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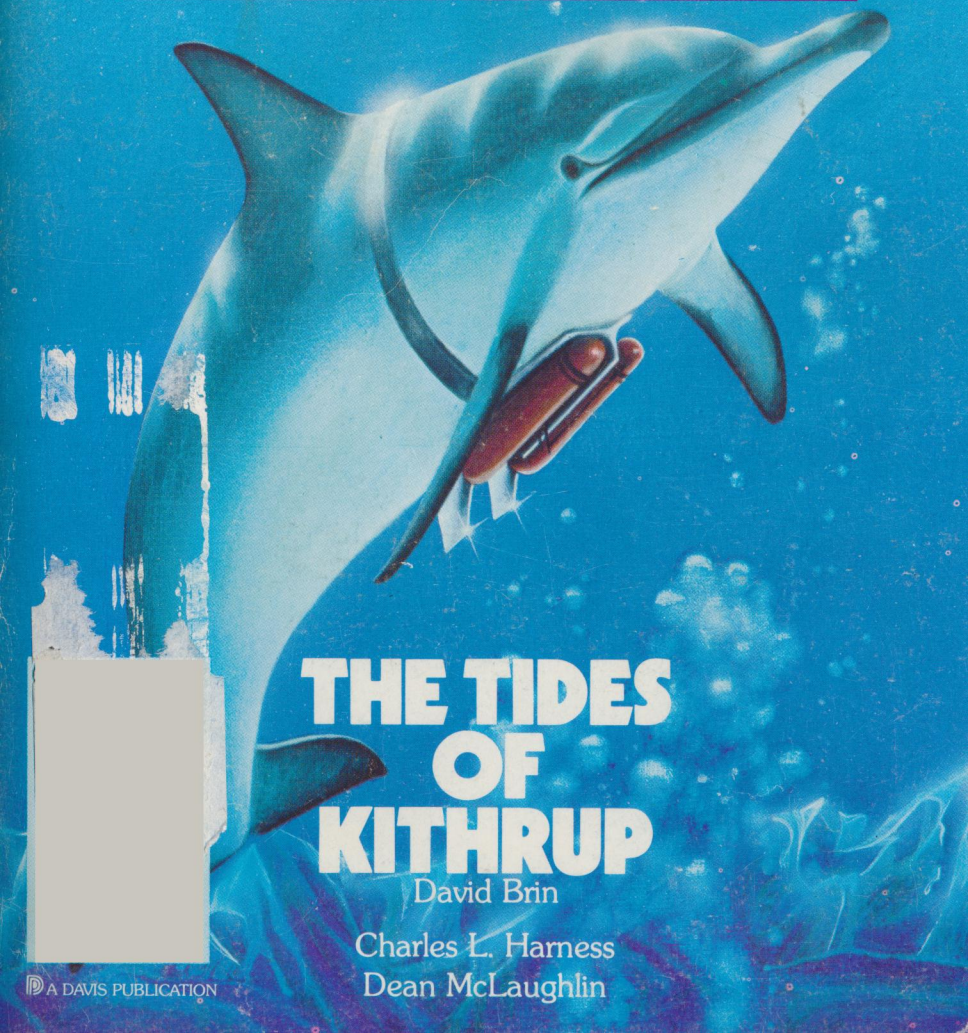

THE TIDES OF KITHRUP

David Brin

Charles L. Harness

Dean McLaughlin

A DAVIS PUBLICATION

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EDITORIAL

CREDENTIALS

STANLEY SCHMIDT

A few years ago I appeared on a panel with several other science fiction writers—including Clifford Simak, Lloyd Biggle, and Dean McLaughlin—at a large conference for teachers of high-school science fiction courses. There was a large unspoken irony in the proceedings: while our listeners had been sent by their schools to hear words of presumed wisdom from us experts in the field, *not one of us on the stage would have been allowed to teach a science fiction course in the schools from which most of those listeners came*.

Nor would almost any other writer or editor you can think of.

Honest!

You see, to teach in a public high school in most places that I know of, you have to have a Teaching Certificate. And to get that, in at least a good many of those places, you have to get a degree (or at least take lots of courses) in Education—before you can even take the examination for the certificate.

Well, you may say, what's so unreasonable about that? Just because you know a subject doesn't mean you can teach it well. True enough, but most writers are pretty articulate and a good many of them *do* teach—in places other than public schools. At the time of that panel, I was myself teaching a science fiction course at a rather expensive private college. I would have had full confidence in the ability of anyone on that stage to conduct an excellent course in any school in the country—but we couldn't, because we didn't have teaching certificates. And the Powers That Be recognized no alternative way to

prove competence. As far as Boards of Education are concerned, teaching certificates and competence are considered equivalent. (True, incompetence can be charged and formally proved in a particular case, but the procedure for doing it is so cumbersome that it's seldom done.)

Yet I also know that some science fiction courses are taught by people who may know teaching methods, but do not know science fiction. In one case I know of, a teacher was told that she would begin such a course in two weeks, and her protestations that she had no prior knowledge of the field and needed time to prepare before she could begin teaching it were ignored. Being a conscientious sort, she made a commendable effort to learn all she could before and while her course was going on—but surely this approach was hardly fair to either her or her students.

And what if she had *not* been so conscientious? Yes, I've seen that, too—as well as teachers who had the Proper Credentials but, in my considered professional opinion, were not very strong on either subject matter *or* teaching methods.

In *all* fields. Science fiction, in the foregoing paragraphs, has merely been a convenient example. Similar things happen in just about any subject you can name.

Such ironies and shenanigans raise serious questions about just how cultures decide who is qualified to do what. *The Random House Dictionary of the English Language* give two definitions of "credentials":

"1. Anything that provides the basis for confidence, belief, credit, etc.

2. Evidence of authority, status, rights, entitlement to privileges, or the like, usually in written form."

I fear that our culture, at least, has largely forgotten or ignored the distinction between the two. Sometimes when I asked students if they knew a certain thing, they replied, "No, I haven't taken that course"—which was not what I asked. They'd been conditioned to consider "taking courses" and "learning" as equivalent—forgetting that it's perfectly possible to do either without the other.

We are infatuated with titles and pieces of paper. People really *believe* that "an expert is somebody from fifty miles away, with a briefcase"—despite repeated experiences with visiting lecturers whom they secretly suspect are real duds. Meanwhile, I've seen *real* experts go virtually unrecognized at their own institutions while their expertise was eagerly sought by others (more than fifty miles away).

Companies increasingly specify a certain kind and level of college degree as a prerequisite for a job opening—and literally refuse to talk to any applicant who doesn't have it. I could tell you from personal experience about a man who did not complete college because what he saw as family obligations made it impossible; he got a factory job as an assembler and by sheer demonstration of competence and ability to learn, worked his way up to chief engineer and beyond. If he came to that same company today, with exactly the back-

ground he now has, he would not be considered by its present management for even an entry-level engineering position.

I could tell you about a young woman who *did* break into the engineering department of a major corporation with only a high school diploma—but only because she was willing to make such a pest of herself that they finally offered to let her take their standard engineering-applicant math test to get rid of her. When she did better on it than anybody they'd hired in the past, they admitted she might have something and gave her a job (and help with financing college).

I could tell you about a self-taught computer programmer who enjoyed an outstanding reputation among people he'd freelanced for at a well-known research complex. But when one contract ran out, he sometimes had trouble landing the next because he didn't have a degree in computer science (though he did have one in physics, plus graduate training and practical experience in a wide range of other fields). On one occasion he was flatly told by a prospective employer who *did* know his background, "Yes, you're qualified for this position that's open. No, I won't hire you for it, because you don't have a Master's in computer science." He considered suing, but lacked the resources and doubted his chances of winning. He eventually relented and went to graduate school to get a piece of paper testifying that he knew what he had known all along—but that piece of paper required at least two years of rehashing familiar material.

Once, when I was in on a discussion of a hiring that was being contemplated, one of my coworkers asked, "Do we need a Ph.D., or can we settle for an M.S.?" When I said, "How about somebody who looks like he'll do a good job?", I think my colleagues thought I was being facetious. (I wasn't.)

I remember an academic colleague who vocally opposed an experimental program of elective seminar courses because some of them were outside their instructors' usual academic specialties. It reeked, he claimed, of "amateurism." Interestingly, one of his favorite targets was my science fiction course—I don't think he knew I was the only practicing professional SF writer within at least fifty miles. Even if the instructors *had* all been "amateurs," is that necessarily a condemnation? Sir William Herschel, whose discovery of Uranus was only one of many important contributions to astronomy, was for quite some time an astronomy *hobbyist;* he made his living as an organist and music teacher. (Astronomy, incidentally, still depends heavily on amateurs for certain kinds of observations.) Aleksandr Borodin, now remembered primarily as a composer, was by training and profession a physician and chemistry professor at the St. Petersburg academy of medicine (and a pioneer in women's education); he had little formal training in music, but became active in it in his thirties. The list could easily be extended.

