who *wants* to be picked up can increase the chance a whole lot

by "focusing" on the telepath he wants to receive it. That just means, really, that you think about them, as a person, for a minute or two beforehand—and of course you use their call-sign if they have one. But that's for the *sender* to do—you can't focus on a person so as to get pickup, or most of us can't.

Apart from messages there's what we in C(L-D) call *seepage* (The PR people don't like that word and want us to call it "Interference" instead.) This is when you pick up stray thoughts without trying to — sometimes you can recognize them because they break the sequence of your own thoughts, or they concern a subject you don't know anything about; but as a rule it's hard to be sure. Anyway, it's no *use* for anything—a mild nuisance, a random interference with one's own thought processes; and the first practical exercises we did during training were concerned with setting up a seal to keep seepage *out*.

(Rumor says one or two telepaths *can* "focus" on a particular sender, at any rate sometimes; especially Commander Rivers, who started C(L-D). He might even be able to teach the rest of us, I suppose; but I know he wouldn't, because having their private thoughts picked up is exactly what most people are afraid of—we're strictly forbidden to try.)

As for getting into somebody's mind and going through it to find particular thoughts and memories, which seems to be what people mean by "mind reading," I don't believe *anybody* can do that. It certainly isn't part of training for C(L-D).

So my one hope of saving Fred was to try and fake something, and the more I knew in advance the better, so I said "*What* minds does he want me to read? And what for?"

Fred hunched his shoulders in a negative sort of way. "He just told me to bring you along."

The driver pursed his lips thoughtfully. "Well, seeing it's at the race track . . . The Man's been a bit worried lately about the way some of the horses were running. That I do know. It wouldn't surprise me much if he wanted to know whether the owners are planning to stick to the arrangements he made with them, about winning, and not winning, and so on . . . It could be that. No guarantee, mind, but it *could* be."

Well, I suppose it could have been something worse. I took a deep breath and said "All right. I'll come."

"Good," said the driver.

"You took long enough making up your mind," said Fred.

"Just a minute," I said. "Supposing I can't do what he wants? I've only had four months' training—"

"That'll be all right, Miss Harrison. He'll understand that you did your best. It'll be all right for *you*, that is . . . Oh, you're wondering about getting home. Well, just in case The Man shouldn't happen to remember about it you'd better have money for a taxi. Five credits should cover it. Give it to her, Fred."

Fred grumbled and fished around, but the smallest coin he could find was a ten. He gave it to me, the driver switched on the field, and we were off.

Since I stopped living in Chetwood I'd only ridden up the exit shaft a couple of times, the last more than a year ago; I had forgotten what it felt like. However, after that moment when the floater

slid off the solid ramp and the Upfield took hold—I don't care what's *really* happening, it *feels* as though you're falling—my stomach settled down, and if I'd been with somebody else on a different sort of outing I might have enjoyed it. As it was, I was trying so hard to work out some kind of plan that I barely noticed when the floater slid over the lip of the shaft and there was a solid surface under us again. I was vaguely aware of the noises you get Topside —wind, I mean, and the *whpp! whppp!* of lighting poles; and the smells, damp and earth and vegetation alive and dead, and a whiff of bug-spray as we went past fields or gardens . . . I still hadn't thought of anything useful when I became aware that the contours of the land on either side were changing—becoming full of lumps and ridges and hollows. Ruins, in fact; this had been a town, once.

I remembered that to save wasting fertile land the race-track had been set up in the remains of one of the old towns, where there was too much concrete and asphalt for crops or woodland to grow.

The ruins around the track itself stood a good deal taller than elsewhere, because the bottom two stories had been turned into stands and boxes for the race-goers. Anything higher had mostly been pulled down, but there were a few jagged lumps of brickwork sticking up here and there against the sky.

Behind the standing buildings a strip a hundred yards wide had been bulldozed flat. Hundreds of floaters of all sizes were lined up in the open space, with a few gaps reserved for someone-or-other by force-lines that glowed faintly in the shadow. Our floater slid into one of these.

From the back, the buildings were very patchy; windows and doorways had been filled up with different colored materials and new doors cut without regard to appearances. Here and there you could see outlines of buildings that had once been joined on. Staircases had been tacked on so that people could get up to their boxes: most of them went up to long iron catwalks serving a whole row of doors, but one or two boxes had a stairway to themselves. Fred got out of the car, slapped his clothes tidy, ran a comb through his hair and started for the grandest of these—wider than the rest, with sides made of a sort of thick metal lace-work, and a balcony at the top where several men in dark suits were lounging in purposeful idleness. I tagged along behind. The men on the balcony took a good hard look at us, and one came forward and waved the wand of a metal detector over our clothes before we went through the door, but nobody spoke to us.

Through the door was a big room, three times as long as Mom's living room and about as wide. The far side, facing the track, was nearly all glass. Nobody was there, though; they were all gathered round a battery of big TriV screens at the far end. There was a roar coming out of hexaphonic speakers and somebody's voice yelling over it that Polytype and The Xeno were neck and neck on the final stretch.

Fred came to a halt just inside the door. I stood beside him and wondered which of those well-fed backs belonged to The Man.

A few seconds later one or other of

the horses got to the end of the track a few inches in front of the other one and the roaring rose to a bellow and then died away. All but three of the backs did an immediate switch-around and streamed to the other end of the room, where there was a complicated setup of vidiphones, each with the sort of slots you get in a wall-bank. Three of them stuck credit-cards into one sort of slot and a kind of ticket into another; the rest started shouting horses' names into the phones. All the screens lit up, either with horses' names and associated fractions or with sums of money. I spent a couple of minutes puzzling it all out and finally decided it was a complete betting set-up that paid winnings directly into credit accounts. After that I started to get bored.

The three backs at the TriV end were still talking. Somebody brought each of them a drink—there was a table of bottles and glasses to one side. The people who had been betting and claiming winnings were now straggling along to it and helping themselves. I wondered what the race track looked like and started towards the window, but Fred grabbed me by one arm and somebody else grabbed me by the other—yet another man in a dark suit.

We were kept waiting another two minutes, and then—I didn't see any signal but I suppose there must have been one—the man in the dark suit went over to the three by the TriV. You could see he was being humble by the shape of his back. Then he straightened. After another thirty seconds the middle one of the three turned round.

I was surprised to see that he was very handsome, in a middle-aged sort of way, like the sort of retired heartthrob who befriends the widow with five kids on TriV.

Then his eyes came to rest on Fred and I decided he was the kind of guardian who turns out to have embezzled all the money the heroine's father left her, instead.

He just glanced at us and let his eyes move on; then he strolled over towards the window. Fred grabbed my elbow again and hustled me across the carpet. My mouth suddenly filled with water as though I were going to be sick. I swallowed hard and concentrated on the view. Either the space below had been bulldozed flat or this had been the kind of town with a big open parkway running through the middle. The buildings on the other side were quite a long way off; long open spaces at the bottom, filled with faces, and long slot-like windows above, mostly blank. The open space was covered in something green and slightly grainy—not grass, some sort of seamless fabric; just under the window the edges had curled back from a V-shaped split and I saw it was at least eight inches thick.

I swallowed the last of my spit and turned to look at The Man. He was looking me over to see where they put the switch on this model. I suppose that was when I finally made my mind up, though I wasn't aware of it. My mouth just opened and said "Someone is thinking about killing you."

Fred's muscles jumped in six different directions and left him where he was. The Man just stiffened, and stared at me. He had the sort of eyes called piercing; they get that way by being very dark and not moving much.

After a moment he said "Where?"

"Not up here—I don't think so. Somewhere outside."

The focus of his eyes shifted and the man in the dark suit materialized alongside. The Man spoke to him briefly in a language I didn't know. The other man bowed and walked out of the room, speaking to another, who had taken his place near the door, on the way.

The Man turned to me. "This person who wants to kill me. His name?"

"I don't know," I said. "He isn't thinking about his name. People don't, much."

Even if you know what produces the effect, piercing eyes are uncomfortable to look into. I let my gaze float off past him in the direction of infinity.

"And what does he look like—this man?"

"He isn't thinking about his appearance, either," I said.

Actually, when I thought of this approach—which was not until I was climbing out of the floater—I had invented an appearance for the would-be assassin, all complete. On the short side, dark hair, long narrow face with a long bare upper lip, side-burns, and a tufty little beard on the point of his chin. . . . Then it occurred to me that there might be somebody around who really looked like that; I didn't want to put him in danger.

Anyway, it is quite true that people don't go around thinking about their appearance—not about their description, anyway.

The Man seemed to feel it was my fault that they don't. He said impatiently, "Well, what do you know about him, then? What weapons has he got?"

I had thought that one out pretty carefully. "He wanted to use a knife," I said. "Stick it in and pull it out and stick it in again; but he's afraid of metal detectors. He has a cryo-gun."

Since metal-detectors became capable of distinguishing shapes, pros don't carry pistols much, or not on public occasions. Cryo guns are plastic tubes shaped like a cane. The bottom end is heavily insulated and contains a sharp sliver of ice, frozen at about 80° K. The upper end is a powerful air-gun. It stays usable for about two hours. (I didn't get that from Captain Brown. I learned it watching a police serial on TriV.)

By now the other people in the room had realized that something was going on. They had stopped talking; some of them were standing and watching us and the rest were very obviously *not* watching: except for a second man in a dark suit. He came forward and said something to The Man and they talked briefly in a strange language—a different one, by the sound of it—then dark-suit went away.

Then The Man turned to me. I don't know what I had expected to happen; maybe that he would be so grateful for my warning he would drop his other demands; maybe that it would set off such a panic that Fred and I would be forgotten while everybody hunted the assassin. But in fact The Man had delegated that, in the best tradition of Business Efficiency, and was now ready to have me perform the function for which he had requisitioned me in the first place.

In fact I was back to Square One and I still didn't know what to do. He had just started, with "Now, Miss Harrison,

I had you brought here because certain of my business ventures—'' when an uproar started on the other side of the door.

It did not last long. The Man just had time to look astonished—which was more reaction than I'd got by telling him somebody planned to murder him—when the door banged open and two men in Space Force uniforms strode in.

Every mouth dropped open, including mine.

You don't see that uniform often, except on TriV. Charcoal cloth, with insignia in the purest possible white; not showy, but dramatic. Walk down the street in it and you'd be mobbed; by kids wanting autographs, teeners wanting souvenirs, women wanting kisses, everybody just wanting to touch. . . . These two were wearing Security flashes and one of them had a Sergeant's chevrons on his sleeve. They both carried what looked like a sheet of thin black plastic folded over the left arm.

They walked straight across and halted in front of The Man. The Sergeant said ''Cadet Harrison?''

It took all of three seconds to realize he meant me.

I uttered a sort of croak. He took an envelope from somewhere and gave it to me.

''You are hereby recalled from leave for emergency duty, effective immediately. Please come with me.''

The Man had got his mouth shut some seconds before. Now he spoke up, and his voice was colder than a cryodart: ''Miss Harrison is doing a job for me. You may wait for her outside.''

The Sergeant said ''Come along, Cadet.''

I pulled myself together and took a step towards him. Then I remembered Fred. I said ''My brother?''

''We'll give him a lift.'' He glanced at the other Spacer, who took Fred by the arm, and we all started across the room.

A couple of The Man's henchmen moved in front of the door. A moment later it flew open and knocked them sideways, and what looked like a full squad of uniformed police surged into the room. They engulfed the two Spacers and Fred and me and we all went out on to the balcony and started down the stairs.

The two Spacemen simultaneously unfolded the black sheets and shook them out into loose raincoats, which they simultaneously put on, hiding their uniforms. At the bottom of the stairs the police peeled off in various directions, except for one who escorted us across the park, to a big box-bodied floater with three doors a side; where he saluted, and went away.

The Sergeant ushered me into the back section while his sidekick tucked Fred in beside the driver; then the two of them got into the middle seat and each turned to look through the nearest window. I sat down in the corner, so bemused that it was several seconds before I realized that the dark shape in the corner opposite was another person.

He said, ''It's Tina, isn't it? Tina Harrison. How do you feel? On key?''

My tongue stuck to the roof of my mouth. It was *him;* the Commander; The Boss; Old Man Rivers himself.

(I suppose we would have called him that even if his initials had not been O.M.—nobody seems to know what

they stand for—but in fact he was probably not as much as ten years older than me. They don't make anyone a Commander at that age, of course—not unless they *have* to, because there's nobody else with the qualifications to run a brand new and highly specialized Corps and that's the minimum rank from which he can do so.)

I had seen the Commander before, often—he ran some of our training classes personally—but never so close. He had very dark eyes (but they weren't at all piercing) and thick, dark hair which, I could now see, had quite a lot of grey in it, mostly underneath. He was not very tall, but strongly built; not bad looking, and quite tidy, but you somehow got the impression that somebody else put a fair amount of effort into keeping him that way—

I suddenly remembered he was the world's top telepath and put a stop to that train of thought. I said "How—?"

He touched a switch and spoke to a microphone. "Let's go, Bill." The floater rose smoothly from the ground and slid forwards and towards the Exit. The Commander turned back to me.

"How did we happen to arrive? That's a bit complicated. . . . You've been through several hypnotic sessions by now, haven't you? Half a dozen at least."

What on earth—? I'd had the usual Loyalty sessions—not heavy, since C(L-D)s don't handle public funds or large quantities of equipment or admissions or promotions or postings or any of the other items over which Service personnel might be tempted to bend the rules for personal advantage. So I'd just been conditioned against major breaches of discipline, and against feeding unauthorized information to the media. We don't get full Space training—most of us couldn't take it, apart from not having time—so we also get the kind of conditioning they give passengers on a spaceship, to make sure they don't get in the crew's way or mess about with anything dangerous or panic in an emergency. And I'd had a couple of sessions to help with C(L-D) techniques—mostly forming and dissolving a seal. But how did that—

I realized he was waiting and said, "Yes."

The Commander pushed his hands through his hair. I suddenly realized he was embarrassed. "Well . . . during one of those sessions you were . . . er . . . supplied with a . . . a sort of alarm system. It's not easy to explain, but roughly speaking, if anything seriously frightens you, you broadcast a signal, with a call-sign, that alerts any senior member of the Corps. It gives your identity and location; then whoever is stationed nearest takes over. I happened to be at the Space Gate, so I was in the best position to take action this time."

I said "But I didn't know—"

"Well, you see, we were afraid that the process of sending the signal might be distracting at a time when that was dangerous; so it was made subconscious. . . . Damn it, I *know* it's unethical and half-way to being illegal, but some of our people are easily panicked and rather less than bright. I couldn't see what else to do!"

I thought about it and said, "Well, I'm very glad you did it, anyway."

"You are?" he sounded relieved.

"Well, at least we know now that it works . . . Since you were in Rockwell Deep I called the police, and found that the surveillance system had got on to your problem already. They'd identified the driver of the floater as an employee of a certain businessman who operated in some very shady areas, and he'd already been reported at the races this afternoon, so when the floater took the North-East exit shaft they had a good idea of where it was going. Patrols reported it from time to time, confirming. Meanwhile I'd managed to get pickup on you and gathered you still weren't happy. The report was that you were with your brother and had said you didn't need help, but I didn't like what I was told about the fellow you were presumed to be going to see, so I requisitioned a floater and a couple of Security men and came out to the track. I saw you arrive, and a little while later I managed to get pickup again and had the impression you could use a little help. Was I right?"

"And how," I said. "I mean—"

"Good. Tell me about it."

I did. At first I tried to keep some sort of censorship over what I told him, but he didn't seem to have any idea of criticizing the way I had handled things, and when it sort of slipped out that I didn't like Big Fred much he seemed to take that as normal enough. In the end I just let it out as it came.

Afterwards he said thoughtfully, "Is your brother still in danger from this man, do you suppose?"

I said "Jesus! . . . Sorry. I don't know. Fred had filled *his* part of the bargain—but I suppose The Man would say *I* didn't deliver."

The Commander rubbed his chin thoughtfully. "I suppose he might . . . What gave you the idea of saying somebody was after him?"

"Dunno," I said wearily. "I mean I don't know, sir. I was just trying to think of a way to distract him."

"Yes, well . . . we can notify the police, of course, and they would make it clear to him that in the event of injury to your brother he would immediately be under suspicion. However, he apparently spends his life under suspicion of one thing and another, and no investigation has managed to pin anything on him—not with evidence—so that may not impress him too much. I rather think—"

That was when Fred seemed to go mad. He had been sitting beside the driver, quietly enough; now he suddenly gave a great jerk and hunched forward over something. Then he began waving his hands and turning round to make faces through the glass partitions—two of them—between him and us. Or maybe it was the two Spacers he was trying to communicate with—

"Permission to stop, sir," said the driver through his speaker.

"Of course, Bill. What's wrong?"

The floater was on a fairly busy road; it slid sideways on to the shoulder and settled to the ground.

"Permission to lower the partitions, sir?"

"Get on with it!"

Two sheets of glass dropped into slots between the compartments and we could hear what Fred was shouting.

"The Man! He got The Man! He got him!"

The two Security men leaned forward

as one and somehow shut him up. The Sergeant spoke to the driver and turned back to us.

"It's on the News, sir. Perhaps you'd like to set your screen for playback."

There was a twelve-inch TriV screen in each compartment. The Old Man fiddled with dials for a moment and then the face of a local reporter filled the screen.

"An assassin goes to the races . . . A wealthy race-goer was murderously attacked while leaving the Rockwell High race-track at the conclusion of today's program. The assailant took the place of the victim's driver, who was later found unconscious behind a wall nearby, and stabbed him three times. He then mingled with the departing crowds and has not so far been arrested.

"A cryo-gun, discharged, was found with the unconscious driver and it is thought likely that he was shot with a sliver containing anaesthetic. His jacket was found abandoned near the exit from the park.

"The victim was given emergency treatment at the track clinic and is now undergoing surgery in St. Luke's hospital. The assailant was seen by a number of race-goers and is described as somewhat below average height, white-skinned and dark-haired, wearing a blue tunic and grey pants. A provisional electro-fit portrait has been assembled."

It flashed on to the screen; a long narrow face with a long bare upper lip, sideburns, a little tuft of beard on the tip of the chin. . . .

The reporter went on saying something about getting in touch with the police if anyone recognized it, but I wasn't listening. Then another one appeared, talking about something else, and the Commander switched off.

"Jeez, sis," said Fred with the nearest to respect I had ever heard from him, "You really called it. He looked just like you said. Funny, I thought you were making it up. How did you know?"

The heads of the two security men turned towards me in unison.

"I didn't *know*," I said. "I didn't, I didn't!" I could hear my voice rising and I had a horrible feeling I was going right into hysterics and there wasn't a thing I could do to stop.

Maybe the Commander thought so too, because he reached into a recess and handed me something.

"Here," he said, "drink this."

It was one of those bulbs they drink from in zero-*g*. I'd never tried to use one before. It was stiff, and when I finally got something out of it the squirt was hard enough to make me choke; but by the time I'd found out how to drink from it the urge to shriek my head off with mirthless laughter seemed to be over. I put the bulb into the disposal slot and started to shiver, instead.

Seepage, I thought, *sorry, I ought to say interference, of course. . . .*

Who had it come from? The murderer—? (Well, he might not have pulled it off; but I didn't want even a would-be murderer's thoughts in my head.) But as I'd told The Man, people don't use up thoughts on describing themselves.

However The Man's entourage probably knew he had an enemy; one of them *might* have been thinking about him; *might* even have spotted him there . . . that driver, for instance; or even Fred—

Fred. . . . I turned to speak to him, but he was listening to the two Security men, who were discussing the fact that the would-be assassin had managed to get a knife past the metal-detectors at the entrance to the track. They finally agreed that it wouldn't be difficult, if he had planned the thing in advance; he could have smuggled the knife in days beforehand, and buried it where it could be easily retrieved.

"In fact," one of them summed up, "metal detectors are pretty well has-beens since cryoguns came in."

Cryoguns. . . . Nobody but the murderer could have known that he was carrying one, could they? Maybe the driver or Fred had been thinking about him, and their thoughts had acted as a sort of link between me and him, just for a moment; that sort of thing could happen—

Fred. *How had he known about my idea of what the assassin looked like?* I hadn't spoken about it—I was sure I hadn't—

Suddenly I became aware that my brother was speaking to the Old Man—

". . . So I gave her the p-pock-packet, and she gave me an envelope, but when The Man orphaned—oop—opened it, there was only some cut paper inside. So he sent someone to talk to Franny, but he was in the hospital. Someone had fed him dipped whicker—I mean dupe—doped . . . doped whisker, and he'd passed out and fallen down stores. So they said—"

Oh, *no!* NO!

But it was true.

Something Fred said—not about the description of the murderer, but about thinking I'd made him up—had given the Commander the idea of testing him; and it was positive. So when we reached our destination—the Space Gate—he sent for equipment and put Fred through some more formal tests. My big brainless brother turned out to be a telepath too.

He won't be in my training class, which is the one good thing about it—except that Mom won't need to worry about him any more. You can't put an overgrown juvenile delinquent straight into a spaceship, whatever his talents, but there's a lot that can be done these days; all the no-good bums could be turned into good citizens if there were enough psycho-correction specialists around. And since the Space Service is desperate for more C(L-D)s, my brother Fred will have hundreds of man-hours spent on him, and thousands of credits. He'll never be very bright, but he'll end up with inhibitions against so many forms of anti-social behavior that he'll be practically unable to get into trouble again.

Unless he turns the offer down, of course, and nobody ever does that. So Fred will get to Space, like everyone wants to and hardly anybody gets the chance.

There's just one thing I mean to make plain to him. He is *not* going to address me as "Little Sis" ever again. If he does, I'll bite him, and I don't care who's around.

I don't have to put up with that. ■

The Alternate View

THE COMING OF THE SSC

John G. Cramer

Modern high energy physics is the study of quarks and leptons and their interactions. The experimental physicists who work in this area have never been troubled by a lack of imagination. In 1954, on the occasion of the 200th anniversary of the founding of Columbia University, Enrico Fermi proposed his vision of the ultimate particle accelerator, a machine that would encircle the entire Earth, a truly world-class machine. Interestingly enough, while no accelerator approaching the scale of Fermi's vision has ever been built, the Tevatron accelerator at FermiLab near Chicago has now reached collision energies which exceed those that Fermi's machine would have produced.

Now the visionaries of the high energy physics community are ready to take the next step, the Superconducting Super Collider or SSC. By now you must have heard or read something about this machine. It is being pushed by President Reagan and the Department of Energy. It will have a total cost in 1987 dollars of $4.4 billion and will be built at a location now in the process of selection. It will be a *big* machine, the largest proton synchrotron ever planned, "the greatest public works project in the history of mankind," as one congressman put it. The tunnel in which it will be constructed does not circle the Earth. It is more modest, with a circumference of "only" 52 miles. Yet the SSC will produce proton-proton collision energies 40 times higher than those of the FermiLab Tevatron or Fermi's dream machine.

This AV column is an overview of the SSC: what it is, why the high energy physics community wants to build it, and a bit about the political side effects of a scientific program of this magnitude. I do not, by the way, do high energy physics or have any vested interest in the SSC. We'll start with some questions and answers, including some very basic ones.

Q: *What's a particle accelerator?*

A: A particle accelerator is a machine that applies electromagnetic forces to particles, usually protons or electrons, to give them a very high velocity and a very large energy of motion (or kinetic energy).

Q: *What's a synchrotron?*

A: A synchrotron is a sub-species of particle accelerator. It uses magnetic fields to bend the paths of the particles accelerated so that they travel in vacuum in a large circle or oval, retracing the same path over and over again as the particles are accelerated. Most of the hardware in a synchrotron is devoted not to acceleration but to the dual functions of bending the particles in the desired path and "focusing" them, restoring to the particle herd those that have strayed from the main group. As particles are given more and more kinetic energy from the acceleration process they become "stiffer," so that stronger and

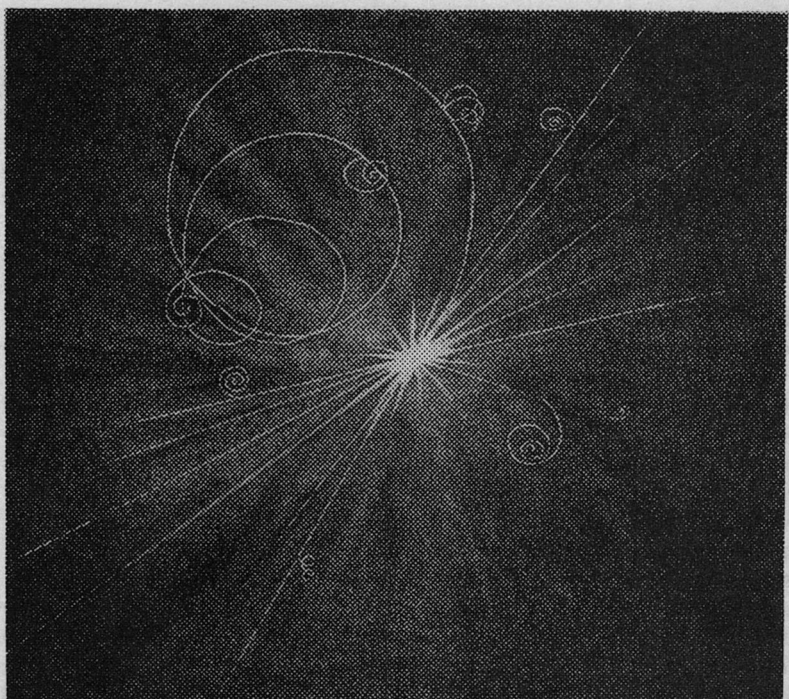


Illustration by William R. Warren, Jr., 1988

stronger magnetic fields are required for bending and focusing. The magnetic fields of the synchrotron must be progressively ramped up to higher field strengths as the particles acquire more energy.

The actual input of energy in the synchrotron is performed by a few resonant electromagnetic cavity units that develop large alternating electric fields. The peaks in the electric field cycles are timed to match the arrival of a group of particles and to give them a maximum push. As the particles pass through these accelerating structures over and over again, their energy builds until it reaches the desired value, usually the highest energy the magnet system can bend.

Q: *How fast are protons traveling when they reach maximum speed in the SSC?*

A: The particles at full energy in *any* accelerator useful for high energy physics are traveling at only a small fraction less than **c,** the speed of light. The real issue is not their speed but their kinetic energy and their mass. This is because of the effects of relativity: as a particle is accelerated and given more and more kinetic energy, its velocity and its mass both increase. But while the velocity must hover just below **c,** the mass can continue to increase without limit. By the time protons reach full energy in the

SSC they will be about 20,000 times more massive than at rest. The energy of their rest mass becomes a negligible fraction of their total mass-energy.

Q: *What's a collider?*

A: Imagine an accelerated proton striking a second proton that's standing still. The important energy in this collision for producing new particles, etc., is for complicated reasons the energy as viewed from a moving coordinate system where the protons collide head-on with equal relativistic masses and equal but opposite velocities. The available energy in that system is only a small fraction of the kinetic energy of the accelerated proton.

But now imagine instead that we accelerate *both* protons in opposite directions so they collide head-on in the coordinate system of the laboratory. Then the energy of the two protons combined is available for making particles, etc. This is what's done in a collider. It's really two accelerators, one accelerating particles clockwise, the other accelerating counter-clockwise. Several collision regions are provided where the particles have overlapping paths and high collision probability.

In a collider using particles of opposite charge, protons hitting antiprotons or electrons hitting positrons or protons, only one set of magnets is needed to bend both particles because the opposite direction of the two beams is compensated by the opposite particle charges. However, in the case of the SSC particles with the same charge are to be collided, protons with protons. This requires two acceleration paths with opposite magnetic fields, one with field direction up and the other down. This makes the design of the machine more complicated, but also more versatile.

Q: *Why does the SSC have to be 52 miles in circumference?*

A: As protons are given more energy they become harder to deflect with magnetic fields. This effect can be compensated by simply making larger magnetic fields. The SSC is designed to use magnets that run at about 6.6 tesla, about the largest fields feasible with conventional superconductors. After the highest fields possible are used in the design, the only means left of going to a higher energy is to make the radius of the circular path of acceleration bigger. At 20 TeV, the proton beam energy to be reached by the SSC, magnets with a 6 tesla field can bend the beam in a circle with a circumference of no less than 52 miles. To reduce the ring size, one would have to either reduce the energy or use larger magnetic fields. It is likely that the 52 mile accelerator tunnel will be bored deep underground and could lie under farmland or even houses.

Q: *Why not use the recently discovered warm superconductors for the SSC?*

A: This is a deceptively simple question which requires a rather detailed answer. The discovery in early 1987 of warm superconductors created an ongoing revolution in physics. These new materials become superconducting at temperatures between room temperature and the boiling point of nitrogen (77° K), and can sustain much higher magnetic fields then the older "standard" superconductors.

Many have suggested that the SSC project should be delayed until warm

superconductors can be incorporated in the design. This, from my point of view, is a reasonable-sounding bad idea. There are three characteristics needed for the superconducting magnets: (1) ability to sustain high magnetic fields, (2) ability to carry large currents, and (3) ability to withstand the mechanical stress produced by magnetic forces. It is clear that the new materials when cooled to near absolute zero would do very well on criterion (1). Critical fields of up to 200 tesla have been estimated for them under these conditions. On (2) the issue is less clear. Physicists have reported the observation of large current densities in single crystals, but a method is not yet in hand for sustaining large currents in bulk superconducting material. But the "crunch" comes, quite literally, with (3). The most troublesome aspect of superconducting magnet design is that, when carrying large currents in large magnetic fields, wires experience a large mechanical force. For this reason, magnets for the SSC design are made with massive quantities of iron on the outside of the superconducting wire windings that act both to channel the magnetic flux away from the wires and to hold the wires in place. The real field limits of the SSC magnets are imposed by the mechanical forces they can withstand while carrying current.

The new superconductors are not ductile metals easily made into wire. They are quite brittle, with a consistency more like powdered rock. Even if they can be formed into superconducting wire capable of carrying high currents, their tolerance for mechanical stress will remain a very serious problem.

FermiLab was built in the late 1960s with the proven magnet technology of the time, "warm" magnets with copper windings. Later it became possible at a relatively low cost to convert the same basic machine into the Tevatron, using high field superconducting magnets that more than doubled the machine's energy while reducing electrical power consumption. It seems that this might be a model for the SSC: build it now with conventional superconducting technology, but at the same time develop the new high field superconductors into very high field magnets that could later be used to increase the capabilities of the machine.