There are exceptions even now, of course, to the fashionable practices of pigeonholing and judging competence by stylized pieces of paper. That's one of the things I find refreshing about the

science fiction community—hardly anybody *cares* what degrees you have (or don't have). In general (though not, of course, without exception), if you do a piece of work somebody likes, he'll buy it—regardless of your past. If you don't, he won't—equally regardless. Only the quality of your work matters.

Real credentials (as in Definition 1) are very important. It makes plenty of sense to want qualified people, and only qualified people, in any position. My fear is that we have saddled ourselves with an imperfect, fallible system of *written* credentials (Definition 2) and have taken to acting as if these are a perfect reflection of real qualifications. Unfortunately, they're not. Therefore we have at least occasional—and my own experience says rather frequent—cases of less-than-competent people getting jobs and highly competent people being denied them.

So whom does it hurt? One answer, of course, is the qualified individuals who are denied opportunities—but this one won't cut much ice with some people. You may say, they don't have to sit around feeling sorry for themselves—if they're qualified, why don't they go through channels and *get* the necessary credentials? Well, in the first place, not everybody *can*. Sometimes other commitments make it literally impossible to spare the time or money or both. In the second place—and perhaps more importantly—who gains anything from making an intelligent human being waste years of his life and/or thousands of dollars pretending to learn things he already knows, just to get a piece of paper stating that he knows what he already knew when he started? And why should he be subjected to that indignity if he can already offer some other proof of his qualifications? Life is too short, and intelligence too precious, to waste any more than necessary in drudgery and busywork.

Personally, I'm bothered by any unnecessary injustice to any individual, and consider it worthwhile to seek ways to remove or reduce it. But maybe you can dismiss my concern for these cases as "statistically insignificant" or "bleeding-heart altruism." If so, consider the effect of an inflexible credential system on civilization itself. You may not be in the awkward position of having qualifications unconventionally earned and therefore hard to sell, but can you afford to be smug? Sure—if you're one of those who managed to get more paper credentials than you really earned. On the other hand, *all* of us are affected repeatedly, every day, by those incompetents who have managed to get into influential positions. And we certainly have enough problems needing solutions that we could use all the skilled people we can get working on them, regardless of how their skills were obtained.

The programmer I mentioned earlier did not actually attempt a lawsuit for being denied a job for which he was admittedly qualified, but the possibility is intriguing. Could this be the next fertile area for antidiscrimination suits—people denied jobs because of the lack of a college degree? I think I'd like to see a case like that in court—with a Clarence Darrow as attorney for the plaintiff, and lots of media coverage.

Should be interesting . . . .

If it ever happens, though, and the plaintiff should win, I hope we don't follow our penchant for swinging between extremes and start requiring companies to hire a quota of degreeless persons. That strikes me as painfully absurd—but no more absurd than some similar things which have already been done.

Anyway, I do think we could use some work on improved ways for establishing *real* qualifications—ways that would reduce the number of poor performers who squeak through the academic obstacle course, *and* provide more recognition for *other* ways of gaining education. Some alternatives already exist, here and there, but their range is pretty limited. Tests, for example, are a good alternative for some people, but not all. The problem is that they test not only their nominal subject matter, but simultaneously a whole separate set of test-taking skills. Some people are chronically lousy test-takers, but quite good at what they do under normal, real-world working conditions. Others are highly skilled test-takers, but do not perform well on the job.

(Since tests are a normal part of virtually all conventional educational channels, incidentally, these problems suggest an area for improvement within those. I've often marvelled at such things as Ph.D. qualifying exams, especially when given by science departments. Any competent scientists knows that if you want to measure the intrinsic properties of a system, you design an experiment to (a) disturb the system as little as possible, and (b) take enough measurements to be sure you're not looking at a statistical fluke. But a qualifying exam—or any other large exam with a large part of the subject's future riding on it—can be viewed as an experiment in which you make one measurement on the system in a highly disturbed state, and believe that measurement in preference to the ones you've been collecting over a couple of years of normal operation! True, it does serve the useful purpose of stimulating some really intensive study. But isn't there a better way?)

The kind of reform—or evolution—I'd eventually like to see is a *big* job. It needs some really innovative thinking by lots of minds. Let me close with just one small proposal, as my contribution to get things started.

Let's abolish all degree requirements of any kind, for any job whatsoever.

I used to have fun springing that one on students. Initially, almost always, they were shocked—at least partly, it usually turned out, because they weren't hearing precisely what I was saying. I am *not* suggesting the hiring of unqualified people; we do more than enough of that already. Nor am I suggesting the abolition of college or degrees; college can be one very good component of an education, and a degree can be valuable as one piece of evidence of education. All I suggest is that it should be viewed as *only* one piece of evidence, and not the whole case in itself—or as the only possible kind of case. I ask that employers remember that a degree does not necessarily prove more about its holder than that he went through college and won

enough approval there to satisfy the degree requirements. I suggest that they not be allowed to treat the lack of a degree as proof of noneducation.

The key word is *requirement*. Under my proposal, employers could define the requirements for a job in terms of a certain degree "or its equivalent," but their goal would be not the piece of paper, but the knowledge and skill that it supposedly represents. If an applicant did not have the degree but claimed equivalent competence, the burden of proof would be on him. Sometimes it would be quite hard—I'd want to be *very* convinced before I went under the scalpel of a surgeon who hadn't gone to med school. But if he had other solid evidence to offer, and could present it in a reasonably concise form, the employer would have to give it due consideration.

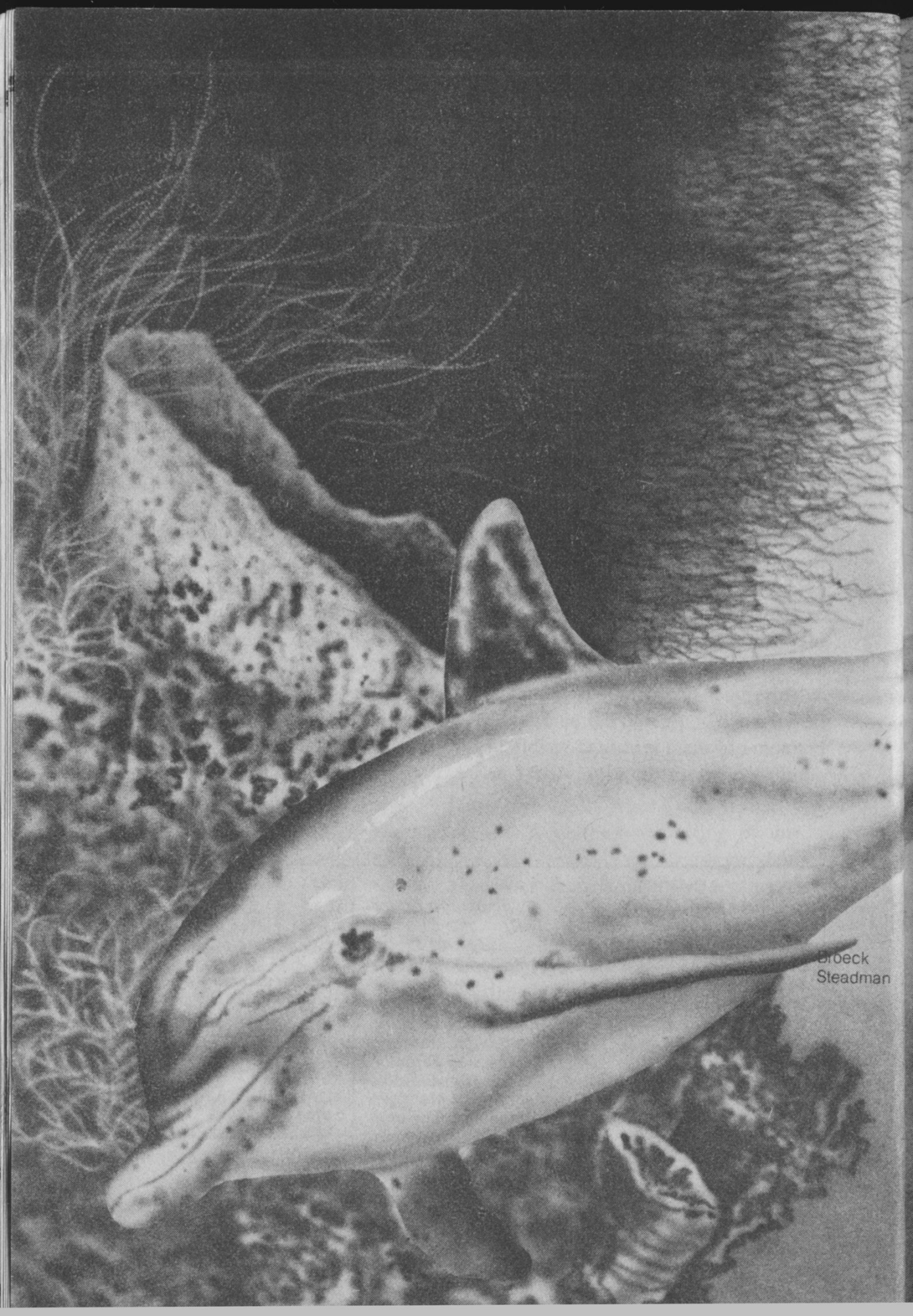
This much clarification usually relieved much of my students' uneasiness, but some of them remained visibly uncomfortable with the idea. And I was left with the question: why? Did they really *prefer* being locked into a system that, in most situations, offered them only one way to acquire and demonstrate education?