Q: *Why do we need the SSC?*

A: In the past 15 years there has been remarkable progress in particle physics. The quark has gone from a curious might-be particle to the central focus of attention, with the well grounded quantum chromodynamics theory to describe quark interactions. But there remain some mysteries. The "top" quark, the missing member of the 6-quark family, (down, up, strange, charmed, bottom, top) is still unaccounted for. The "higgs" particle, the keystone of the broken symmetries underlying quantum chromodynamics likewise remains without convincing experimental evidence. In the new energy domain that the SSC will open may be a rich territory with new particles and unsuspected new effects, or it may be the beginning of the "energy desert," a vast energy domain where nothing of interest happens until the Planck energy of 10^{23} GeV is reached. The only way to find out what the territory holds is to go there and look. It is a maxim of physics that if you would see what no one has seen before, you

must look where no one has looked before. The SSC will make this possible.

Q: *Where will the SSC be built?*

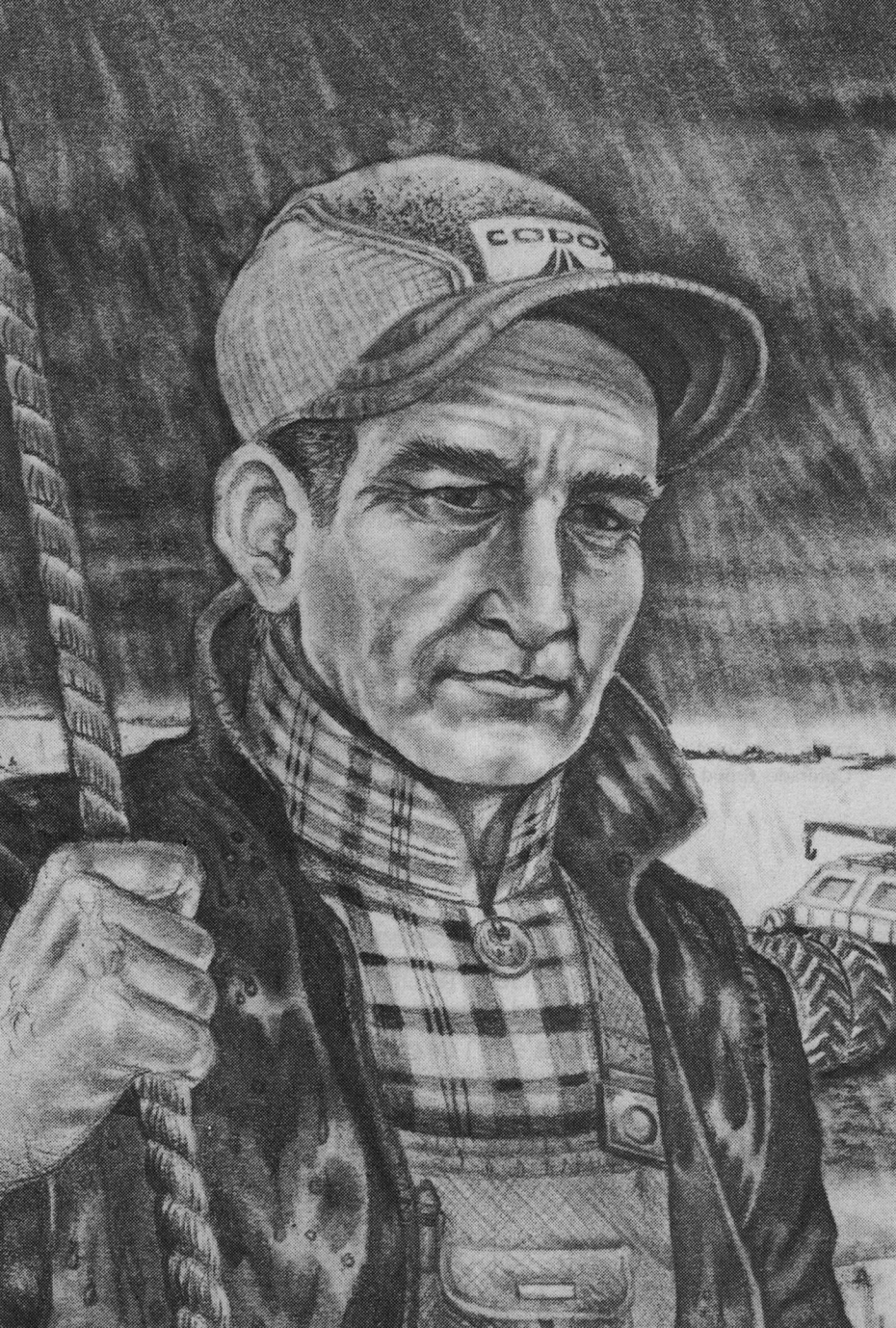
A: That remains an open question. Originally the SSC site proposals were to be submitted by August 3, 1987, with final site selection in January of 1989. Congress, sensing the great "slice of pork" implicit in placing a $4.4 billion facility with an annual $370 million operating budget in just one lucky state, voted to extend the deadline a month to September 2, 1987, giving slow starters a better chance to compete. In the 1960s, when what became FermiLab was being considered, there were 135 site proposals.For the SSC, 25 states submitted 43 proposals. Seven of these were eliminated for technical reasons, leaving 36 proposals still in contention. Some of the leading contenders for the SSC site are Illinois (the FermiLab Tevatron could serve as an injector), New York (congressional clout, close to many East Coast universities and labs), Colorado (good site near Denver airport), Texas (congressional clout, much effort on proposal), Washington (good site near Spokane airport, cheap electric power), Arizona (good desert site, room for expansion), and California (congressional clout, good universities). The Department of Energy is playing the siting very carefully, like a card game. It's all rather like a lottery. There will be great enthusiasm in Congress as long as most states have a proposal "ticket" that is a potential winner. As soon as the lucky winner is announced, however, enthusiasm in other quarters will be greatly diminished. Therefore the DOE must see that the SSC is past most of the congressional hurdles and well on track before the site selection process is completed or even before the field is significantly narrowed. It's going to be interesting. ■

Further Reading

Irwin Goodwin, Reagan Endorses the SSC, a Colossus among Colliders, *Physics Today* 40, #3, 47 (March 1987).

●Believing that life and the universe are a mystery quite beyond our grasp keeps you humble. Either there's an order of being in the universe, of which we're a very low order, or else it's all an accident. And really, the arrogance of thinking it's an accident, the conceit of thinking we know everything.

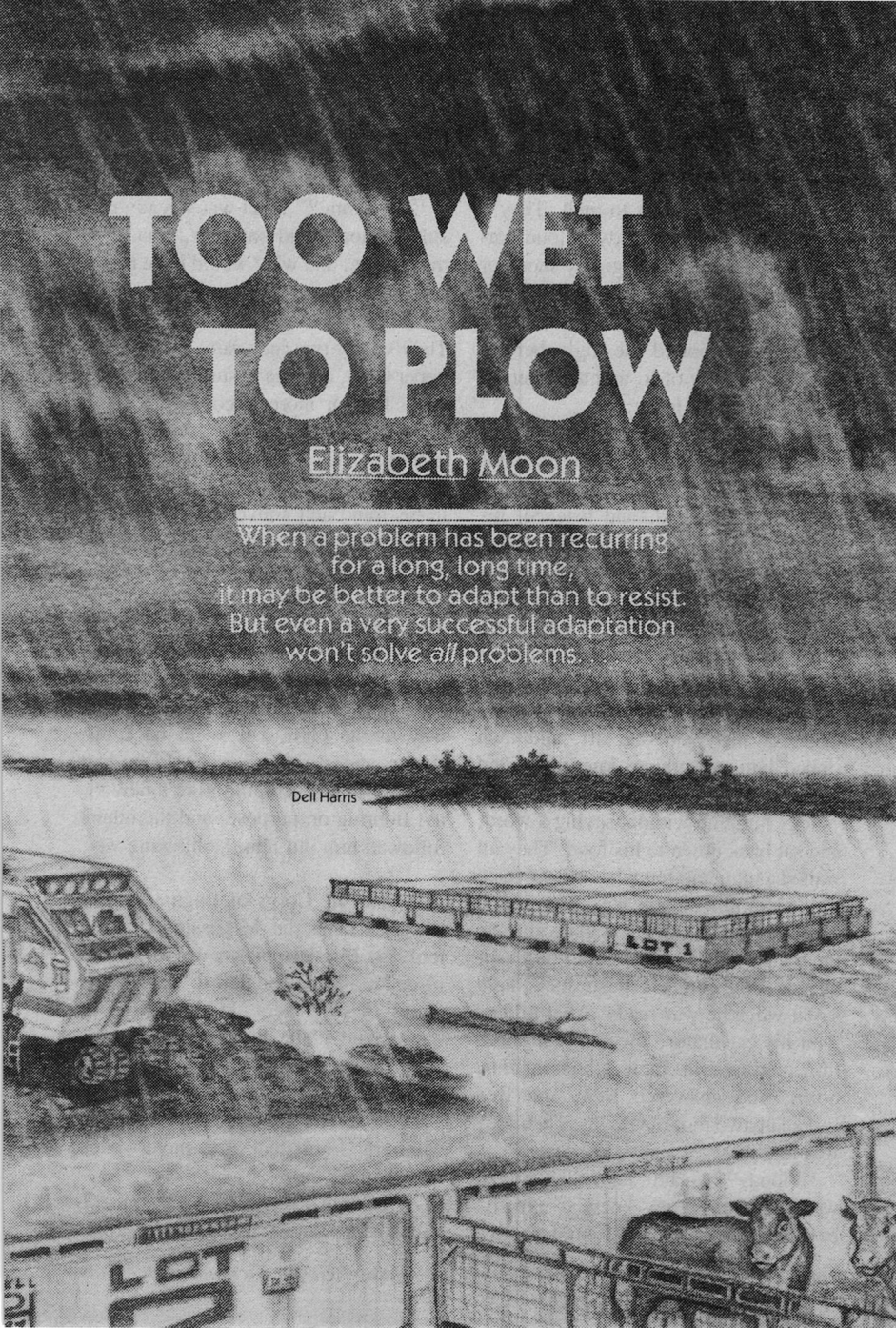
J.B. Priestley


СОВО

TOO WET TO PLOW

Elizabeth Moon

When a problem has been recurring
for a long, long time,
it may be better to adapt than to resist.
But even a very successful adaptation
won't solve *all* problems.



Abel Jacobsen picked up the first warning on the weathernet well before dawn. He'd expected it. Winter snow accumulation was up—the highest in fifteen years, since the first Floatholes were installed—and starting to melt. They'd had plenty of rain already. Cloud patterns and the feel of his gimpy shoulder told him everything else he'd needed, without even the ring around the moon that Joey'd reported the night before. Rain, and plenty of it, and the river already set to bust loose.

They were eating breakfast when the alerts came through. A clamorous double ring on the emergency phone system; Joey answered, and listened, his mouth clamped tight. His eyes stared past them, seeing whatever the watch officer reported. Abel figured he could guess that well enough. Flood on the way. That damn river, he told himself, had a way of waiting until you just got brave enough to take out another mortgage, or just paid one off, and then ripped into everything, knee deep and a mile wide at best.

Joey hung up without saying a word, and sat back down to his food. They all waited a moment, but when he shoveled in a mouthful of hotcakes, Ben asked Abel about the shift to higher nitro in the weaner feed as if nothing had happened. You couldn't push Joey; he'd say it when he was ready. Abel fiddled with his calculator, checking the monitor readings in their silage against norm, and answered Ben, and Ben forked up two more sausages. Then Joey was ready.

"Flood," he said. They all stopped, watching him. They knew it already, being Abel's boys, and bred to that river. He took another hotcake, mopped the corn syrup off his plate with it, and stuffed it into his mouth. "Big one," he said around it. "It'll lift us for certain, that's what they said."

"How long?" Abel was already calculating loads and balances, what they might save, and what would have to go, part of the river's brown cargo.

"A week, maybe, for the crest. They've got two inch rains all over the upper Ohio, and heavy stuff moving this way. Two or more to come. They say it'll take the snow with it." Joey quoted acre-feet, but Abel put fifty years of Mississippi flood-plain farming to work in his mind and converted it all to rise in feet. Plenty. More than knee-deep and more than a mile wide. He looked around at his sons and their families, the tightness around the eyes.

"Well," he said, as they waited for him, "I hope those damned idiots are right. I swear to God, if we float all the way to the Gulf, I'll swim back upstream and strangle 'em." He pushed back his chair, scraping Ellie's new vinyl flooring on purpose, and the others followed him out into the blowing wet.

It took the Corps of Engineers fifty years to tame the Mississippi, and it took the Mississippi five terrible years of death and destruction to destroy the Corps of Engineers. In the textbooks they called it the Forecast Flood Disaster. In southern Louisiana they don't talk about it. There's no one left to talk. The great shallow bay that replaced southern Louisiana has never been named.

After that, the arguments of the "idealistic" and "unrealistic" ecolo-

gists and hydrologists seemed to make more sense. Asked the right questions, inventive Americans answered with, of course, new technology. Hence the Floatholes. The name really didn't fit, since holes didn't float, but the rhyme with bolthole caught on, as did the near-rhyme floathold. A Floathole was an escape from the flood, and it floated, and it held—it wasn't a boat. It was anchored in place, held by cables tied to bedrock. It was anything that fit that description, and nothing that didn't fit the description could be built in the cleared area of the Mississippi Main Channel Project.

High above, the Mississippi Main Channel satellite in geosynchronous orbit, was supposed to keep track of each beacon, notifying Main Channel Control if any one of them moved, came adrift. Only a few feet of downstream movement was allowable, since a drifting farmhouse or barn posed a threat to everyone moored downstream. That system had been tested in smaller floods, the annual spring rises, over the past few years. The beacons worked. The computers were able to track. But this was the first real test, the first major flood since the satellite went up.

Two days later Abel could look east across his farm and see the water. Instead of the dark line of a levee against the dawn, he saw silver, glinting in the first light. No more levees, he thought grimly. They say we don't need levees. I hope they're right. He and Ben drove that way, carefully, in the swamp buggy. Already the little grove of cottonwood and sycamore was half under, dark water swirling around slender young boles, tugging at the drooping sycamore twigs. Abel looked at the drifting trash, gauging the speed of it. He had to admit it was slower there than in the main stream beyond.

By noon it was closer. It was raining, too, a cold soaking rain that drummed on the cold soil. Abel and Joey started the pumps in the hog section, using the methane they'd stored over winter. Ben and Joanne were shifting feed, swinging the silos on their new pivots with the cranes that had cost as much as the whole farm—but on a special loan. If they failed, they wouldn't have to pay for them. Ellie was packing, moving everything in the deep cellar up, and balancing the load for a rise. Before dark, they all drove out to the last bit of dry ground east of the buildings, and picked up strays: three of their own cross-bred heifers that had wandered from the higher west lots, and a couple of hogs, and someone's fresh milk cow. Abel saw a bull stranded on a sandbar out beyond the young trees, bawling like a calf, but he couldn't do anything about it.

The buildings were all above water still, the hog section lowest, then the silos, then the equipment sheds and the house, with the cattle section a foot higher than the house. That wasn't the way Abel had built the farm in the first place, but that's what he had to live with now.

That night they listened to the weathernet all through supper, filling up on hot cornbread and baked beans and corned beef and cabbage. Joey made a bad joke about that meal giving them enough lift on its own, and Abel scowled at him. No sense being dirty minded,

just because there was trouble. He thought of his fields, now a bleak tannish gray with dead grass, the grass that had replaced his winter-sown grains. No more wheat, on this stretch, no more corn. Just the mat of mixed grasses the range biologists gave him. Soggy grass, right now, but supposed to hold even against the river. It didn't seem much like a farm, any more, and he suspected that the government hoped he'd quit, let them turn the land back into forest completely. But he wasn't about to quit. It was his land, and he'd stay on it even if it meant turning the barns into barges . . . even the house.

After supper, Louise called from New Bank. She and the kids had been there all winter; there were no more schools inside the Channel. Joey talked to her longest, then Ben and Joanne talked to their kids. Thirty miles seemed a long way away when they hung up.

Ben sat up that night, and caught the emergency phone on the first ring. He woke them all up: stage one flood, expect stage two by noon, stage three by day after. That took them off the phone system, and put them on radio linkage. Abel and Joey went out to check the hog section, and found that another sow had chosen exactly the wrong moment to farrow. She'd already rolled on three of her thirteen; Abel fished them out while Joey distracted her. They checked the weight distribution and cussed. They had to move two pens—never easy—and of course one shoat got loose in the confusion. Abel decided to eat more pork, no matter what the docs said. The damn pigs deserved to be eaten. They rechecked the balance, and the pumps, and turned on the running lights. Then Joey looked over, his face a question in itself, and Abel shrugged. One on each block and tackle, they set the lines that let the hog section float, lifting as the water came, moored to bedrock yards below, but with plenty of line.

Abel called in his first launch when he got back to the house. Three in the morning; he felt like an idiot on the radio, especially when the operator at Main Channel Control didn't understand "hog section" at first.

"Not 'house' section!" he bellowed back. "Hog—pigs—you know, bacon!"

"Pigpen?" asked the timid voice from miles away.

"No—oh, hell, call it a damn pigpen if you want!" A thirty-five thousand dollar hoghouse, set on a ninety thousand dollar barge, and they wanted to call it a damn pigpen. He gave them the beacon signal code. He felt the floor quiver; Ben had started the main pumps. A wet wind fanned his cheek: Joanne going out to check the silos. The radio buzzed at him, then another voice spoke in his ear.

"You'll have an eight-foot minimum, eleven foot maximum for at least ten days. How about the house?"

"We're pumping now." Abel could feel the tremor as all four compressors lifted the house off its foundation. Ellie came panting up the cellar stairs, thumb high. That meant she'd sealed the lower cellar, and checked the inner locks. "Sealed and separated," he went on, smiling at her. "You want the house beacon now?"

"Yeah—go on. Give us a beep when you've launched."

Abel gave the number. Across the

kitchen, the screen lit on the computer as Ellie hooked up the inboard power and switched it on. She punched in the beacon code. The screen flickered, then steadied, as the Channelmaster computer locked in. Abel gave the computer a grim smile. Something was working right, at least.

Then Joanne slammed in through the kitchen door, mud to the knees, and cussing like two regiments of Marines.

"Those . . . silos . . ." she finally said. Abel didn't hold with that kind of language, and not from his sons' wives especially, but when he saw the silos he could sympathize. One was safely down, resting in a cradle of inflated rubber, moored properly to upstream and downstream bedrock anchors. But the other two—including the big one—were in trouble. The crane had jammed, slipping in the mud as it was carefully designed not to do. Instead of lifting the silo off its locked base far enough for the lower curve to pivot through, it had caught it partway. The silo leaned at a highly unstable angle, downstream high.

"So why'd you pivot it that way?" growled Abel, still angry about the language. Joanne was his son's choice, an Oklahoma girl he'd met at the University, and Abel was still convinced those cowgirls grew up with barn dirt in their mouths.

"The house," she said shortly. Abel knew it as she said it, remembered too that it was his fault. The experts had told him to leave room to pivot all the silos with the upstream high, but he hadn't wanted to move either the house or the equipment shed. Nor had he wanted the silo on lower ground, or farther from the hog section. He snorted. Joanne gave him a worried look. "Listen, I can't free that thing. I've bounced the crane, but the footings are sagging."

He took his anger out on the contractor. "They told me they went to bedrock with those footings."

Headquarters, Mississippi Main Channel Control, occupied a squat block of new construction just outside the Channel markers in southern Indiana. Long before Abel launched the hog section, Channel Control had logged fifteen hundred twenty eight launchings in the Ohio Valley. The first were on the small tributaries like the Miami, where three launchings were already back down, having floated for only thirteen hours. There the water rose and fell quickly. Downstream, as the swollen tributaries poured in yard after yard of turbid water, the floods came later, and lasted longer. Through the cold spring rains, monitor crews tramped woodland and pasture, checking the rise, the bank resistance, the current's velocity.

With all of them working on it, the Jacobsen family got the smaller of the two stuck silos rotated and into its cradle of pontoons. That had been nothing worse than a jammed winch, and Abel had been clearing jammed winches since he first owned one. But the big silo still canted sideways, its high end looming over the walk between the house and the cattle section. It had to come up before it could come down—or it had to gouge a groove in its foundation. The cattle section was still unlaunched, but ready. Abel took another look at the silo, which looked too much like an Army rocket he'd once seen at

the county fair, cocked up like that, and then at the water. Running lights on the house and hog section, and the worklights on the silos were all gleaming on a moving skin of black water that half-engulfed the house.

"Launch the cattle," he said to Ben, who nodded. Then to Joanne: "I don't know why everything that goes wrong out here has to go wrong in the damn dark. And you'd better excuse my French, Jo, after what you've been saying."

"I'm sorry, Pop Jacobsen," she said. She could be sweet when she wasn't cussing, and he knew exactly why the boy had married her. "I was just so mad . . ."

"Yeah. Well, now—so it's slipping on the foundations?"

"I think so. Look there." She pointed her worklight upward to the linkage of crane and pivot; raindrops glittered in its ray. Abel nodded. The angle was all wrong. Something had gone bad underneath; he could almost see, in his mind, the footing shifting slowly through the wet soil, forced by the unbalanced weight of the silo. "Worst thing is," Joanne said, "we pumped out of number two into the big one, to get the best average buoyancy. That's what they told us, remember?"

"Yeah. And we can't pump it back, now they're down. How full is it?"

"Twenty-two percent," she said. Quick as always, she anticipated his next question. "If we dump it, we'll be short 30 days. And even then it might not work."

"What if we put maximum lift under it—" Abel snorted as a swirl of wind sprayed heavier rain on his face. His feet were cold. He looked down and realized that the water had crept instep high on his boots.

Ben came jogging back, splashing with every step. "I'll check the hog section while I'm doing it," he called. "Last time on foot, I reckon." They heard the change of sound as the deeper water slowed him. Then a high yelp.

"You all right?"

"Yeah—water's deeper than I thought. Cold, too. Over my boot tops."

"Thirty days—the damn government ought to give us that, after okaying the contractor on that pivot job. If we save the silo itself, that's plenty." And the house, he thought privately, and whoever else is downstream.

"Can we pump from partway down?" asked Joey.

"Don't know. Might as well try." This approach had served Abel well, and he trusted it more than his sons' tendency to consult a computer at every move. Joey clambered up onto the silo's main foundation, and went to work.

They smelled it first, the sweet pungent stench of silage like a reminder of summer in the cold wet. Then the auger motor caught, adding its racket to the storm noise, and gouts of silage spurted out into the worklights. One of them smacked into the water only inches from Abel's feet.

"Aim it somewheres else!" he roared. He couldn't hear Joey's reply, and turned to Joanne, but she'd already left. He saw her lurching toward the hog section, already knee-deep. He helled. Then he saw Ben wading toward her, and turned back to the silo.

Because of the angle, the augur couldn't empty the silo, but it was down

to twelve percent. Abel helped rig the pontoons. He hoped the upward pressure would substitute for the crane's lift, hoisting the silo enough to clear the base, so it could swing down into the buoyant cradle. The water was knee-deep even on the silo platform, and he began to wonder if they should have brought the boat out for this chore. This water didn't seem to be moving fast, yet he found himself more than once nearly stepping off the downstream end of the platform when he hadn't headed that way.

Dawn showed a landscape more than half water by the time they'd done as much as they could for the silo. They held hands and waded back to the house, Joanne waist deep, nearly swimming. Abel felt the cold strike clear to the bone. They had trouble getting in; they were used to the porch steps, and now the house floated a foot higher.

Ellie had hot coffee and oatmeal, and clothes warmed by the oven. Abel hardly noticed that none of them had bothered to leave the kitchen to change. They were all too cold and wet to care, shivering and miserable. But coffee and food brought them back quickly.

"It's not fixed," Abel told Ellie, as she put sausages on to fry. "Damn thing won't go up, and won't go down. It's just hanging there. What we did, we emptied it as much as we could, and lashed the pontoons along it. We hope maybe the river will lift it the rest of the way. Undogged the cable—"

"No, dad," said Joey, suddenly alert. "I didn't. I left it tight so it couldn't drop suddenly—"

Abel opened his mouth to say what he thought, and shut it again. They'd all been tired, and he hadn't thought to check it. "Undog it after breakfast," he said mildly. "It's got to be able to come down."

"Think it'll be okay till then?"

"If we don't eat breakfast all day." He chuckled then, and saw by Joey's puzzled look that he didn't understand. Ellie did, reaching over with her long cooking fork to tap his bald spot. She remembered the time they'd eaten breakfast all day—or that's what her folks had said.

During breakfast he noticed for the first time the floor's gentle quiver under his feet. It made him uneasy. He'd never been one for boating, though anyone along the river had spent time in some kind of boat, some flood or other. He saw Joanne steal a look at the floor when one corner seemed to dip, and smiled at her.

"Like boats, Jo?"

"No." She shook her head. "I'm a dryland girl, remember?"

"I don't either, and I've lived by this river all my life. But the way things went, we don't have much choice." He pushed back his chair and went to the window. The rain had stopped again. Nothing showed of the rosebushes in the front garden, the yard fence. They'd forgotten to take down the kids' tire swing, and the ropes dragged at the tree limb, the tire jerking against the current. He could see land, only a quarter mile away, range grass beaten flat by rain. Beyond that the road to New Bank showed as a silver stripe across the rising land, dipping and lifting again. North, the silo's looming presence blocked most of his view from the kitchen.

He went down the hall to the bedroom, and looked again. Now he could see the floating sections, each with a rippling wake behind it, widening to join other ripples before meeting the house. When he looked down, he could see that a curl of water rose around the blunt prow of the house barge where the cables held it against the current. North was almost all water, beyond his barges, but he thought he saw the wooded point in Armison's pasture, a dark blot against the brown water. East—nothing but river.

He shook his head, thinking. He'd been through many floods on this land, but this was the worst so far—and more was coming. In the old days, the levees held much of it back. His lower fields went under every year, and the house had had a foot of water in it once, but nothing like this.

"How's it look?" asked Ellie from behind him. He turned, seeing the same strain on her face.

"Like a lot of water," he said, shrugging. "I never really thought—" He didn't finish; she didn't ask. None of them had ever thought to see so much water right where the house was—where it would have been without the Floathole technology.

"How deep is it?" she asked.

"I don't know. There's nothing to tell by: everything's under." He led the way back to the kitchen, and peered at the several dials that had been installed. They'd explained all that at the time: the depth finder, the water velocity meter, all the things that made his house seem more like a boat, but he hadn't paid much attention. Now he found everyone clustered around, watching.

"Five feet," said Joey, and whistled. Ellie shivered; Abel realized she was thinking of five feet of water *in* the house, how far up the wall it would be.

"Well," he said gruffly, "at least we're floating. They were right about that. Now let's get that cable fixed, so that monster can come down if it wants to."

Even without rain it was cold and raw outside. They wrestled the dinghy they'd been given off the wall of the porch, and checked the little motor. The government advisors had had plenty to say about landsmen, farmers, using boats on a flooding river, and now that he could see the river for himself, Abel decided to follow their advice. They launched from the downriver end of the porch, and hooked a clip on the cable that connected the house section to the highest Floathole, the number two cattle section.

"It's like a cable ferry," the government man had explained. "That way you can't drift too far away, and you'll use less fuel anyway. And with all the other sections upstream, you can clip to a cable and get back to the house without any power at all."

It had sounded unnecessary, but as the boat moved out into the current, Abel changed his mind. The current wasn't particularly fast, he thought, watching bits of trash drift by, but he could feel its grip on the little boat. Five feet of this water seemed more powerful than five feet of the river he'd fished last year. It was going somewhere, and determined. Their engine snarled, forcing them crosscurrent to the cattle section. From there, other cables led to the other Floatholes; from each a cable led

back to the house. The silos, though, had no cables. Cables ran nearby, but not to, the silo foundations.

After that first ride, Abel decided to do the cow work first. "Otherwise," he explained, "we'll have to make the same trip over. If we feed and clean up now—" They all saw the reason behind that. Ben milked out the cow they'd found the day before, while the others spread hay in the feeders and shoveled manure into the chutes. From there it went below, to the big methane generating tanks. Abel hoped they'd be back down before they had to clean sludge: he couldn't imagine how they were going to get that stuff out while floating. Somehow all the advances that had come in his lifetime had done nothing to change the essentials: if you had animals at all, you had to feed one end and shovel up after the other. Nothing the biologists had done in breeding improved stock had changed that. Now they had methane generators, and automated feeders that weighed each animal and each ration, and all the rest—but in a flood, when anyone could see you needed *less* to do, you got more instead. With the silos disconnected, the automatic feeders didn't work, even though they'd moved enough feed to each floating section for the next two weeks. Back to buckets and barrows, and back to shovels—the tools of Abel's childhood, familiar as well to his father and grandfather.

It made sense to all of them to go on and do chores in the other sections before tackling the big silo: cattle section one, the hog section. It took longer than they thought it would. Rain started again while they were working in the first section, and they had a wet miserable trip over to the next. It was nearly noon—and again the rain had stopped for awhile—when they managed to snare the crane support on the silo while hooked to the house cable, and pulled themselves over to it. The inflated rubber sausages they had lashed under the low end of the silo bulged up, quivering with the current. Abel touched the leg of the pivot crane, felt the vibration in it. Water swirled around the inflated pontoons, tilting the dinghy at an angle away from the silo.

"I'll do it," said Joey, looking up at the locked winch some five feet above the bobbing boat.

Abel nodded. He didn't want to, not at his age, and Ben had never been as handy. Joey reached up and caught hold of the crane legs. The dinghy tilted back again with his shift of weight. Abel felt the sideways lurch when Joey put his weight on the crane, and left the boat. Ben shook his head.

"I hate boats," he said over the sound of water dragging at the pontoons and silo.