Could it be that, having learned how to cope with this system and convinced themselves that they could get through it to the magic piece of paper, they felt threatened by any proposal that would let people who didn't follow that route compete with them?

I suspect it could—just as I suspect that many employers prefer the degree-requirement approach because it's so much *easier* than taking the trouble to really evaluate every applicant's qualifications.

But in the long run, might it not also have the effect of encouraging students to think they're better educated than they are—and employers to think they've hired the best available when in fact they may not have even *looked* at the best available?

Think about it. ■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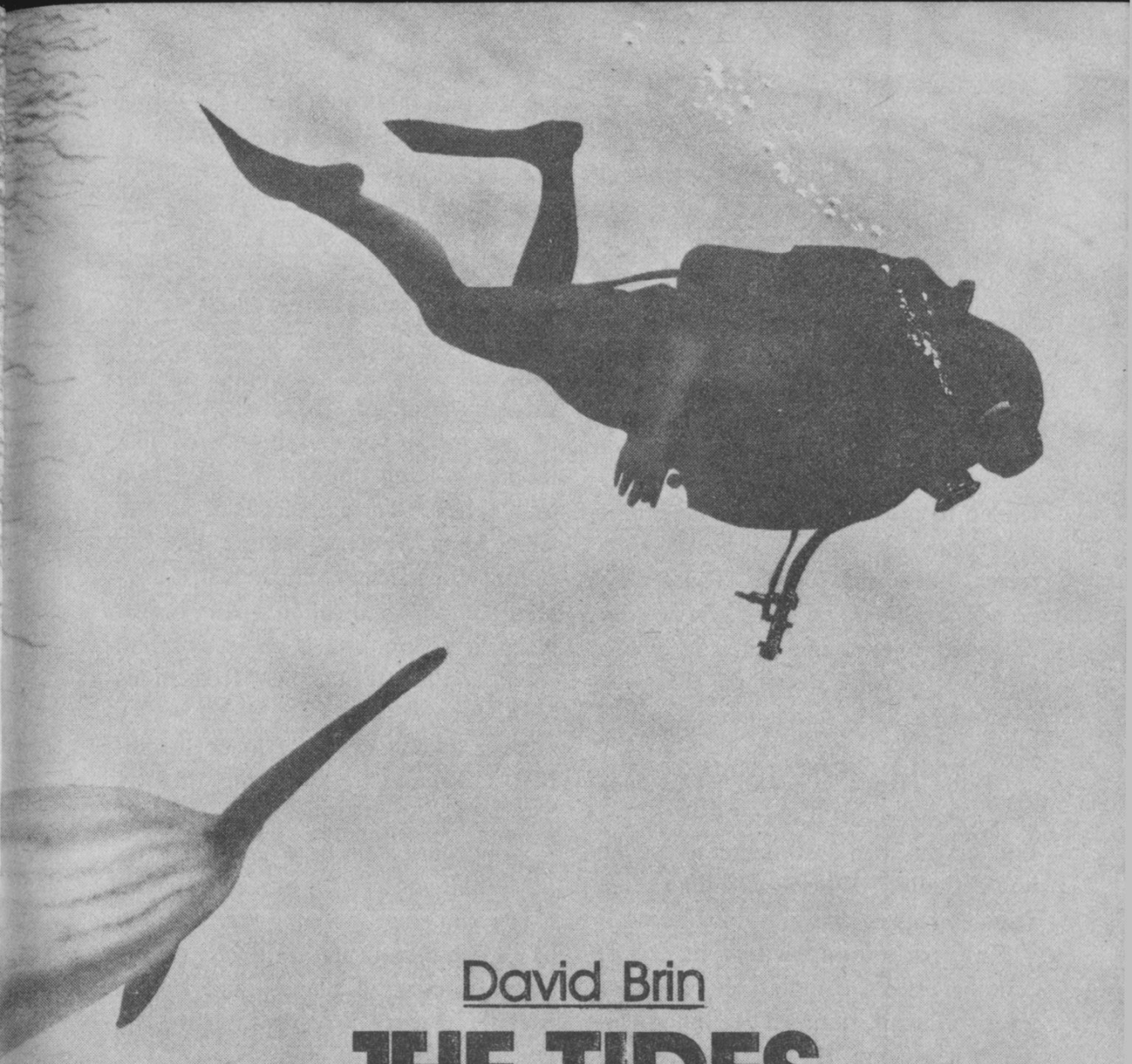


David Brin

THE TIDES OF KITHRUP

How intelligent races will
treat each other will depend
upon their characters—
and each will bring with it
a large share of its own,
highly individual, pre-sentient origins.

I

Fins had been making wisecracks about human beings for thousands of years. They had *always* found men terribly funny. The fact that humanity had meddled with their genes and taught them engineering hadn't done much to change their fundamental attitude.

Fins were still smart alecks.

Toshio looked down at the small instrument panel of his sea-sled and pretended to check the depth gauge. The sled thrummed along at a constant ten meters below the surface. There were no adjustments to be made, yet he concentrated on the panel rather than look up when Keepiru swam up alongside —undoubtedly to start another round of teasing.

"Little Hands, whistle!" The sleek gray cetacean did a barrel roll to Toshio's right, then drew nearer to eye the boy casually. "Whistle us a tune about ships and space and g-g-going home."

Keepiru's underwater buzzing, echoing from a complex set of airsacs under his skull, rumbled like the groaning of a bassoon. He could just as well have made his voice an oboe, or a tenor sax. It was all a matter of his mood and how far away he wanted to be heard.

"Well, Little Hands? Where is your s-s-song?"

Keepiru was making sure the rest of the party could overhear his tauntings. The other fins continued their intermittent, gossipy flutings. But Toshio could tell they were listening. He was glad that Hikahi, the leader of the expedition, was far ahead, scouting. It would be far worse if she were here and ordered Keepiru to leave him alone. Nothing Keepiru said could match the shame of being protected like a helpless child.

Keepiru was a sleek spearhead of slate gray, who rolled lazily, belly up, next to the boy's sled, kicking with slow, water-flaying flukestrokes and arching body twists to stay easily abreast of Toshio's machine. In the crystal water of Kithrup, everything seemed strangely refracted. The coral-like peaks of the metal-mounds shimmered like mountains seen through the haze of a long valley. Drifting tendrils of dangleweed hung from the surface like the millions of feathery filaments that covered Kithrup's red sun in a hairy beard. Keepiru's skin had a phosphorescent sheen and the needle-sharp teeth in his long, narrow vee-mouth shone with a teasing cruelty that *had* to be magnified . . . if not by the water, then by Toshio's own imagination.

How could a fin be so mean!

"Won't you sing for us, Little Hands? C-can you sing us a song that will buy us all fish-brew when we finally get off this s-so-c-called planet, and find a friendly p-port? Whistle to make the Dreamers dream of land!"

Above the tiny whine of his air-plant and the hum of the sled, Toshio felt his ears buzz with embarrassment. At any moment, he was sure, Keepiru would stop calling him "Little Hands" and start using the new nickname he had chosen for Toshio: "Great Dreamer."

It was bad enough to be taunted for having made the mistake of whistling while accompanying an exploration crew of fins—they had greeted his absent-minded melody with raspberries and chittering derision—but to be mockingly addressed by a title almost always

reserved for great musicians or humpback whales . . . it was almost more than he could bear.

Toshio tried to maintain a certain degree of dignity when he answered, "I don't feel like singing right now, Keepiru. Why don't you bother somebody else." He felt a small sense of victory that he managed to keep a quaver out of his voice.

To Toshio's relief, Keepiru merely squeaked something high and fast in gutter Trinary, almost Primal Delphin—that in itself a form of insult. Then the dolphin arched and shot away to surface for air.

The water on all sides was bright and blue. Shimmering Kithrupan fish flicked past with scaled backs that faceted the light like drifting, frosted leaves. All around were the various colors and textures of metal. The morning sunshine penetrated the clear, steady sea to glimmer off the strange life-forms of this strange and inevitably deadly world.

Toshio had no eye for the beauty of Kithrup's sea. Hating the planet, the crippled ship that had brought him here, and the fins who were his fellow castaways, he drifted into a poignantly satisfying rehearsal of the scathing retorts he *should* have said to Keepiru.

"If you're so good, Keepiru, why don't you whistle us up some vanadium!"

Or:

"I see no point in wasting a *human* song on a dolphin audience, Keepiru."

In his imagination the remarks were satisfyingly effective. In the real world, Toshio knew, he could never say anything like that.

First of all, it would be absurd. It was the cetacean, not the anthropoid, whose vocalizings were legal tender in a quarter of the spaceports in the galaxy. And while it was the mournful ballads of the larger cousins, the whales, that brought the real prices, Keepiru's kin could buy intoxicants on any of a dozen worlds merely by exercising their lungs.

And it would be a terrible mistake to try to pull human-vs.-dolphin rank on any of the crew of the *Streaker*. Old Hans Suess, one of the other six humans aboard, had warned him about that just after they had left Neptune.

"Try it and see what happens," the mechanic had suggested. "They'll laugh so hard, and so will *I*, if I have the good luck to be there when you do. Likely as not, one of them will take a nip at you for good measure! If there's anything fins *don't* respect, it's a human who never earned the right putting on patron airs."

"But the Protocols . . ." Toshio had started to protest.

"Protocols my left eye! Those rules were set up so humans and chimps and fins will act in just the right way when Galactics are around. If the *Streak* gets stopped by a Soro patrol or has to ask a Pilan Librarian for data somewhere, *then* Dr. Fenn or Mr. Orley—or even you or I—might have to pretend we're in charge . . . because none of those stuffed-shirt Eatees would give the time of day to a race as young as fins are. But the rest of the time we take our orders from Captain Creideiki.

"Hell, that'd be hard enough—taking brown from a Soro and pretending you like it because the damned ET is nice enough to admit that *humans*, at least, are somewhat above the level of fruit

flies! Can you imagine how hard it would be if we actually had to *run* this ship? What if we had tried to make dolphins into a nice, well-behaved, slavey client race? Would you have liked that?''

Suess had been emphatic. At the time, Toshio had shaken his head vigorously. When put that way, the idea of treating fins as clients were usually treated in the Galaxy sounded repulsive. His best friend, Akki, was a fin. To force Akki to behave servilely and humbly struck him as unnatural as clipping the wings of a bird.

Yet, there were moments like the present, when Toshio wished there were compensations for being the only human boy on a starship crewed mostly by adult dolphins.

A starship which wasn't going anywhere at the moment, Toshio reminded himself. The acute resentment of Keepiru's goading was replaced by the more chronic, persistent, hollow worry that he might never leave the water world of Kithrup and go home.

** Slow your travel - boy sled-rider **
** Exploring pod - does gather hither **
** Hikahi comes - we wait here for her **

Toshio looked up. Krookida, the elderly fin metallurgist, had come up alongside on the left. Toshio whistled a reply in Trinary.

** Hikahi comes - my sled is stopping **

Toshio eased the sled's throttle back to a stop.

On his sonar screen Toshio saw tiny echoes, converging from the sides and far ahead. The scouts were returning. He looked up and saw Hist-t and Keepiru playing at the surface.

Krookida switched to English as he drifted near the nose of Toshio's sled. His English, though somewhat shrill and stuttered, was still better than Toshio's Trinary. It had been dolphins, after all, who had been modified by generations of genetic engineering to take up human styles, not the other way around.

''You have found-d no t-traces of the needed substances, Toshio?''

Toshio glanced at the indicator on the molecular sieve his sled carried. ''No sir. No traces so far. This water is almost unbelievably pure, considering the metal content of the planet's crust. There are hardly any metal salts at all.''

''And nothing on the long s-scan?''

''I don't get any resonance effects on any of the bands I've been checking, though the noise level is so high I'm not sure I'd even be able to pick up any monopole-saturated nickel, let alone the other stuff we're looking for. There's so much metal here, it's like trying to find that needle in a haystack!''

It was a paradox. The planet had metals in superabundance. That was one reason Captain Creideiki had chosen this world as a refuge and a place to find the substances needed to repair the ship. Yet the water was relatively pure . . . pure enough to allow the dolphins to swim freely, although each would need a full range of chelating treatments when he got back to the ship.

The explanation lay all around them, in the plants and fishes and topography of the sea of Kithrup.

Calcium did not make up the bones of Kithrupan life-forms. Other metals

did. The water was strained and sieved clean by biological filters. As a result, the sea shone all around with the bright colors of metal and metal oxides. Fish skeletons and gleaming dorsal spines of living fish—the shining, silvery seed-pods of underwater plants—all contrasted with the more mundane but pleasant green of chlorophyllic leaves and fronds.

Dominating the scenery were the metal mounds . . . giant, spongey islands shaped by millions of generations of coral-like creatures whose metallo-organic exoskeletons had accumulated into huge, flat-topped mountains sticking up a few meters above the mean water mark.

Atop the islands the drill-trees grew, sending their metal-tipped roots deep through the mound they rested upon to suck useful organics and silicates upwards. In doing so, the plants laid a nonmetallic layer on top and created a cavity below . . . a grave awaiting the metal-mound when the undermining was completed. So the substance of Kithrup was recycled, in a rather unique fashion.

Toshio's instruments had detected resonance echoes from clumps of pure tin, mounds of chromium fish eggs, coral colonies built from copper; but so far no convenient, easily gathered piles of vanadium. No lumps of the special variety of nickel they sought.

What they needed was a miracle—one that would enable a crew of dolphins, normally clumsy with tools, with the aid of seven humans and a chimpanzee, to repair their ship and get the hell out of this part of the galaxy before those who were chasing them caught up.

At best they had a few weeks to get away. The alternative, at minimum, would be capture by any of a dozen not-entirely-rational ET races. At worst, it could mean interstellar war on a scale not seen in a million years.

Toshio could hear, faintly, the high-pitched sonar echoes of the returning scouts. Each distant squeak had its tiny, colored counterpoint on his scanner screen.

Krookida left him, flinging himself upwards toward the surface to join Keepiru and Hist-t there. Then two gray forms appeared from the east, diving at last into the gathering above in a cavort of playful leaping and biting. Finally one of the dolphins arched and dove straight down toward Toshio.

"Hikahi's coming and wants the s-sled topside," Keepiru chattered quickly, slurring the words almost into indecipherability. "Try not to get lost on the way up-p-p-p."

Then Keepiru streaked away.

Toshio grimaced as he started to let ballast out of his buoyancy tanks. Keepiru didn't have to make his contempt so obvious. Even speaking English normally, fins usually sounded as if they were giving the listener a long series of raspberries.

Toshio's sled rose in a cloud of tiny bubbles. The water slipped away when he reached the surface and drained along the side of the sled in long, gurgling rivulets. When the machine was steady, Toshio locked the throttle and rolled over onto his back to undog his faceplate and let in some fresh air.

The change in sound was a great relief. The whine of the sled, the pings

of the sonar, and the squeaks of the fins all faded into a distant background, suddenly ignorable. The freshness of the breeze swept past his damp, straight black hair and cooled the hot feeling in his ears.

Kithrup's breeze blew across him from west to east, carrying with it the smells of an alien planet—the pungence of secondary growth on an older island, the heavy, oily odor of a drill-tree in its peak of activity.

And overlying everything was the slight tang of metal.

It shouldn't harm them, they'd said back at the ship. Least of all Toshio in his waterproof suit. Chelating would remove all of the heavy elements one might reasonably expect to absorb on a scouting trip . . . though no one knew for sure what other hazards this world might offer.

It still wouldn't do to get punctured by a big sliver of dissolvable beryllium.

And if they were forced to stay for months? Years?

In that case, the medical facilities of the *Streaker* would not be able to deal with the slow accumulation of metals. In time they would start to pray for the Jophur or Thennanin or Pilan ships to come and take them away for interrogation or worse—simply to get off of a beautiful planet that was slowly killing them.

It wasn't a pleasant thought to dwell on. Toshio was glad when Krookida drifted alongside.

"Why did Hikahi have me come up to the surface?" he asked. "I thought I was to stay out of sight below in case there were already spy-sats overhead."

Krookida sighed. "I s-suppose she thinks you need a break. Besides, who could spot so s-small a machine as the sled with so much metal around?"

Toshio shrugged, then realized the gesture probably could not be seen outside his suit. "Well, it was nice of Hikahi, anyway. I did need the rest."

Krookida rose up in the water, balancing upon a series of churning tail-strokes. "I hear Hikahi." He announced. "And here she is-s."

Two dolphins came on fast from the north. Through his headphones Toshio could hear the voice of the party leader.

** Flame-fluked I - Hikahi call you **

** Dorsal listening - ventral doing **

** Laugh at my words - but first obey them **

** Gather at the sled - and listen! **

Hikahi and Ssattatta circled the rest of the party once, then came to rest in front of the assembled expedition.