"So do I, but we couldn't do this without 'em." Abel peered upward, watching Joey climb toward the winch. He started to yell be careful, but Joey knew that metal was slippery as well as he did. Better. From below, Abel's view was obscured by Joey's boots and rain gear. He couldn't tell what the boy was doing—not boy, he reminded himself. Not any more, married and with kids in school. It seemed to be taking a long time, though, and Abel began to wish he'd gone up himself. They knew the river, his boys, and farming, but it seemed sometimes they got slower every

year. Joey's elbow jerked outward, then down, then outward again. He had to be through—

He felt it before he heard it, with that part of his mind that had learned to feel trouble in time to jump away. Then the sound: the whine of heavy steel cable unrolling too fast from the drum, the incredible racket of metal-on-metal that meant something loose, and the concussive thump as the big silo slapped into the water all at once. The far end went under, then bobbed up, and a wave smashed into the house above the barge waterline. The dinghy shook like a horse determined to ditch its saddle, and all three of them grabbed for its sides. The half-submerged pontoons rebounded, rocking, shaking the water around them and the boat on its surface. Arm-wrenching jerks, and then Ben and Joanne held it steady against the rubber pontoons. Abel got his eyes straightened out and looked up.

Joey still clung to the pivot crane support, but he wasn't coming down. He wasn't moving at all.

"Joey!" Abel's voice didn't seem very loud to him. Nothing seemed loud, after all that noise, and Joey didn't move. Abel looked at Ben and Joanne, met their eyes wide with the same fear, and heaved himself toward the crane support.

"Dad, you can't." Ben had his arm, hard, and Abel didn't trust the boat enough to pull free.

"I can, and I will. Dammit, Ben, you have to make it." Already he suspected he'd find something too far gone to cure, but he knew Ben had to come home safe.

"Mom Jacobsen's at the window," said Joanne in a small voice.

"After that crash she would be," Abel said. "Now listen—don't either of you climb that thing, not until I say. That's the first thing. Second thing is, if I fall, don't go up there, and don't bother chasing me. I've got a life jacket on. Just get back to the house and report."

"Yes, but—"

"Jo, no buts." Ben had already let go his arm, the habit of years, and Abel pulled himself slowly out of the boat, taking his time to be careful. Joey was on the maintenance ladder, taking up the whole thing, of course, and he had to figure out how to get past him. He didn't want to go up the inside of the support, between the crane and the silo. He'd learned early on not to get between something big and heavy and something hard and immovable. He climbed the ladder as far as Joey's feet. They were still planted on the ladder rail. That was something, he reckoned. He reached up and touched Joey's leg above the rubber boots.

"Joey?" He didn't expect an answer; when one came, he nearly fell with relief.

"Dad. I can't. Can't climb." The voice was one he hadn't heard in years, not since the time the boy had suffered a burst appendix. He'd wanted to play in the district championship game, and hadn't told anyone about his bellyache. Then he'd crumpled, just as the game started, and in just this tight colorless voice had told them he couldn't play. He was sorry, he'd said. "I'm sorry," Joey said now, and Abel grunted.

"What is it?" he asked.

"Arm."

"Winch?"

"Yeah." Abel nodded, having figured that much right. The winch had messed up, as winches so often did, and had either trapped Joey's arm, or ripped it off. Bad enough, but not as bad as what he'd feared, that the cable had snapped and hit Joey in the head.

"I'm here," he said, which was all he could offer right then. "We'll take care of it." Joey didn't answer. Abel hadn't expected him to waste that energy. He looked down into the boat, at the white faces staring up at him.

"He's alive," he said. Joanne's face crumpled a moment, and he turned his eyes to Ben. "I want that rope," he said. Ben picked up the coil of rope, and tossed it upward, letting it roll open as it flew. Abel caught the loops easily, and nodded. "You get on back to the house," he said. "Check the moorings on this thing, call in a medical emergency, then get back out here with the boat and a jug of coffee."

"Right." Ben let go the pontoons, and let the current haul the boat along the current to the house. Abel turned back to Joey, and knotted the rope around the angle of support and ladder rail. Slowly, carefully, he worked his way upward, wrapping Joey onto the support with the rope. When he had to move between the silo and the crane support, he didn't even notice. From there he could see Joey's face, white around the mouth, eyes closed.

He looked up and sideways, but all he could see of the trouble was streaks of blood dripping down the metal. He sucked his cheeks tight against his teeth. Cursing wouldn't help, not now. A little higher, and he could see what had happened. Somehow the lower drum had released cable too fast when the winch unlocked, and the freewheeling motor had let a coil spin wide. That loop had caught Joey's arm and yanked it into a tangle of cable; luckily the arm had given. One of those splashes when the silo fell must have been his hand. It could have been his body, not his arm, if the arm hadn't gone. Now the stump lay crushed between the coils on the winch.

Abel looked back at Joey's face. This time the eyes were open. "Is it gone?" Joey asked in the same tight voice.

"Yeah." No sense in lying. "Stump's caught."

"I knew something was." He blinked, then went on. "Knife's in my pocket."

"Damn government," said Abel. He knew he'd raised good boys, but right then it was all he could say. They could think, they had guts, and a damn government contractor had stolen his boy's arm . . . "Tourniquet first," he said to Joey. Joey nodded. Carefully Abel hooked an arm into the maintenance ladder and felt under his rain gear for his own knife. He put it into his other hand, unsnapped his jacket, and pulled out his shirt tail. If he'd thought about it, he'd have said that cutting a strip off the tail of his shirt with one hand while clinging to a wet metal ladder was a tricky sort of thing . . . not safe, not good practice. He didn't think. When he had the strip of tough fabric, he shut his knife and replaced it, then moved to a better position.

"Going to tie it," he warned Joey, who nodded without words. It was hard to get his legs wrapped safely around

the ladder, hard to get the right angle. He had the tourniquet tied before he remembered that he'd need a stick to tighten it. He didn't want to use the knife. He looked down and saw that Ben and Joanne were already back, with the boat tied on to the crane support. It had taken longer than he thought to climb that far.

"I'm going down," he told Joey. "Got to get a stick for that—"

"Wrench," Joey said, more faintly. "Hip pocket." Abel nodded, realized Joey wasn't watching, and touched his shoulder.

"Right. I'll get it." He felt his way gently along Joey's body, afraid he'd dislodge the wrench, but managed to lever it out from under the rain suit. When he tightened the tourniquet, he heard a faint sound from him, hardly speech. He didn't look. He'd had to place the tourniquet high, nearly at the shoulder. From just above the elbow the arm was either gone or mangled, locked into the coils of cable. He couldn't imagine how Joey had managed not to scream when it happened. Or had the sound been lost in all those other sounds? He pushed that thought aside, and got out his knife again.

"They said two hours, at least," said Ben when Abel clambered past Joey to pick up the coffee. "The nearest helicopter was already on a mission, and the next one is across—" Their eyes turned to the shoreless expanse of water to the east. "They've got more rain on the way, too. Anyway, they're sending a boat that was out, and the chopper. Whichever is first. Dad—"

"He's alive," said Abel, though he thought Ben knew that. "He's lost an arm in the winch. He can't stay there any two hours, though. We'll have to get him down."

"Is he conscious?"

"Off and on. We can't trust him to come down on his own, thought." He noticed now, for the first time, that the boat was nearer Joey than it had been. "I've got a tourniquet on it, but it's high—it may not hold."

"You had to cut—?" Ben's eyes moved to Joanne, who had said nothing at all, hands clenched on the blankets she held. Abel nodded, and went on.

"I'll go back up—I know how I tied him on. Put a line around his chest—"

"No." They both stared at Joanne, surprised. "Not just that, Pop Jacobson." With quick gestures, she showed him what she meant. "Between his legs, and then up—and it's a sort of sling. Just around his chest, and with his arm gone it might not hold."

"You've done it, Jo?"

She shook her head. "No, but my roommate at college was from Colorado. She did rock climbing, and she showed all of us."

"Okay." Abel thought a moment. "Like I said, I'll go up. I'll use Jo's idea, and then I'll run the line over the winch drum and drop the end to you. Then I'll unwrap what I've done, and you can lower him slowly while I come down on the other side, steadying. How about that?"

Ben nodded. "Joanne and I'll take him to the house. Boat won't hold all of us, with him down flat." Abel didn't like that: what if they lost him? But he saw the sense of it.

"Okay. Then you come back, Ben,

and get me. Leave Jo with Ellie." He took the extra ropes and started back up.

He could not estimate how long it was taking. Joey roused to drink a mouthful of hot coffee, but choked on the second. Abel feared to give him more. He drank it himself, needing the bite of it, the heat and sugar: he'd felt his arms begin to quiver. Then he rigged the rope sling, explaining to Joey as he went. He didn't know if the boy was awake enough to understand. He dropped the rope's end to Ben, then started undoing his earlier work.

In the end, Joey was able to help, clinging to the ladder with his remaining arm, and lowering his feet one rung at a time, as Abel coached him. Joanne almost stood to reach him, but the boat rocked, and she sank back down. Abel watched as they wrapped Joey in the blanket and started back toward the house where Ellie stood at the kitchen door. They got Joey out of the boat, onto the porch, into the house, and then Ben came back, working his way against the current to pick Abel off the pontoon. He'd edged along the silo on top of them to cut the distance, hardly noticing the danger.

Joey lay on the bed in his room, gray-white around the lips. They had bound the stump of his arm tightly, following directions on the radio. He wasn't supposed to eat or drink, the doctor had said, because they'd want to do surgery. But Abel ignored that: the boy needed fluids, needed nourishment, same as a hurt animal, and he wasn't going to listen to someone miles away in a safe hospital. So a bowl of soup had gone into him, spoonful by spoonful, and then they'd let him rest.

Outside, the dull afternoon showed nothing but rolling brown water on every side. From time to time the radio crackled at them, reporting the location of the boat coming their way. Abel dutifully answered, reading off the depth and velocity of the water passing the house, when they asked, without thinking about the reasons. Fatigue weighed on his mind and shoulders, deadening even the sorrow he felt for Joey, even the worry. When he glanced out the windows at the blunt-ended silo, resting so innocently on its flotation cradle, he could hardly believe he had been up on the pivot crane himself, had managed to get Joey down.

Water depth hit eight feet, eight and a half. With no reference points but the trees in the front yard, their branches now drooping downstream, it was hard to estimate how steadily the water rose. Abel went back to Joey's room, settling into the old chair beside the bed. Ellie sat on the other side, checking his pulse, feeling his forehead from time to time. When the rain began, Abel hardly noticed. But when the wind rose again, and the fine drops ticked against the window, he looked up. Already it was darker. With rain and wind against it, with the river's current stronger every minute, how could a boat get to them? And even if the depth at the house were enough, what about the sandbars, and the young plantations of trees the forestry service had put in? Abruptly he stood, and went to the window. It wouldn't work, and he should have known it—would have known it, if he'd been thinking instead of letting himself

sink into self-pity. They'd have to care for Joey themselves, alone, as farm people had always taken care of their own. He switched on the overhead light, ignoring Ellie's frown. Joey looked as bad as Abel felt.

In the kitchen, Ben and Joanne were head-to-head over coffee at the table. Abel could see the streaks of tears on Joanne's face. He glanced at the computer screen.

"When's that boat due?" he asked gruffly.

"They're having trouble," said Ben. "Crosscurrents, and this wind and rain. Said they might not make it before dark, and they didn't dare come inshore without good visibility. Too many trees and sandbars and such."

"Always said those damn trees would cause trouble," said Abel without much heat. He saw in Ben's face the worry that this caused, the fear that his father had lost his ability to fight back, to think. For a moment he wondered if he had, but he knew better. He'd caved in like an old, untended levee for an hour or so—an hour they could not spare—but now the native stubbornness that had kept a Jacobsen on the land in the Mississippi floodplain for generations had caught its breath and taken hold once more. He wouldn't waste grief on the time he'd wasted, no matter what came of it. He turned away from the table, poured himself a cup of coffee, and took the last cold sausage from the drainer. As he bit into it, and remembered last night's fury at that miserable sow, he suddenly realized that he was hungry. They'd given soup to Joey, but no one else had eaten since breakfast.

He sat down heavily, mouth full of sausage, and waited until he'd swallowed before sipping the coffee. Ben and Joanne waited, silent. Then Abel looked at them, forcing himself to smile.

"Could be a whole lot worse," he said. "Could be, and isn't. You kids do the late chores yet?"

They looked shocked, both of them. Abel took strength from that, too. "Come hell or high water," he said, "stock's got to be fed, and that fresh cow needs milking."

"But we can't leave Joey—" began Ben.

"Your mother's doing the nursing," said Abel. "We've got to get the work done, and while we're doing that we can figure out what to do for Joey besides what we're doing."

"I wish we had a small boat we could take him in," said Joanne. "Something small enough to be safe going out through the trees, but big enough to be safe on the open river. Then we could meet that boat."

"That dinghy isn't it," said Ben. "Even if we were better at handling it, I wouldn't want to try it out on the river itself."

"Chores," said Abel again. He led the way to the door.

The chores had their own rhythm, enforcing a harmony on them. Abel leaned into the stray cow's flank, milking her out, and listened to the way Ben and Joanne moved in and out of step as they carried the feed, dumped it into the troughs, shoveled manure. By the end of the first cattle section, they were working smoothly together, a team that had functioned this way for years. They had come to the hog section before the

thought that had struggled to come out broke free of his worry. He stopped, staring vacantly at the sow with her piglets. Then he went back to work, without saying anything, thinking it over. He foresaw the protests of the medical teams at the other end of the radio—but that's exactly where they were, out of reach.

Before they left the hog section, he took the vet kit off the wall and checked it.

"What are you doing?" asked Ben, coming up behind him. Abel said nothing, pointing to the nested vials of pharmaceuticals, the neat coils of tubing, the packets of needles. And the three large bags of saline solution in the bottom . . . recommended by their vet, to keep on hand for emergencies. He'd used them, too: twice on a calf, and once on a piglet.

"But—it's for animals," said Joanne. "We can't—we aren't doctors . . ."

Abel shrugged. "The doctors are a long way away, Jo. If I can start an IV on a pig, why not on Joey?"

"For one thing, they don't stick people in the neck," said Joanne. "You could tie that pig's snout down, but—"

"That vein in his arm is bigger than the pig's neck vein was," said Abel. "Besides—if it comes to that or letting him die, I'm not going to let him die." Before they could say more, he lugged the kit out to the dinghy and got in. They followed, silently, and said nothing on the way to the house. From that side, they could see the light in Joey's room, and Ellie sitting there like a painted picture.

Once back inside, Abel set the vet kit in the hall. The kitchen smelled of cooking food; he realized that someone —probably Joanne—had put something in the oven during the afternoon. Now she moved around the kitchen, heavily as an older woman, laying the table and opening cans of vegetables. Abel went back to check on Joey. He looked no worse, but didn't answer when Abel called his name softly. Ellie just shook her head.

Supper was a silent meal: pot roast, potatoes, carrots, peas, eaten quickly and with scarcely a word spoken after saying grace. Ellie came out, filled her plate quickly, and ate in Joey's room. Abel was thinking how he could ask on the radio for the kind of medical advice he wanted, when it erupted in a squall of static that stabilized into a voice. Abel grabbed the mike. The boat couldn't make it in, he was told, but they'd send the helicopter at daylight. If it wasn't storming too badly. Abel kept his temper, and asked his questions quickly. Their reaction was about what he expected. He kept asking, insisting that if they couldn't do anything, they ought to tell him how. Finally he worked his way up past the first level of emergency radio crew and advisors, to a voice he'd heard in the background. And that voice, quiet and precise, told him exactly what to do and how.

"If you miss," the voice said, "you realize you'll make things worse . . ."