Among mankind's gifts to the neo-dolphin had been a somewhat expanded repertoire of facial expression. Of course, a mere five hundred years of genetic engineering could not do for the porpoise what a million years of evolution had done for man. Fins still expressed most of their feelings in sound and motion.

But they were no longer frozen in what humans had taken (in some degree of truth) to be a grin of perpetual amusement. Fins were capable now of *looking* worried. Toshio might have chosen Hikahi's present expression as a classic example of delphin chagrin.

"Phip-pit has disappeared," Hikahi announced in English. For fins it was the language of slow and deliberate thought.

"I heard him squeak, over to the

south of me, then nothing. He was searching for S-sassia, who disappeared earlier in the same direction. We will forego mapping and metals search to go and find them. All will be issued weapons.''

There was a general susurration of discontent at this. It meant the fins would have to put on the harnesses they had only just had the pleasure of removing upon leaving the ship.

Toshio was briefly very busy dropping harnesses into the water. They were supposed to spread naturally into a shape suitable for a dolphin to slip into easily, but inevitably one or two fins needed help fitting the connectors from the harness to the small nerve amplifier socket each had just above his left ear. The tiny knobs, ideally suited to be manipulated by the neo-porpoises' ''fingers,'' sometimes had to be placed within the grasp of those still somewhat vestigial nubs—the protrusions which had recently given back to these cetaceans a portion of the hands they had forsaken millions of years before.

Toshio finished the job quickly with the unconscious ease of long practice. He was worried about Ssassia, a gentle fin who had always been very kind and soft-spoken to him.

''Hikahi,'' he said as the leader swam past. ''Do you want me to call the ship?''

''Negative, Ladder-runner. We obey orders. Spy-sats may be high already. Set your speed sled to return on auto, if we all fail to survive what is in the s-southeast.''

''But no one's seen any big animals. . . .''

''That-t is only one possibility. I want word to get back whatever our doom . . . should even rescue fever strike us all.''

Toshio felt cold at the mention of ''rescue fever.'' He had heard of it, of course. It was something he had no desire at all to witness.

They set out to the southeast in skirmish formation. The fins took turns gliding along the surface, then diving below to swim alongside Toshio. The ocean bottom rippled like an endless series of snaketracks—pitted and marked by strange pock-holes, like craters, only deeper and more darkly ominous. In the valleys Toshio could usually see bottom, a hundred meters or so below . . . gloomy with dark green tendrils.

The ridges, by contrast, were topped at intervals by the shining metal mounds, like hulking castles of shimmering, spongey armor. Many were covered with a thick iceplant sort of growth, in which Kithrupan fishes nested and bred.

One metal-mound appeared to be teetering on the edge of a precipice—the cavern dug by its own tall drill-plant, ready to swallow the entire fortress when the undermining was done.

The sled's engine hummed hypnotically. Keeping track of his instruments was too simple and well-known a task to keep Toshio's mind busy. Without really wishing to, he found himself thinking. Remembering.

A simple adventure, that's what it had seemed when they had asked him to come along. No, more than that. He had already taken the Jumpers Oath, so they knew he was ready to leave his

past behind, if need be. And they needed a midshipman to help with hand-eye work on the new dolphin ship.

Streaker—a small exploratory vessel of unique design. There weren't many finned, oxygen-breathing races flying ships in interstellar space. Those that did used artificial gravity everywhere onboard for convenience, and usually took leased members of some client species along to act as crafters and handmen.

But the first dolphin-crewed starship had to be different. It was designed around the principle adhered to by Man and his clients ever since Contact: *"Whenever possible, keep it simple. Avoid using the science of the Galactics whenever you don't understand it."*

Three hundred and fifty years after Contact with the gigantic, loose civilization of the Galactics, mankind was still struggling to catch up with its science. Species which had been using the eons-old Library since before the first mammals appeared on Earth—adding to it with glacial slowness—had seemed almost godlike to the primitive Earthmen, with their early, lumbering slowships.

Earth had its own Branch Library now. But only in recent years had it proven to be much more a help than a confusing hindrance.

In three centuries the races of Earth had made a virtue of simplicity. To the amazement of all of the ETs, they put a spin on their cylinder ships to mimic gravity . . . even after they had mastered the basics of artifically induced fields. They eschewed the ultra-machines they could not understand and fought with weapons of almost ludicrous simplicity . . . and startling effectiveness.

Streaker, with its complex arrangements of centrifugally held pools and weightless workshops, must have seemed an incredibly complicated Rube Goldberg to the aliens who had looked it over just before launch.

Then, on her way home after her shakedown cruise, *Streaker* stopped at the small human-dolphin colony of Calafia, to pick up a few of the best graduates of its academy.

It was to be Toshio's first, and possibly last, visit to Old Earth.

"Old Earth" was still home to 99 percent of humanity, not to mention the other terrestrial sapient races. Galactic tourists still thronged in to gawk at the birthplace of the enfant-terrible species which had caused such a stir in a few brief centuries. They were open in their wagering over how long Man would survive without the protection of a Patron.

All races had patrons, of course. Nobody reached spacefaring intelligence without the intervention of another spacefaring race. Had not men done this for chimps and dolphins? How pathetic that a few men still clung to the notion of "evolved" intelligence!

Too bad no one had yet found humanity's benefactor. The race was apparently hiding its identity in shame. No matter. They would be found, in time, and properly chastised for leaving the job half done.

Toshio wondered, as just about everyone had for three hundred years, what the patrons of Man might have been like. If they ever existed.

Of course the Galactics had their

mysteries, too. Every last one of the varied, bickering Elder races had its own theory regarding the *first* of the patron species—the fabled "Progenitors," who were said to have begun the chain of uplift over a billion years before. They had roamed the galaxy in its early days, raising the brutish pre-cognates they found to spacefaring intelligence, and teaching them to do the same in their turn.

By now all of the first generation—all of the first hundred generations—were gone into extinction. But the chain of uplift and the cultural bootstrap of the Library was a permanent feature of the Galaxy.

Of the fate of the Progenitors themselves, there were many legends and, even, mutually contradictory religions. One story had it that they departed the Galaxy, once they saw that they had the ball fairly rolling. Leaving behind a set of loose injunctions, they departed for times and spaces unknown.

Toshio frowned as he checked his readings. Thinking about the old Galactic legends wasn't very pleasant right now. Especially considering what the *Streaker* had found, and the consequences of its discovery.

The Terragens Council had sent her out to join the scattered fleet of exploration vessels through which Man was checking the veracity of the Library. So far, only a few minor gaps had been found in its thoroughness. Here, a star misplaced. There, a species miscatalogued. It was like finding that someone had written a list describing every grain of sand on a beach. You could never check the total list in a thousand lifetimes of a race, but you could take a random sampling.

Streaker had been poking through a small gravitational tidepool fifty thousand parsecs off the galactic plane when she found the Fleet.

Toshio sighed at the unfairness of it. One hundred and fifty dolphins, seven humans, and a chimpanzee: how could we have known what we found?

Why did *we* have to find it?

Fifty thousand ships, each the size of a moon. That's what they'd found. The dolphins had been thrilled by their discovery—the biggest derelict fleet ever encountered, with all the appearances of being incredibly ancient. Captain Creideiki had psicast to Earth for instructions.

Damn it! *Why* did he call Earth? Couldn't the report have waited until they'd gone home? Why let the whole eavesdropping galaxy know you'd found a Sargasso of ancient hulks in the middle of nowhere?

The Terragens Council had answered in code.

"Go into hiding. Burn your records. Do not reply."

Creideiki obeyed, of course. But not before half the patronlines in the galaxy had sent out their warships to find them.

Some already *had* found them. The survivors were still on the trail.

Toshio blinked.

Something. A resonance echo at last? Yes, a faint trace on the magnetic ore detector, toward the south. He concentrated on tuning the receiver, letting the sled follow its own course. He was relieved at last to have something to do. Self-pity was becoming a bore.

Yes. It would have to be a pretty fair

deposit. Should he tell Hikahi? Naturally, the search for the missing crewmen came first, but. . . .

A shadow fell across him. The party was skirting the edge of a massive metal-mound. The coppery-colored mass was covered with thick tendrils of some green, hanging growth. Toshio was close enough to see, where the rough metal jutted through, the tiny, rainbowed arches where each of the coral-like creatures that comprised the colony made its home.

"Don't go too close, Little Hands," Keepiru whistled from Toshio's left. Only Keepiru and the sled were this close to the mound. The other fins were giving it a wide berth.

"We know nothing of this flora," Keepiru continued. "And it is near here that-t Phip-pit was lost. You should stay safe within our c-convoy."

Keepiru rolled lazily past Toshio, keeping up with long, languid fluke-strokes. The neatly folded extensors and beamers of his harness gleamed a coppery reflection from the metal-mound. The fin appeared to be grinning.

"Then it's all the more important to get samples, isn't it?" Toshio replied in irritation. "It's what we're out here for, anyway."

Without giving Keepiru time to react, Toshio banked the sled toward the shadowy, verdant mass of the mound.

They had come around to the eastern side of the island. On approaching, Toshio dove into a region of darkness as the metal bulk blocked off the afternoon sunlight. A drifting school of silver-backed fish seemed to explode away from his path as he drove at an angle along the thick, fibrillose weed, preparing to reach out and snap a clump of drifting fronds.

Keepiru squeaked in startlement behind him—an oath in Primal Delphin—that alone showed the fin's distress. Toshio smiled.

The sled hummed cooperatively as the mound loomed like a mountain on his right. Toshio banked once again and grabbed at the nearest flash of green. There was a small impact, then a satisfying snapping sensation as his sample came free. Toshio smiled at the clump in his hand. No fin could do that! He flexed his fingers appreciatively, then twisted about to stuff the greenery into a collection sack.

Toshio looked up and saw that the green mass, instead of receding, was closer than ever. Keepiru's concerned beepings were more pronounced.

Crybaby! Toshio thought. So I let the controls drift for a second. So what? I'll be back in your damned convoy before you finish making up a cuss-poem!

Frowning, he steepened his leftward bank and simultaneously set his bow planes to rise. In a moment he realized it was a tactical mistake. It slowed him down just enough for the rapidly moving cluster of pursuing tendrils to reach his sled.

There must have been larger sea creatures on Kithrup than the party had seen so far, for the tentacles that fell about Toshio and his sled were obviously meant to catch big prey..

"Oh, Koino-Anti! Now I've done it!" He pushed the throttle over to maximum and braced for the expected surge of power.

The power came . . . but not the acceleration. Long, ropy strands curled

about the sled as the impellers groaned, stretching them away from the island's bulk. But forward movement was lost. Toshio felt a slithery presence across his back, then another. The tendrils began to tighten and pull.

Gasping, he managed to twist around onto his back and groped for the knife sheathed at his thigh. The tendrils were sinuous and knotty, with loose fronds hanging all along. The knots clung to whatever they touched. When one brushed against the back of Toshio's exposed left hand the boy cried out from the searing pain of contact.

The fins were crying out to each other and there were sounds of vigorous movement not far away. But, other than a brief hope that nobody else was caught, Toshio had little time to think of anything but the fight at hand.

The knife came free, gleaming like hope solidified. And hope brought hope as two of the smallest strands parted under his slashing attack. Another larger one took several seconds to saw through. It was replaced almost instantly by two more.

Then he saw the place to which he was being drawn.

A deep gash split the side of the metal-mound. Within it a writhing mass of filaments awaited. Deep within, a dozen meters further up, something sleek and gray lay already enmeshed in a forest of deceptively languid foliage.

Toshio felt open-mouthed steam fill his facemask. The reflection of his own eyes, dilated and stricken, was superimposed on the motionless figure of Ssassia. Gentle as her life had been, though not her death, the tide rocked her.

With a cry Toshio resumed hacking at his assailant. He wanted to call out to Hikahi—to let the party leader know of Ssassia's fate—but all that came out was a roar of fear and loathing of the Kithrupan creeper. Leaves and fronds flew off through the churning water as he sliced out his hatred. To little good, as the tendrils fell more numerous about him to draw him toward the gash.

** Ladder climber - Sharp-eyed rhymer **

** Call a fix - for seeking finders **

** Trill sonar - through the leaf blinders **

Hikahi calling.

Above the churning, bubbling of his struggle and the hoarseness of his breathing, Toshio could hear the combat sounds of dolphin teamwork. Quick trills of Trinary, unslowed for human ears except for that one, brief command, and the tiny, whining sounds of the gear on their harnesses.

"Here! Here I am!" He slashed at a leafy vine that threatened his airhose . . . barely missing the hose himself. He licked his lips and tried to whistle in Trinary.

** Holding off - the sea-squid's beak **

** Suckers tight - and outlook bleak **

** Havoc done - on Ssassia wreaked! **

Lousy form and rhythm, but the fins would hear it better than they would a shout in English. After only forty generations of sapience, they still thought better in an emergency when using whistle rhyme.

Toshio could hear the sounds of combat coming closer. The fronds nearby began to agitate from more than the feeble commotion he was creating. But, as if hurried by the threat, the tentacles

began drawing him back more rapidly, in toward the gash.

Suddenly a sucker-covered strand wrapped itself around his right arm. Before he could shift his grip, one of the burning knots reached his hand. In the writhing that followed he screamed and tore the tendril to bits, but the knife was lost.

Other filaments were falling all about him. At that moment Toshio became distantly aware that someone was talking to him.

"... says there are ships out there! Captain wants to know why Hikahi hasn't sent a monopulse confirmation ..."

It was Akki's voice, calling from the ship. Toshio couldn't answer his friend. The switch for the sled radio was out of reach.

"Don't respond to this message," Akki went on obligingly. Toshio moaned at the irony as he tried to pry a tendril off his facemask without doing further insult to his hands. "Just come on back-k, all of you. We think there's a space battle going on over Kithrup. Probably two or more groups followed us here and are fighting over the right to capture us, just like at Morgran.

"Gotta c-close up, now. Radio silence. Get back as soon as you can. Akki out."

Toshio felt a tendril get a good grip on his air hose. A solid grip, this time.

"Sure, old friend," he grunted as he pulled. "I'll be going home just as soon as the universe lets me."

The airhose was crimped shut and there was nothing he could do. As he felt himself blacking out, Toshio thought he saw the rescue party arrive. He couldn't be sure whether it was real or a hallucination. He wouldn't have expected Keepiru to lead the charge, for instance, or for him to have such a ferocious demeanor, heedless of his own dangers from the burning suckers.

In the end he decided it was a dream. The laser flashes were too bright, the saser tones too clear. And the party came towards him with pennants waving in their wake . . . like the cavalry that five centuries of Anglic-speaking man had come to associate as the image of rescue.

II

There was a ship involved, of course. All of his dreams since the age of nine had dealt with ships. Ships, at first, of plasteel and jubber, sailing the straits and archipelagos of Calafia, and later ships of space. Toshio had dreamt of ships of every variety, including those of the powerful Galactic patron races, which he had hoped one day to see.

Now he dreamt of a dinghy.

The tiny human-dolphin colony of his homeworld had sent him out with Akki riding on the outrigger . . . his Calafian Academy button shining brightly under Alph's sunshine. It started out a balmy day.

Only soon the weather darkened and all around became the same color as the water. The water grew bilious, then black, then changed to vacuum; and there were suddenly stars everywhere.

He worried about air. Neither he nor Akki had a suit. It was *hard,* trying to breathe vacuum.

He was about to turn for home when

he saw them chasing him. Galactics, with heads of every shape and color—long sinuous arms, or tiny grasping claws, or worse—were rowing toward him steadily, shouting with cavernous voices. The sleek prows of their boats were as lambent as the starlight.

"What do you want?" he cried out as he paddled hard to get away. (Hadn't the boat started out with a motor?)

"Who is your master?" they shouted in a thousand different tongues. "Is that He beside you?"

"Akki's a fin! Fins are *our* clients! We uplifted them and set them free!"

"Then they are free," the Galactics replied, drawing closer. "But who uplifted you? Who set *you* free?"

"I don't know!" he screamed. "Maybe we did it ourselves!" He stroked harder as the Galactics laughed. He struggled to breathe the hard vacuum. "Leave me alone! Let me go home!"

Suddenly the Fleet loomed ahead. Bigger than moons—bigger than stars they seemed. The ships were dark and silent and their aspect seemed to daunt even the Galactics . . . who nevertheless bore on, now silently, catching up with each stroke.

Then the foremost of the ancient globes began to open. Toshio realized, then, that Akki was gone. His boat was gone. The ETs were gone.

He wanted to scream, but air was very dear.

A piercing whistle brought him alert in a painful, disorienting instant. He sat up suddenly and felt the sled bounce unhappily with the motion. While his eyes made a blurred jumble of the horizon, a stiff breeze blew against his face. The tang of Kithrup greeted his nostrils.

"About time, Ladder-runner. You gave us-s quite a scare."

Toshio wavered for another moment, then saw Hikahi floating nearby, inspecting him with one eye.

"Are you okay, little Sharp-eyes?"

"Um . . . yes. I think so."

"Then you had better get to work on your airhose. We had to nip it to give you air, at-t first."

Toshio felt the knife-edged cut with his left hand. He noticed that both hands were neatly bandaged.

"Was anyone else hurt?" he asked as he felt through his thigh pocket for his repair kit.

"A f-few minor burns. We enjoyed the fight, after learning you were all right-t-t. Thank you for telling us about Ssassia. We would never have looked there had you not been caught and then told us what you found.

"They are cutting her loose now."