"I realize." Abel bit back what he wanted to say, which was that no one else was likely to realize as well as he did . . . he, after all, had held Joey as a newborn infant, slick and blood-streaked as he came from the womb. But the voice went on, asking now about the drugs in the vet kit, and Abel had

to peer closely at the labels, spelling out the chemical names, and reciting the concentrations. He began to forgive the voice for its earlier arrogance: now that whoever it was had decided to cooperate, he was going farther than Abel had planned, beyond mere fluid replacement. Maybe he was a good doctor—by which Abel meant someone who agreed with him. If, that is, Abel could get the IV line in.

"Don't feel too bad if you can't," the voice finished up. "It takes most people quite a while to learn to do it consistently. And it's going to be harder on your own son."

It would be harder to *lose* my own son, Abel thought. He signed off the radio, and looked around at the others, who had listened to this exchange in silence. He thought about it. Would any of them do better? Ben's eyes dropped; Ben hated giving shots, and always let Joey do it. Joanne had her back to him, doing the dishes; that was a message in itself, since she hated housework. He'd seen the fear in her eyes, when she looked at the needles. And Ellie, too, looked away, shaking her head silently. Abel looked at his own hands: big, blunt, hard with years of work . . . but deft, skillful, obedient to his mind's command. He sighed, and picked up the vet kit.

"It won't get easier for waiting," he said. "You heard that." They nodded, still silent, and Ellie came with him.

He went slowly, all the same, careful with each step as the years had taught him. When he was ready, the bag of saline hung from the old hatstand, tubing full and carefully cleared of bubbles. Strips of tape lay ready to hand, stuck on the headboard of the bed. Ellie's narrow sewing ironing board was ready to stabilize Joey's arm after the line was in. He had scrubbed Joey's arm, wondering briefly why the big vein, usually so prominent, seemed half its size. But that was obvious when he thought of it . . . the difference between an empty sausage casing and a full one. He went over the doctor's instructions again, aloud, to Ellie, then opened the first of the needle packets.

It was harder than he would have believed to force himself to pierce Joey's skin . . . it seemed that half a life went by while he held the needle poised over the vein. Joey lay so still, so helpless . . . and the arm he held was so limp. Abel let out the breath he was holding, took another, and forced himself to slide the needle through the skin, straight at the vein he could see.

"It may roll sideways," the doctor had said. "And it may be collapsed. You should feel a sort of pop when it goes in, if you're lucky . . ."

He felt no pop, just a vague resistance, but Ellie's sudden gasp made him look at the back of the needle. A little blood ran out of it. Quickly Abel grabbed the end of the IV tubing and slipped it into the cuff on the back of the needle, only then remembering that he was supposed to slide the plastic catheter farther into the vein off the front. He pulled the tubing out, eased the catheter forward, got the inner needle out, and reinserted the tubing. Blood pooled in the end of the tubing, coloring the solution. Tape, he thought, and then—no, check to see if it will run. He nodded to Ellie, who carefully thumbed the flow control on. The blood

on the end of the tubing disappeared, and he could see a steady flow from the hanging bag to the drip chamber underneath.

"Turn it off a second," he said. When the flow stopped, he reached over and got the first piece of tape. The doctor had said something about a fancy way to tape the catheter in place, which allowed the lines to be changed, but had finally agreed that simply taping the whole thing down tight would do. Abel finished with a soft cloth tie that held Joey's arm flat on the ironing board. Then he reached up and turned the drip back on, wide open as the doctor had told him.

After that, it was—as Abel liked to tell it later—no big deal to wait until dawn. He didn't admit how he'd felt when the first bag of fluid had no effect, when the first dose of drug the doctor had suggested didn't seem to do anything, when the whole day's tiredness fell on his shoulders all in a lump and he thought he could not do one more thing. But midway through the second bag, Joey had roused, briefly—long enough to complain. His arm hurt like hell, he said, and Abel gave him two of the pain pills the dentist had given Joanne the year before. He told the doctor afterward, and listened unmoved to the tirade that followed.

"He's got to rest," he said finally. "If he hurts too much, he'll thrash around and get worse . . . I've seen it with animals. Sometimes if you just knock 'em out so they don't hurt, they'll make it."

"Well, be sure he keeps breathing," said the doctor. "The big danger is respiratory depression—not breathing well —or nausea. If he vomits and chokes on it, we've got big problems."

"We've got problems already," said Abel testily. "He'll breathe. And he's never thrown up, not since he was six."

Joey kept breathing, and when the medical helicopter finally arrived, letting down two paramedics in a sling arrangement, he was, they agreed, stable enough for transport. So in the cold gray dawn, Abel watched a blanket-wrapped bundle being hauled into the belly of a helicopter, to be flown to the regional trauma center eighty miles away.

"I'll be back, Dad," Joey had said, moving his fingers in Abel's grip.

"We'll be here," Abel had answered. Promised. He saw in Joey's eyes that Joey took it that way, understood it. Then he pulled his hand away, and let the paramedics wrap Joey in a blanket and a waterproof covering, watched the hook on the end of its cable lock onto the suspension of the big basketlike thing Joey lay in.

And they still, he reminded the others when he came back inside, had the chores to do, flood or no flood. They'd have the flood all week, according to the forecast, and then they'd get to clean up after it, resitting all the Floatholes back onto their foundations, clearing debris, restoring order.

"One hand short," he said, before he realized the double meaning of it. He saw them wince, and felt it himself. "Sorry," he said. "I didn't mean—but it's true. And the stock can't wait." He felt that weight in his shoulders, the strength he'd transferred to his sons and would never get back, and wondered how he'd make it through the day. He

was going to have to get back into that miserable little boat, and the last thing he wanted was a ride on those unquiet waters.

"Right," Ben laid a hand on his shoulder. Abel looked at it, and it seemed to glow with its own light. His son's hands . . . like his own, hardened with a lifetime of farmwork; unlike his own, belonging to a different self, a different time. He had a sudden vision of hands, passing the farm along: his grandfather's, his father's, his own, even Joey's hand somewhere in the cold floodwaters . . . they all belonged to the land, had served it, foolishly or well, had taken their strength from it, and given back what skill they had. He shook himself mentally, looked at the three of them: son, son's wife, wife of his own, and couldn't find any words for his thoughts.

"Damn government," he said, a lifetime's meaning in it. "Farming's a hell of a life . . . but there's nothing any better. And I'm not quitting for any miserable tree-farmers' theories, or anything else."

"No," agreed Ben.

"He'll come back," said Joanne. Firmly.

"We'll be here." Abel picked up his gloves again and headed out the door. ■

●Martian chemistry may be stranger than we anticipated, so that the curious results of experiments do not indicate any biological activity. Or it may be that there really are organisms, behaving in a manner which is totally unexpected.

Patrick Moore

the reference library

By Tom Easton

Takeoff Too! Randall Garrett, Donning, $7.95, 311 pp.
Great Sky River, Gregory Benford, Bantam, $17.95, 336 pp.
Sideshow, W. R. Thompson, Baen Books, $?, ? pp.
Roger Zelazny's Alien Speedway, Book One: Clypsis, Jeffrey A. Carver, Bantam, $2.95, 192 pp.
Isaac Asimov's Robot City I: Odyssey, Michael P. Kube-McDowell, Ace, $2.95, 224 pp.
Swimmers Beneath the Bright, M. Coleman Easton, Popular Library/Questar, $2.95, 240 pp.
Toolmaker Koan, John McLoughlin, Baen Books, $16.95, 344 pp.
Robert Silverberg's Worlds of Wonder, Robert Silverberg, Warner, $17.95, 368 pp.

Briefly mentioned: **Jokers Wild,** George R. R. Martin, ed., Bantam, $3.95, 384 pp.; **Tales of the Witch World,** Andre Norton, ed., TOR, $15.95, 352 pp.

My centenary. My one hundredth column. And right now I would give a lot for some of the technological wizardry that has studded the pages of the thousand (more or less) books I have reviewed since October 1978. The human cloning described by David Rorvik in *The Cloning of a Man,* with whose review I began (he eventually admitted he was lying, or fictionalizing). The personality transcription that Fred Pohl used to immortalize in computers his hero, and others, in the Heechee books, and which others have posited as well. Time travel, such as Heinlein used to let Lazarus Long meet his own mother. Orson Scott Card's time-skipping in *Hot Sleep*. The gift of vampiry (remember Saberhagen's *An Old Friend of the Family* or Suzy McKee Charnas's *The Vampire Tapestry*?). Soul capture (Arsen Darnay's *The Karma Affair*, or Gene Wolfe's variant from *The Book of the New Sun,* whose first volume, *The*

Shadow of the Torturer, I covered way back in November 1980). The regeneration of M. A. Foster's *The Morphodite* and its sequels.

I'm sorry, Gary Weingarden. You wrote to say, "The sole reason I subscribe to Analog magazine is to read your column . . . I would love to see a recommended reading list. . . . Perhaps a 'top ten' or 'don't miss' list." The above paragraph will have to do, for I am incapable of the kind of objectivity you request today, this month, perhaps for the rest of the year. I crave the technologies I mentioned, and remember fondly the books that used them, partly because I crave what they could give, if only they were real.

Yesterday, July 13, 1987, my father died. He suffered a mild coronary on July Fourth, spent a few days in the hospital, was encouraged to think he could before long, if he was careful, resume his woodcutting and puttering and fishing and gardening and so on. And then, yesterday, when they were looking him over to see if he could indeed go home, he had a relapse. He died minutes after I and my wife and daughter reached the hospital; we did not get to see him until there was no one home.

He was a biologist and a college prof whose students long recall him with great fondness. He worked his way through college as a butler and a carpenter. He spent World War II in Intelligence. He had a deft hand with a sketching pen or pencil. He had been known to write poetry for friends and family. He told stories, but only orally. He wrote essays reminiscing about the lifeways of his youth in small-town, 1920s Maine for a small local magazine *(Mainely Local)*. He could serve a fancy dinner, build a barn, disarm a Nazi booby trap, repair a waffle iron, bury a horse, spin a yarn, spay a cat, weave a rug, bait a hook, gut a fish. He could do anything, though he made faces at computers. He was, in many ways, a Campbellian Man Who Could.

He lived just long enough to retire, to catch the biggest trout he'd caught in years, to meet his youngest son's fiancée, to see his grandchildren one last time. And if you think an obituary for someone with no involvement in SF has no place in this column, you have no understanding of the emotional, intellectual, and other forces that bias a reviewer's opinions. My father had a lot to do with making me who I am—an opinionated son-of-a-gun whose opinions (I hope) you like to read. His death has and will have a lot to do with the nature of those opinions, for at least a while.

On the other hand, most of the books mentioned in that first paragraph above are memorable in their own right. And that, Gary Weingarden, is the test. Let's not settle for a top ten. Rather, leaf through your back issues. Scan the lists of books reviewed. Look for that frisson of remembered pleasure, the ring of remembrance, for whatever reason. Listen for the thought, "Oh, yeah! I want to read that one again!" You don't need me to tell you what once-read books you should rate highly.

Nor do you need me to tell you what books to tell your children to read. Scan the lists. Pick out the ones *you* remember fondly. *You* recommend them. It will mean much more.

As deaths go, my father's was a good one. It was quick, as he had often said he would prefer, and he kept his mind right up to the end. Far worse, and most to be dreaded by a writer, is the loss of mind years before the body, as happened when Randall Garrett, known in these pages most recently for the Lord

Darcy series, fell ill. It was a virus that in effect wiped out his memory, reports his third wife, Vicki Ann Heydron, and it struck just a year after their 1978 marriage. By 1982, she had to see him hospitalized, apparently permanently, while she continued their jointly begun project, the Gandalara books.

This much of the sad story she lays bare in the introduction to **Takeoff Too!** The book is a collection of Garrett's short fiction and fannish verse, often in a humorous vein, designed to echo the success of *Takeoff*, which Garrett had edited himself. This one Heydron had to edit, and she did a fine job. *Takeoff Too!* aptly embodies the lifework of a man whose mind fit the *Astounding/Analog* pattern as well as we might expect, considering that he began by selling to Campbell at age 14 and later became part of the Campbell "stable" (though he sold to dozens of other magazines as well). And we see it all here, the aroma of classic Campbellian SF—the love of standing ideas on their heads, of puncturing balloons, of irreverence, of Campbellian fancies such as psionics.

Buy it to honor the author, in memory of the heritage we share in these pages, and because many of the stories remain good entertainment.

It is a pleasure to see another book from Gregory Benford. **Great Sky River** continues his future history of a galaxy dominated by machine intelligences who leave little place for fleshly life (see *Across the Sea of Suns* and *In the Ocean of Night*). Here we have a far-distant time on a world, Snowglade, once settled by humans, then found by the machines, or mechs. Over millennia, the mechs have changed the planet's climate and forced humans into a fringe existence of no relevance in the mechs' larger schemes.

Do you sense that humans occupy the place of contemporary Earthly wildlife? The parallel does seem deliberate, especially when we find, after following the flight of the remnant Family Bishop across the desolate face of Snowglade, hunted by the bizarrely unkillable Mantis, a mech with an eye for aesthetically motivated conservation. But that parallel, though it adds a nice level of resonance to the story, is only a subtheme. Benford skillfully and convincingly portrays a fallen humanity, vermin in a world they neither made nor wanted, stripped to the basics of survival. But those basics are high-tech basics—power-assisted suits hand built from mech parts, wired-in communications and sense-extenders, chips that give one the memory and skill stores of long-dead members of the Family (and let Benford reveal Snowglade's history despite the ignorance of his characters).

In this context, we watch Killeen, his son Toby, and the rest of Family Bishop, running, hunted, taking refuge where they can, fighting back when they get the chance, adapting, and running again. The Mantis strikes, they are overwhelmed by a sense of helplessness, and their flight brings them to another Family, one that is building a settlement with the aid of a renegade mech. It dreams of reestablishing humanity's dominance. But Killeen soon discovers the shaming truth, and then an out for those bold enough to take it: An ancient human robot, enslaved (or co-opted, really) by the mechs, reveals that its human masters long ago provided for an escape when humanity might wish to flee the mechs. That escape waits, and so do the vast intelligences that gave Killeen the password that pried the robot's secret loose, and so does—somehow! somewhere!—his father. Those who follow

Killeen have a destiny awaiting, and Benford has more books to write.

Don't miss this one. It's a masterful job, and it promises to be essential to Benford's future history.

The other day, Bill Thompson took me up on my offer to review manuscripts, instead of waiting for galleys or published books, and sent me the thick wad of his **Sideshow,** due from Baen this January. With it he sent a long letter explaining that, no, he doesn't believe in ESP, but telepathy makes good story, and he had this workable explanation, and anyway . . . He also noted that, yes, the parallels to Hitler are deliberate, with several out-and-out steals from history.

He needn't have bothered to tell me. I do have this nasty tendency to pick on writers for what I think (sometimes wrongly) are slips, but when a writer tries to forestall that tendency, he runs the greater risk of making me suspect he doesn't really know what he's up to.

Consider: Thompson's future world is ours, with the addition that not too long from now, a mutation has equipped some people with a double set of nerve cells hooked to the pineal gland. The result is telepathy, and then a particularly nasty variety of persecution. Our benevolent government has established a national Mental Health Bureau to act as the legal guardian for all adults who are incapable of running their own affairs. Since the mutants are abnormal, they are by definition insane, and the MHB takes over, clapping on their wrists an unremovable yellow bracelet. The government is oblivious to the true value of the telepath—they are both so exposed to other people's thinking that they necessarily learn how to think unusually well and are so vulnerable to others' feelings that they can do no harm; far from being insane, they are the sanest of us all.