Toshio knew he should be grateful to Hikahi for putting the misadventure in that light. By rights, she should be dishing out a tongue-lashing for rashly leaving formation and almost losing his life.

But Toshio felt too lost to allow himself even gratitude to the dolphin lieutenant.

"I suppose they haven't found Phippit?"

"Of him there has been no sign."

The slow rotation of Kithrup had taken the sun past what would look like four o'clock, Earth time. Low clouds were gathering on the eastern horizon.

There was a choppiness to the water that had been absent before.

"There may be a small squall later," Hikahi said. "It-t may be unwise to use Earth instincts on another world, but I think we have nothing to fear."

Toshio looked up. There was something to the south. . . . He squinted.

There it was again: a flash, and then another. Two tiny bursts of light followed in quick succession, almost invisible against the sea glare.

"How long has that been going on?" He gestured toward the southern sky.

"What do you mean, Toshio?"

"That flashing. Could it be lightning?"

The fin's eyes crinkled and her mouth curled slightly. Hikahi's flukes churned and she rose up in the water to turn first one eye, then the other toward the south.

"I s-see nothing, Sharp-eyes. Tell me what you see."

"Multicolored flashes. Bursts of light. Lots of. . . ." Toshio stopped wrapping his airhose. He stared for a moment, trying to remember.

"Hikahi," he said slowly, "I think Akki called me during the fight with the weed. Did you get anything over your set?"

"No, I didn't, Toshio. But remember, we fins aren't yet so good at abstract thought while fight-ting. T-try to recall what he said, please."

Toshio touched his forehead. The encounter with the weed was not something he wanted to think about right now. It all blended in with his nightmare—a jumbling of colors and noises and confusion.

"I think . . . I think he said something about wanting us to keep radio silence and come home . . . something about a space battle going on?"

Hikahi let out a whistling moan and flipped out of the water in a backwards dive. She was back immediately, tail churning.

** Close-up*
Lock-up
*Go the other way - then up! **

Sloppy Trinary. There were nuances in Primal delphin which Toshio, of course, couldn't understand. But they sent a thrill down his spine. Hikahi was the last fin he would ever have expected to slip into Primal. As he finished wrapping his airhose, he realized with chagrin what his failure to tell Hikahi earlier might have cost them all.

He slapped his faceplate shut and flopped onto his belly to press the buoyancy valve on the sled, checking simultaneously the telltales on his helmet rim. He ran through the pre-dive checklist with a rapidity that only a fourth-generation Calafian colonist could have achieved.

The bow of the sled was sinking quickly as the sea erupted to his right. Seven dolphins breached in a spume of water and exhaled breath.

"S-s-sassia's tied to your stern, Toshio. C-can you shake your leg!" Keepiru urged. "Now is no time to dawdle making up t-t-tunes!"

Toshio grimaced. How could Keepiru have fought so desperately to save the life, earlier, of someone he ridiculed so?

He remembered the way Keepiru had torn into the weed, the desperate look in his eye and the glow it had taken when he saw Toshio. Yet now he was

cruel and taunting as ever.

A sharp blast of light flashed in the east. The fins squealed almost as one and immediately dove—all except Keepiru, who stayed beside Toshio—as the eastern cloudline spat spearheads trailing fire into the afternoon sky.

The sled finally sank, but in the last instant Toshio and Keepiru saw a hurtling battle of giants.

A huge, arrowhead-shaped space vessel barreled down on them, pitted and fiery. Wind-swept trailers of purple smoke boiled out of great gashes in its side, to be flung back into the needle-narrow shock front of its supersonic flight. The shock wave warped even the shimmer of the great ship's defensive shields, shells of gravity and plasma that sparkled with unhealthful overload.

Two grapnel-shaped destroyers dogged no more than four ship-lengths behind. Beams, likely of accelerated antimatter, flashed from each of the trifoils—warped, usually, by their quarry's shields, but hitting their mark twice, as Toshio watched, in terrible explosions.

Toshio was five meters below the surface when the sonic wave hit. It slammed the sled over, then kept it tumbling amid a roar that sounded like a house caving in, again and again. The water was a churning maelstrom of bubbles and bodies.

As he fought vertigo and struggled with the sled, Toshio thanked Infinity he hadn't been at the surface to hear the battle passing by.

The noise settled down to a series of loud booms. Toshio got the sled righted, then had a chance to look around.

No one appeared injured. Ssassia's sad corpse still lay tied to the rear end of the sled. The other fins, too scared or prudent to go above, began taking turns at the small air-domes that lined the bottom rim of the sled. It was Toshio's job to keep the sled still. It wasn't easy in the churning water, but he did it without a thought.

At Morgran they had seen ships die. But never this close.

They were near the sloping western edge of a huge, grayish metal-mound. He eyed, uncomfortably, the sea-plants that grew, at intervals, along its side. They looked nothing like the strangle weed, but that was no guarantee. Toshio wondered about the larger life forms that were the weed's accustomed prey. They might be dangerous, as well.

More and more he was coming to dislike being here.

He wished he was home, where the sea dangers were simple and easily handled—Kelp Klingers and island turtles and the like—and where there were no ETs.

"Are you all right?" Hikahi asked as she came by. Toshio saw Keepiru drifting nearby, eyeing him carefully.

"I'm fine," he grumped. "It's a good thing I didn't wait any longer to tell you about Akki's message, though. You have every reason to be mad at me."

"Don't-t be silly. Now we head back. Krookida is fatigued, so I have lashed him under an air-dome. You will forge ahead with the scouts. We will follow. Now t-take off!"

Toshio took his bearings and pushed the throttle gradually up to maximum. The thrusters hummed as the sled accelerated. The mound slowly receded

on the right. Several of the stronger swimmers maintained pace alongside.

It had taken them five minutes or so to get started. They still had time to put a little distance behind themselves before the tsunami hit.

It was not a huge wave, as such things come at times. It was merely the first of a series of ripples spreading from a point where a pebble had been plunked into the sea. The "pebble" happened to have been a spaceship half a kilometer long. It had "plunked," at supersonic speed, a mere fifty kilometers away.

It jerked the sled upward and sideways, almost shaking him off. A cloud of sea-debris, torn-up plants and dead and living fish, whirled about him like clods in a dust-devil. The roar was deafening.

Toshio clutched at the controls desperately. Somehow, against incredible inertia, he managed slowly to drive the prow of the sled up and away from the wave front. Just in time he thrust out of the curling, downward circulation and sent the tiny craft flying along the direction the current wanted to go. East.

An ash-gray form speared past him on his left. In a flash he recognized Keepiru, struggling to keep control in the churning waters. The fin squeaked something indecipherable in Trinary, then was gone.

Some instinct guided Toshio; or perhaps it was the sonar screen, now a mess of jumbled snow but still bearing the faint, fading traces of the terrain map it had shown only moments before. Toshio forced the sled to bear to the left as hard as it could without risking a turnover.

The emergency power hum of the engines changed to a scream as he suddenly slewed hard to port in desperation. The huge, dark bulk of a metal-mound loomed ahead.

Already he could feel undertow as the wave began to form breakers on his right . . . curling as the cycloid rode up the sloping shore of the island.

Toshio wanted to cry out, but the struggle to stay upright took all of his breath. Instead he clenched his teeth and mentally counted as the terrible seconds passed.

Just in time the sharp edge of the mound appeared. By ten meters, the sled drove past the cliff-like northern side amid a cloud of bubbles. Toshio was dimly aware that, though he was still underwater, he could look downward to his right and see the lower beach plants of the island. He was riding in the center of a tall mound of water.

Then he was past. The sea opened up and one of the deep oceanic rills lay beneath him, dark and seemingly bottomless. Toshio slammed the bow planes forward and vented his tanks. The sled dove downwards faster than any dive he had taken before.

His stern pulled forward precariously. Toshio passed clouds of falling debris caught in the contrary tides. The darkness and cold came up at him and he sought the chill as a refuge.

The valley sloped gently below him as he brought the sled to a quiet depth. He could sense the tsunami rolling by above him. The sea plants all around waved in an obviously unaccustomed manner. A slow rain of falling rubbish drifted down on all sides. But the water

wasn't trying to beat him to death. Toshio flattened out his dive and headed toward the valley center away from everything, then allowed himself to sag in an agony of bruised muscles and adrenalin reaction.

Automatically he forced himself to check the gauges. Almost as an afterthought he blessed the tiny, man-designed symbiotes that were right now scavenging his blood of the excess nitrogen that would have normally been causing dangerous narcosis raptures at this depth.

He cranked the engines down to one-quarter, and they sighed with the silence of a machine's relief.

The lamps on the sled's display were mostly green—surprising, after the treatment it had received. It would need an overhaul soon, though.

One of the telltales caught his eye—an air-dome in operation. Suddenly Toshio noticed a faint, singing sound; it was a whistling of patience and reverence.