At the same time, the country is suffering from economic chaos. Right-wing extremist groups such as the Iron Guard are gaining strength, and terrorists are running wild. People are scared, and that means that Savoy, the Hitler surrogate who wishes to take over the Iron Guard and then the country, can use the telepaths as scapegoats to whip up enthusiasm for his cause.

In this context we have Julian Forrest, telepathic runaway from the MHB, wanted by the Iron Guard and the government alike, proselyte for rationality. We have a reporter who craves fame, exploits Birge, a telepathic woman, and nearly succumbs to Savoy's appeal. We have the bureaucrat whose job it is to fight terrorism and who must resist the urgings of his superiors to purge the telepaths.

We have . . . Well, what is Thompson really up to here? He writes well. He invents characters with whom we can easily identify, creates exciting action and page-turning plot. But look at that title: *Sideshow*. There are the battle against the terrorists, the fight against the Iron Guard, the struggle of the telepaths for freedom, the developing love of Julian and Birge, the blossoming of the reporter's integrity. There are three rings in this list, and two obvious sideshows. But as one reads, one gains the curious sense that none of these plot threads really have much to do with each other. *All* are sideshows. All are intended to distract our attention from Thompson's main point, that very *Analog*ish paean to the rationality and empathy that define his telepaths.

Thompson writes me that he has two degrees in history. So consider history: Hitler, who stuck yellow badges on his scapegoats, the Jews, and whose am-

bitions Savoy plainly echoes. Consider that it is easy to draw a graph of rationality that shows that blessed state rising steadily through the centuries, spurred ever upward by our reactions to the atrocities of irrationality. Perhaps what Thompson is *really* saying is that all history is sideshow, and the main event is the development of our minds and souls. That, he says, is civilization. And he says it very well.

In the past few years, there have appeared a number of "shared world" series. The trend began when Bob Asprin's *Thieves' World* series proved popular. Now we have dozens of the things, and I wish now to look at a few of them, beginning with Roger Zelazny's **Alien Speedway, Book One: Clypsis.**

I wish I could say this series is as good as, say, George Martin's *Wild Card* success (whose third volume, by the way, is now out; it's **Jokers Wild**). Zelazny is a marvelous writer whose works we all eagerly anticipate, and he has done excellent work in the shared worlds of others (notably *Wild Card*). Now he has created a world of his own, expressly for others to work in, and *Clypsis*, by Jeffrey Carver, is the first installment. And it is not worth your money.

The story: A teenaged boy, orphaned by circumstance, slips away from Earth to pursue his dream of becoming a racer of fusion-powered spaceships in the distant Clypsis system, where space itself has been engineered to form the racetrack. He finds help wherever he turns, including benefactors known only to the reader, and his setbacks are deliberately set up gumption tests. The dice are impossibly loaded in his favor, as long as he comes through in the clutch, and the tale's excitement lies solely in the marvels of the Clypsis system and starship racing. Gosh! Wow! Zoom! Pow!

So it's kid stuff. It even reminds one a little of the Heinlein juveniles. So what's wrong with that? *Good* kid stuff, today, has a little more to recommend it than comic book characters and action and the simplistic moral that dedication to one's dreams will see one through.

In addition, if we object to transplanting sagebrush adventures (horse operas) into space as space opera, we should object no less to relocating Daytona and Indianapolis among the stars. It just does not ring true.

We see a variant on the shared-world idea when writers open up the worlds they developed for their own story cycles for others to use. We've seen volumes of short stories by Darkover fans. Now **Tales of the Witch World** is out, with one new story by Andre Norton and 16 more by Robert Bloch, Charles de Lint, Kiel Stuart, Elizabeth Scarborough, and more. And now there are novel series in the same vein, such as Isaac Asimov's Robot City series.

Asimov has apparently chosen not to develop the period between his robot novels and the Foundation era himself. Instead, he has sketched in the nature of a galaxy in which the worlds of Earth, Spacers, and Settlers coexist, while robots have established a realm of their own where they can study the Laws of Humanics (analogous to the Three Laws of Robotics, and perhaps what will in time lie behind the secret masters of psychohistory). On this stage, he has outlined a mystery of alien pirates, heroic amnesia, and murder in six volumes and turned the actual writing over to others. The first volume is Michael P. Kube-McDowell's **Odyssey.** Later we will see entries by Bill Wu, Mike McQuay, and Arthur Byron Cover; the

fifth and sixth writers are still to be announced. Writes Asimov in his introduction, "The books may not be (indeed, are bound not to be) exactly as I would have written them, but all the better. We'll have other minds and other personalities at work, broadening, raising, and refocusing my ideas."

Does it work? *Odyssey* opens as Our Hero opens his eyes. Remembering nothing of his past, he takes his name —Derec—from a patch on his suit. Rescued by robots who are busily sifting an icy asteroid for a mysterious treasure, he begins to pry. An alien ship attacks, the robots self-destruct, with the last one discovering the treasure and tossing it to Derec. The aliens seize it and put him to work reconstructing a robot. He finds an ally, tries to get the treasure back, sets off a booby trap, and falls, with the treasure and a heroine, Kate, into the hands of a new batch of robots. Here he learns the treasure is a Key to Perihelion, which supposedly permits its possessor to travel anywhere in the universe, and he and Kate use it to escape. But it will take them to only one place, Robot City, where someone has just been murdered and, notwithstanding the fact that they have just arrived, they are the only suspects.

There is considerably more action than we are used to seeing in Asimov's work, but that may be Kube-McDowell's contribution. The basic plot seems to be Asimov's, for it has the sneaky feel of the master, and it invites me to speculate that we are watching a laboratory exercise on the part of the robots of Robot City: I suspect Derec is a robot, a simulation of a human, designed and put into motion in order to help the robots test their hypotheses of the Laws of Humanics. The aliens are probably also robots, designed to flesh out the simulation, for Asimov has elsewhere said expressly that his galaxy of robots and Foundations is for humans only.

You think such play-acting should be easily detectable? Early on, we are shown a robotic technology that should allow total freedom of shape. The aliens keep carefully out of harm's way. Derec does not give orders to robots. Kate does, and to Derec as well.

We'll see. If I am right, then we have here a masterful puzzle or literary game prepared for the Master's fans and to honor the Master almost in the vein of an academic *festschrift*. If I am wrong, then there is no more here than meets the eye, and it is just more kid stuff.

So go ahead. Buy the book. And *you* figure it.

M. Coleman Easton (no relation) has an intriguing idea—and in its basic form an old one—in **Swimmers Beneath the Bright.** The idea is that our feverish, incessant invention, our drive toward the pinnacles of technology and into space, is due to Spore, an infectious, bacterium-like alien within. Uncountered, it destroys us. And there is no way to counter it, until we invent cyborgs with artificial blood that cannot support the invasion.

Once invented, the cyborgs realize the situation and begin to fight back. They find a clean world, Safehold, and design a race of swimmers to populate it, giving them the power to defeat Spore if it ever arrives. Then they leave their starships orbiting Safehold as satellites, Brights to the natives, and put themselves into cold sleep to await the day when Spore indeed arrives and their help is needed once more.

That day comes with the opening of *Swimmers*, eight millennia later. Only one of the Cyborgs awakens successfully, and she faces a world in which

their creation has gone awry. The people of Safehold are swimmers, but swimming is commonly viewed as sinful, a surrender to the senses, and their kings have monopolized the sea's resources. The ancient knowledge is lost. And Spore is hard at work on an island not far from two opposing kingdoms, one militaristic and greedy, one more sanguine and honoring of what is left of the old ways.

You get the drift? Once we know this much, all else is detail in the service of the inevitable. The cyborg, Mera Magus, must try to bring the truth to the people but finds only one or two who are ready to believe her heresies. Then they, despite all the difficulties two kings can pose, must spread the word, find and train swimmers to combat Spore, and defeat the alien.

And that is precisely what happens. Easton has produced a predictable stock adventure of no great complexity. It should appeal to all of you who don't wish to think about your reading.

To a biologist, the great secret of John McLoughlin's **Toolmaker Koan** is no secret. The book begins as a Soviet deep-space probe encounters a strange artifact beyond Uranus, reports back briefly, and goes silent. East and West then, in a world more polarized than our own, mount their separate expeditions to investigate. On approach, they nearly destroy each other. And the four survivors, two from each ship, are taken aboard an enormous habitat, where a robotic intelligence that calls itself Charon explains the title.

A "koan" is a parable. The "toolmaker koan" says that all tool-making species—or all those in Charon's vast experience—destroy themselves even as they step into space, on the verge of a "meta-stasis" that would fling them abroad, beyond vulnerability. To prove its point, Charon introduces the survivors to another species, the whileelin, who built the habitat and named it *Hwiliria*. Whileelin society is built around a core of fertiles served by vast numbers of neuters, generally specialized by surgery and conditioning for their tasks, who wear iridium helmets. They are obligate carnivores who run down and rend their prey. They are tailed bipeds, huge, and reminiscent of . . . I cannot say without giving the game away. I must content myself with saying simply that anatomy, technology, the creatures that share the habitat with the whileelin, all are clues that reveal the whileelin's true identity, Charon's vast patience, and something of the innate antipathy that must interfere with any attempt of humans to coexist or cooperate with the whileelin.

If I can't reveal the gimmick, then what can I say? McLoughlin has little hand for characterization; his people are mouthpieces for numerous lectures, and his story's strength is very much its ideas. But the gimmick is a nifty one indeed; I loved it, even though I saw it coming. And he had a surprise or two in reserve for the ending, which neatly ducks the koan by taking advantage of the way humans never seem to get their act together until something scares them half to death.

Robert Silverberg's **Worlds of Wonder,** says the author/editor, "is actually three books in one. It's an anthology of some of the finest short stories in the history of science fiction; it's a series of essays intended to constitute a textbook of sorts on the art and craft of writing science fiction; and it's a collection of personal reminiscences. . . . [It is] a three-level attempt to come to some understanding of what science fic-

tion is and how one goes about creating it, and to convey some of that understanding to others.''

What more can I say? The stories include Alfred Bester's ''Fondly Fahrenheit,'' C. L. Moore's ''No Woman Born,'' Cordwainer Smith's ''Scanners Live in Vain,'' Bob Shaw's ''Light of Other Days,'' Frederik Pohl's ''Day Million,'' and eight more undeniable classics. The essays are Silverberg, sharing what he has been, done, and learned over the years, and the long introductory essay is invaluable for its revelation of the answer to one of literature's greatest mysteries: ''Just what—and when—is the difference between a hack writer and a prolific pro?'' ■

ON GAMING

(continued from page 101)

ran Overlord Government, a powerful empire that rules almost the entire galaxy. With fighters sporting Latin mottoes on their insignia, and references to the Glory of New Rome, *Interceptor* mixes an ancient imperialistic mythos with Electron-Particle canons and Fibroplastic armor.

The game is an impressive package. The rule book includes a detailed introduction to the world of the Renegade Legions, with the deluxe drawings of TOG (Terran Overlord Government) and Renegade legionnaires, and full-page illustrations of fourteen different starships.

Essentially a game of ship-to-ship combat, *Interceptor* features a complicated, if dynamic and innovative, damage system. Each fighter uses a record sheet with a flow chart that monitors all systems. A template is used to show the type of damage done by an assortment of weapons. The template is matched against the ship's armor, and damage is noted.

Some weapons, such as lasers, penetrate deeply into a ship's system (as shown by an extended, needle-like template) while others inflict a more widespread (but easily deflected) damage.

When a system is hit (like the Superstructure, or Engineering) the player moves along a flow chart, marks off the appropriate amount of damage, and rolls a ten sided die at key points to determine the final extent of the damage.

The flow chart is nothing less than a schematic drawing of the ship's systems, and it has a remarkably realistic feel to it. For example, damage taken by the Cockpit Systems could lead to shutdown of the Communications Systems, Navigational Computer, or Long-Range Sensors.

Most fun of all, though, are the cardboard box ships included with the game. These are little boxes (one inch by one inch by a half-inch) that show top, front, rear, and side views of the ship. But on the bottom there are locations for unit insignia and a place to record enemy fighters shot down. FASA includes small stickers to personalize each ship, and the use of the ''Kill Markers'' makes this well-designed game of the far future nostalgically recall the gaudily decorated bombers of World War II. ■

brass tacks

Dear Dr. Schmidt:

I was puzzled by your insistence in the editorial for the July issue that "I have carefully avoided . . . expressing any opinion about the positive or negative worth of these movements," when, in the same editorial, you say, about a person calling himself a conservative, "his listeners should realize that their emotions are being manipulated by a subtle pretense" and "He just may be trying to distract you so he can put something over on you." I think that you are being a bit disingenuous in your claim to be impartially analyzing the use of words. You give no similar analysis of the word "liberal," and it's not obvious to me that those who now call themselves liberals especially favor individual freedom, or are especially generous with their own possessions. These qualities, by the way, are among those found in definitions of the word "liberal."

But there is a deeper problem with your whole line of reasoning. Suppose some person opposes a particular change, and then that change takes place, whether suddenly or over a period of time. According to the definition of "conservative," that person could be called conservative with respect to that one change, up to the moment the change took place. If he then continued to oppose the change, he would suddenly be a "reactionary" with respect to that change. But nothing else would be different at all. The grounds on which he opposed what had taken place would not have changed, nor would the nature of what he opposed. So if he did switch to supporting the change, then it would hardly be possible to say that he was the same sort of person. If he was a conservative before supporting the change, he could not be called a conservative after supporting it. If he was a conservative after

supporting it, then he must have been something else before supporting it.

Note that I am not talking about someone who decides later that he was mistaken about the nature of the change. What I am talking about is the automatic support of all changes that have already taken place, just because they have already taken place. Whatever word is used to describe such a person as this, that word cannot be "conservative." Such a person conserves nothing, and his whole way of thinking is self-contradictory. To oppose all or most changes until they have taken place, simply because they are changes, and then turn around and support them because they have taken place, just does not make much sense. In fact, I hardly believe that such persons even exist.

To forestall a reply that you might consider using, I will say that I do not believe that this is how the definition of the word should be applied. But it appears to be how you are applying it. The implication of your editorial is that anyone who continues to oppose any change after it has taken place, no matter what the change is, must be labeled a reactionary. The trouble with applying definitions in this manner is that in the end it leads to sheer nonsense. For instance, any German in Hitler's Third Reich who was trying to bring about the restoration of the Republic would be called a reactionary. Obviously this is an unsatisfactory use of that word.

To go on to other matters: I think that the last two issues of *Analog* have been two of the best that I have seen lately. That is why, in spite of having very little time to spare for reading science fiction nowadays, I have decided to subscribe for the first time in over ten years. The June issue was especially good. "The Forest of Time" was easily one of the best alternate worlds stories that I have ever read, making the issue worth buying in itself, and there were also three very good short stories, an interesting, if somewhat dry, description of the next real step into space, and a fascinating "Alternate View" column by John Cramer.

As for the July issue, your lead story belongs to a type that I've always liked. Please publish more authors like Robert Chase, who take us away from Earth and into the future. *The Report on Bilbeis IV* is set in the far future (more or less), but it is based too much on a rather ordinary political plot for my taste.

FREDERICK FOWLER
Atlanta, GA

The distinction may be subtle, but I really did avoid (in that editorial) making value judgments on any of the movements calling themselves "conservative." Warning that people should be watched very closely when they say they're doing something other than what they're really doing is not *a value judgment on what they're doing. What they're doing may be worthwhile; but if they're not describing it accurately, a healthy skepticism is in order. That warning applies to* anybody *who's using words loosely for emotional benefit. You're quite right that "liberal" often suffers similar misuse, and I'll probably pick on it some other time. The most conspicuous examples of the practice I was describing when I wrote that editorial, though, were being provided by people calling themselves "conservative."*

I doubt that anybody is genuinely conservative per se, *about everything. The problem we have gotten ourselves into is that a word that started out describing a stand with respect to change or lack of it, on any issue or group of issues, has been misappropriated to describe a stand on the issues themselves.*

Communication would be much clearer if "conservative" was left alone and a different word coined to describe the stand on issues.

Dear Dr. Schmidt,

I just finished reading your July '87 editorial, "The Reactionary Revolution." Let me see if I've got the major points straight:

1. The fundamental advantage of language is that it makes it possible to communicate and think about concrete and abstract concepts. This is one reason why language is so widespread.
2. The fundamental disadvantage of language is that many people tend to fall into the habit of reacting to language symbols as if they were the actual object or concept, especially if these symbols acquire "emotionally loaded connotations."
3. Would-be leaders within society will attempt to gain power through subtle manipulation of these symbols, knowing that the unwary may not be conscious of point two.
4. You then described "a case in point" in which a movement within our society has taken on the label "the great conservative revival"; and how, when compared to dictionary definitions, the terms do not accurately describe the goals of this movement. You emphatically deny any correlation between the label's implied meaning and it's explicitly defined meaning.
5. You show how the goals of this social movement would better fit the term "reactionary revolution," though the members of this movement would dislike such a label.
6. You stress that your arguments in this case in point are entirely semantic and that you were carefully avoiding expressing any opinion about the positive or negative worth of the movement.

To quote another science fiction writer with strong opinions, "I saw you palm that card." If the label "conservative revival" is an emotionally loaded one intended for subtle manipulation of people, so is "reactionary revolution." Simply because, in your opinion, it is semantically more accurate, does not make it any less an appeal to emotion or any less an implicit negative expression. You did make a good semantic argument—that the "conservatives" are in fact not concerned with conserving anything—unfortunately, you stepped outside the bounds of simple analysis when you suggested an even more emotionally loaded label. Furthermore, you went on to attempt the same type of manipulation you described earlier by claiming that you were *not* expressing an opinion, thereby implying that you were making an objective observation.

I have a suggestion to make: an editorial is the right place for opinions—so state your opinions as opinions, not as purely objective statements of fact.

A letter-to-the-editor is also the right place for opinions and here is mine: while labels are extremely tempting to use—direct, objective (where possible) analysis of actions and motivations are more likely to persuade a reasoning person. I hope in the future you will express your opinions succinctly (I know from past editorials that you can do this), and support them objectively, without giving in to the temptation of fighting fire with fire.

BURLE R. ARNOLD, JR
2015 37th Street,
Galveston, TX

You missed the entire point, but in so

doing uncovered another one. I did not *express a value judgment by identifying "the reactionary revolution"; I can easily conceive of things which fit that definition which I approve wholeheartedly. The denotative definition found in the dictionary would still fit, even though people would react negatively to the words. In fact, that negative reaction is unfortunate, if not dangerous: we have here a case where emotional connotations have attached themselves to words like leeches and made it impossible to use the denotatively correct words without being misunderstood.*

Dear Stan:

I've just finished reading *The Report on Bilbeis IV*. It reads well, but left me a bit puzzled, until I realized the cause of my unease. The psychology isn't human, at least insofar as my experience is any guide.

Sabium was made immortal, or nearly so, by medical intervention. Isn't *anyone* in Turtledove's universe interested in being immortal? Why was there no clamor to mount an expedition to study this medical phenomenon? Sure, she's not human, so the same treatment couldn't be directly applied. But she's not so different that Federacy medical science couldn't aid her, and so she's not so different that study might not lead to some extension of human life spans. If no one was interested in the possibility, forget biology, these people aren't human psychologically!

Indeed, what has become of humanity in this story? Given such a passage of time, even the puny investment we make today in life extension should have paid off in near immortality. Given the vast population of an interstellar civilization, even a tiny minority interested in life extension could bring resources to dwarf the present world economy. Any story placed in a technologically advanced future which doesn't include either near immortality or some explanation why it doesn't exist despite some people wanting it, is fatally flawed as futurism, though it may still be great entertainment. (As Turtledove demonstrates.)

Why, just look at the literature today! I can see several routes to an extended life span, any one of which could pay off in the comparatively near future. Genetic engineering. Central nervous system transplantation. Personality transfer into nonorganic media. Drug therapy. Molecular scale bionics and surgeons. (Read *Engines of Creation*, by K. Eric Drexler. The applications he discusses are tame compared to what's being kicked around in the technophile subculture.) The FDA may obstinately refuse to classify aging as a disease, but the pharmaceutical companies are getting into the act anyway, so look out!

There may be something to what Vernor Vinge has said, to the effect that SF writers have to drastically underestimate technological advances in order to write about a humanly conceivable future. The only story that comes to mind that doesn't shortchange progress is *Blood Music*. But does that excuse taking 1987 technology, tacking on ray guns and space ships, and then leaving out a fairly common desire from a fundamental drive of all life?

BRETT PAUL BELLMORE
8750 Burt Road
Capac, MI 48014

Dear Dr. Schmidt:

How *could* you? How could you let Tom Easton say that right in black and white in front of God and Everybody? The "that" to which I refer is in the July 1987 issue. The particular quote is in the review of Teresa Plowright's

Dreams of an Unseen Planet. It states, "I suspect she will appeal much more to readers of the women's magazines than to *Analog* readers." That appears immediately following Easton's listing of all the reasons the novel failed: "adjectivitis verging on the purple; the sheer boredom of her introspective romanticism; the utter, unlikely arbitrariness of her characters; the simplicity of her solutions."

Now I can't really object to that critique of the work, not having read the book, but my button certainly got pushed by "the women's magazines" part of the review. Probably you've figured out that I am not only a reader of *Analog* (long-time and avid, I might add), but am also a sometime reader of "women's magazines" and a woman. Let me first offer congratulations as, even though I am a voracious and catholic reader, very little that I read upsets me. A long time ago I decided that most things with which I disagreed weren't worth getting upset over. Everyone is entitled to his (see—I'm not a militant feminist, either) own opinion and I've certainly held conflicting opinions at different times in my life. I like to think that the processing of more and more information as we age leads to ever more refined and enlightened opinions.

However, after calming down (sort of) and trying to analyze why that particular phrase got to me, I decided that my first problem was with the "the" part of "the women's magazines." It sort of seems to me like saying *the* plague or *the* holocaust. It implies a homogeneity that doesn't exist. Some of the women's magazines have fairly decent fiction, some don't, and some have no fiction at all. And is it indeed fiction to which we are referring here? The offending passage doesn't really say. If it *is* fiction being deplored, then Dr. Seuss should be offended, too, since it was in Redbook that I was first introduced to him. Actually, I don't read "women's magazines" for the fiction. I read novels, *Analog*, and *Ellery Queen's Mystery Magazine* for fiction.

What usually draws my attention to "women's magazines" is the picture of some sinfully luscious looking dessert on the cover. After the cover picture, what usually draws my attention is the listing of an interesting sounding article. I confess that I *have* picked up one of those awful magazines because of a heralded excerpt from a favorite author, but only rarely.

Of course, I realize that what really jangled my chain was the perceived insult to little old me. It looks to me like the logic of that passage when personally applied goes like this:

1. I occasionally read women's magazines
2. Readers of women's magazines like:
   a. adjectivitis (purple prose)
   b. introspective romanticism, i.e., boring stuff
   c. vaguely defined characters
   d. plots which require little thought
3. Therefore, I must like a, b, c, and d.

WELL I DON'T!!!!!!! (Except for a little b now and then.)

And I'm not going to, *ever*, and you can't make me, SO THERE! (Picture a graying woman, complete with wrinkles and bifocals sticking her tongue out at a completely impervious computer screen.)

But I'm still going to continue to subscribe to and read *Analog* cover to cover including Tom Easton which just goes to show you how BROAD-minded I am.

MARY JANE BEHRENBRINKER
Birch Run, MI

How could I let him say that, you

ask? Well, since a review column is an opinion column, I avoid censoring the columnist's opinions unless he says something that's going to get us sued. But I do try to let those who disagree have their say from time to time, too—your letter, for instance.

Dear Mr. Schmidt and Mr. Easton,

I am writing in regards to Mr. Easton's column of July 1987, specifically, his comments concerning the two anthologies, *Kindred Spirits* and *Worlds Apart*. Truth to tell, I've not read *Worlds Apart*, so my comments concern only *Kindred Spirits*.

After Mr. Easton's opening statements extolling the "openness" and "variety" he enjoys in SF, I do not understand his condemnation of anthologies that contribute to those concepts.

Kindred Spirits is a theme anthology for and about gay men and women, not a debate on "homosexuality." Theme anthologies are generally not debates, as Mr. Easton suggests, with a pro/con format, but rather a collection of short stories on a particular topic. *Magicats!* edited by Jack Dann and Gardner Dozois is not a debate on cats but rather a collection of SF short stories about cats. The same applies to *Kindred Spirits*.

The stories (not the topic) are the appropriate subject for a literary criticism. This same type of restriction was placed on the work of other writers until Harlan Ellison collected their stories in his *Dangerous Visions* series. As even Mr. Easton is forced to admit, "Both are anthologies of gay and lesbian (sic) science fiction, and together they contain a wealth of excellent stories . . ." Therefore, if you are a gay woman/man, or want to learn more about us through literature, read the book. But, if your mind is closed to novel experiences, do not.

I find Mr. Easton's comment, "I would say the same things were I a homophile, or even a homophile-phile," offensive. Since he states he is not gay or even sympathetic, he can not know how I and other gay people feel. His statements are not of a "homophile-phile" nature nor even tolerant. His reaction to the topic (not the stories) seems more homophobic in nature and this fact darkly colors his review. As a gay man (I prefer the term gay because I am more than my sexual activities), I enjoyed *Kindred Spirits* because it was refreshing to read about characters similar to myself and because the stories were excellent. Most SF, as with most literature, is heterosexual (or straight, if you prefer), and my world view is excluded. I am but one of ten to fifteen percent of the population excluded from full participation in predominately heterosexual activities, including your magazine.

To paraphrase Mr. Easton's closing comments: Perhaps more to the point, I think one's preference in sex objects (whether it is those of the opposite gender, pillows, pictures, or dogs) is largely irrelevant to one's humanity. One's humanity is comprised of all that one is—black, white, single, married, living with someone, young, and old. One's humanity is one's world view. Mr. Easton is entitled to his world view, but he is not entitled to attempt to restrict mine.

I believe this column told us more about Mr. Easton than it did about the books in question. The more one knows about a reviewer, the more one can understand why they did or did not appreciate a certain book and how much credence to give that review.

SEAN T. HAMMOND

Bloomington, IN ■

a calendar of analog upcoming events

4-6 March
CONCAVE 9 (UpperSouthClave XVIII) at Park Mammoth Resort, Park City, Ky. Guest of Honor—Lynn Hickman. Registration—$9.95 until 14 February 1988, $15.00 thereafter. Info: Concave, Box 24, Franklin KY 42134-0024. (502) 586-3366.

4-6 March
BASHCON '88 (Ohio Gaming Convention) at Student Union Third Floor, University of Toledo Main Campus, Toledo, Ohio. Info: Student Activities Office, UT-BASH, BASHCON, 2801 W. Bancroft Street, Toledo OH 43606 (include S.A.S.E.) or (419) 537-4654.

18-20 March
MIDSOUTHCON VII (Middle South SF conference) at Marriott Hotel, Memphis, Tenn. Guests to be announced. Registration—$15 until 1 March 1988, $20 thereafter. Info: MidSouthCon VII, 1229 Pallwood Road, Memphis TN 38122. (901) 682-2003.

21-25 March
General meeting of the American Physical Society at New Orleans, La. Info: A.P.S., 335 East 45th Street, New York, NY 10017.

24-27 March
AGGIECON 19 (Texas A&M SF conference) at College Station, Texas. Special Guest of Honor—Katherine Kurtz, TM—Kerry O'Quinn. Registration—$10 until 1 March, $14 thereafter and at the door ($6/day at the door). Info: AggieCon 19, MSC Cepheid Variable, Box J-1, Texas A&M University, College Station TX 77844. (409) 845-1515.

25-27 March
MAGNUM OPUS CON 3 (Georgia SF conference) at Columbus Iron Works and Convention Center, Columbia, Ga. Guests include Michael Bishop, L. Sprague and Catherine Crook de Camp, Hal Clement, Philip Jose Farmer, George R.R. Martin, Norman Spinrad, Jack Williamson, Lloyd Arthur Eshbach, and Charles N. Brown. Registration—$25 through mid-March, $30 at the door. Information: Pat Robinson, Box 2303, Columbus GA 31902.

26 March
APRICON IX (NYC SF conference) at Columbia University, New York City. Info: Barnard-Columbia SF Society, 317 Ferris Booth Hall, Columbia University, New York NY 10027. (212) 280-3611.

1-5 September 1988
NOLACON II (46th World Science Fiction Convention) at Sheraton Hotel & Towers, Marriott Hotel, Rivergate Convention Center, New Orleans, La. Guest of Honor—Donald A. Wollheim, Fan Guest of Honor—Roger Sims, TM—Mike Resnick. Registration—Attending $60 until 31 December 1987, $70 to 10 July 1988. Supporting—$30. 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: Nolacon II, 921 Canal Street #831, New Orleans LA 70112 (504) 525-6008.

—Anthony Lewis

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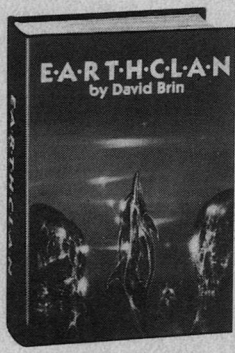

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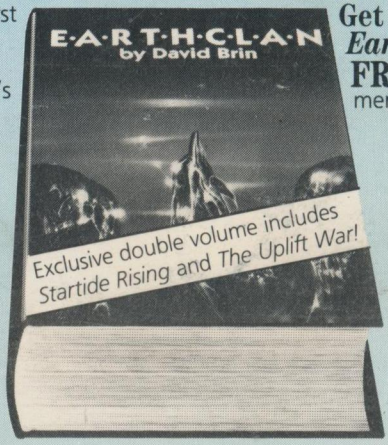

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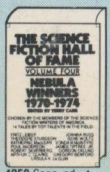

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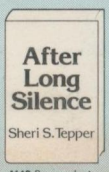

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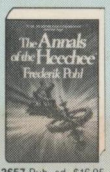

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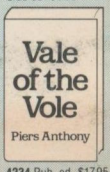

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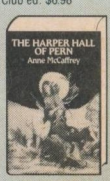

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