** The Ocean is as is as is—*
the endless sigh of dreaming—
Of other seas that are that are—
*and others in them, dreaming— **

Toshio snapped on the hydrophones.

"Krookida! Are you okay? Is your air all right?"

There was a sigh, tremulous and tired.

"Fleet-t-t Fingers, hello. Thank-k you for saving my life. You flew as truly as any Tursiops."

"That ship we saw must have crashed! If that's what it was, you can bet there will be afterwaves. Maybe we'd better stay down here a while. I'll turn on the sonar so others can find us and come for air while the waves pass." He flicked the switch and immediately a low series of clicks emanated into the surrounding water. Krookida groaned.

"They will not come, Toshio. Can you not hear them? They will not answer your call."

Toshio frowned. "They *have* to! Hikahi will know about the afterwaves. They're probably looking for us right now! Maybe I'd better head back. . . ." He moved to turn the sled and blow ballast. Krookida had started him worrying.

"Do not go, Toshio! It will do no good for you to die as well! Wait until the waves pass-s-s! You must live to tell Crei-deiki!"

"What are you *talking* about?" Toshio cried out.

"Listen, Sharp-eyes. Listen!"

Toshio shook his head, then swore and pulled back on the throttle until the engine died. He turned up the gain on the hydrophones.

"Do you hear?" Krookida asked.

Toshio cocked his head and listened. The sea was a mess of intonation. The roar of the departing tsunami dopplered down as he lay there. Schools of fish made panicky noises. All around came the reports of rockslides and surf pounding on the islands.

Then he heard it. Primal delphin . . . no modern dolphin spoke it when fully in command of his faculties.

That, in itself, was bad news.

One of the cries was clear. From two separate voices he could easily make out the Basic Distress Call. It was the earliest delphin signal human scientists had understood.

But the other noise . . . at least three

voices were involved in that one. It was a strange sound. Toshio wanted to cry out on hearing it. It was very poignant and *very* wrong!

"It is rescue fever," Krookida groaned. "Hikahi is beached and injured. She alone might have s-stopped this, but she is delirious and now adds t-to the problem!"

"Hikahi. . . ."

"She is a student of Keeneenk-k . . . the study of logical discipline. She would have been able to force the others to ignore the cries of those washed ashore, to make them dive to safety for a t-time."

"Don't they realize there will be aftershocks?"

"Shock-k-ks hardly matter, Sharp-eyes!" Krookida cried. "They may beach themselves without assist! You are Calafian. How can you not know this about us-s-s? I thrash here to go and die answering that call!"

Toshio groaned. Of course he knew about rescue fever. Every few years the tragedy struck even the highly advanced fins of Calafia. Akki had told him, once, that sometimes the sea itself seemed to be calling for help.

Some humans claimed to have felt it, too—particularly those who took dolphin RNA in the rites of the Dreamer Cult.

Once upon a time the Tursiops, or bottlenose dolphin, had been about the least likely cetacean to beach himself. He was partly resistant to the nematodes which afflicted the ears of other whales, and had found his own ways to fight off rescue fever.

But genetic engineering had upset the balance somewhere. For three generations human, fin, and chimp geneticists had been working on the problem. But for now the fins swam along a knife edge, where irrationality was always a constant, if distant, danger.

Toshio bit his lip.

"They have their harnesses," he said uncertainly.

"One can hope. But-t is it likely they will use them properly when they are even now speaking P-primal?"

Toshio struck the sled with his balled fist. Already his hand was growing numb from the chill. "I'm going up," he announced.

"No! You must not! You must guard your safet-ty!"

Toshio ground his teeth. Always mothering me. Mothering or teasing. The fins treat me like a baby and I'm *sick* of it!

He set the throttle to one quarter and pulled up on the bow planes. "I'm going to unlash you, Krookida. Can you swim okay?"

"Yess-s. But-t-t. . . ."

Toshio looked at his sonar. A fuzzy line was forming in the west.

"Can you swim?" he demanded.

"Yes-s. I can swim well enough. But don't cut me loose near the rescue fever! Don't you risk the aftershock-ks!"

"I see one coming now. They'll be several minutes apart and weakening with time. I'll fix it so we rise just after this one passes. Then you've got to get going back to the ship. Tell them what's going on and get help."

"That is-s what *you* should do, Toshio."

"Never mind that! Will you do as I ask? Or do I have to leave you lashed up!"

There was an almost unnoticeable pause, but Krookida's voice was different. "I shall do exactly as you say, Toshio. I will bring help."

Toshio checked his trim and flattened the sled's rise slightly. Then he slipped over the side, holding onto the rim stanchions with one hand.

Krookida looked at him through the transparent shell of the air dome. The tough bubble membrane extended from the lip of the dome to surround the dolphin's head.

Toshio tore loose the lashings holding Krookida in place. "You're going to have to take a Breather with you, you know."

Krookida sighed, but made no move as Toshio pulled the lever by the air dome. A small hose descended and inserted into the fin's blowhole. Like a snake it continued to fall, until a ten-foot coil was wrapped around Krookida's neck. Now the fin was not only uncomfortable, but incapable of communication. He also would not have to come up for air.

Toshio wrapped the last lashing around a stanchion and pulled himself onto the upper surface just in time to feel the rolling passage of the first afterwave overhead.

The sled bounced vigorously, but he was prepared this time. The wave passed with surprising quickness.

"Okay, here goes." He pushed the throttle forward to maximum and blew his ballast. Soon the metal island appeared on his left. The screams of his comrades became distinctly louder. The distress call was now pre-eminent over the rescue fever response.

Toshio steered past the mound to the north. He planned to give Krookida a big head start. The Breather would help the old metallurgist ignore the cries in the water—a constant uncomfortable reminder of his membership in a technological culture. But Toshio wanted to give Krookida distance as well.

Just then, however, a sleek spearhead of steel gray shot past Toshio just overhead. Toshio recognized it at once . . . and saw where it was headed.

He cut loose the last lashing. "Get moving, Krookida! If you come back anywhere near this island again I'll rip off your harness and bite your tail in half!"

He didn't bother looking back as he kicked in emergency power to catch up with Keepiru. The fastest swimmer of the *Streak*'s crew was heading directly for the western beach. His cries were pure Primal delphin.

III

"Damn you, Keepiru. Stop!" The sled thrummed quickly just under the water's surface. The afternoon had aged and there was a reddish tinge to the clouds overhead, but Toshio could clearly see Keepiru leaping from wavelet to wavelet up ahead. He appeared indifferent to Toshio's calls as he neared the island where his comrades lay beached and delirious.

Toshio felt helpless. Another aftershock was due in three minutes. If it didn't beach the dolphin, his own efforts probably would. Keepiru came from Atlast, a new and rather rustic colony world. It was doubtful he had learned the tools of discipline studied

by the likes of Creideiki or Hikahi or, to a lesser extent, the Earthborn sophisticate Krookida.

"Stop! If we time it right we can work as a team! Miss the aftershocks! Will you let me catch *up?*" He screamed, but it was no use. The fin had too much of a head start.

Odd how he could have lived and worked with dolphins all his life and known them so poorly. And to think the Terragens Council had chosen him as midshipman because of his experience. Hah!

Keepiru, for instance. Toshio had always taken a lot of kidding from fins. They kidded *all* human children, while protecting them ferociously. That had not been much different from the way the *human* adults treated them. But on signing aboard the *Streak,* Toshio had expected to be greeted as an adult and officer. Sure, a little repartee, as he'd seen between adult man and fin back home; but some mutual respect, as well.

Keepiru had been the worst, starting right off with heavy sarcasm and never letting up. It had been nonstop humiliation from the beginning, except when Hikahi intervened. And that was even worse.

So why am I trying to save him?

He remembered the fiery courage Keepiru had shown in saving him from the weed. There was no rescue fever then. The fin had been in full control over his harness. That was proof enough.

So he thinks of me as a child, Toshio thought bitterly. No wonder he doesn't hear me now.

Still, it offered a way. Toshio bit his lip, wishing vainly for an alternative. To save Keepiru's life he would have to utterly humiliate himself. It wasn't an easy thing to decide to do. His pride had taken such a beating, of late, that he almost chose to do nothing.

With a savage curse he pulled back on the throttle and set the bow planes to descend. He turned up the hydrophones to maximum, swallowed once, then cried out in pidgin Trinary:

** Child in danger - child's distress, is **

** Human child - in need of savior **
** Human child - come do your best! **

He repeated the call over and over, whistling through lips dry with shame. The nursery rhyme was taught to all the children of Calafia. Any kid past the age of seven who used it usually pleaded for transfer to another island to escape the subsequent razzing.

There were more dignified ways an adult called for help.

None of which Keepiru had heard.

Ears burning, he repeated the call.

Not all kids did well with the fins, of course. Only a quarter of the population of Calafia worked closely with the sea. But those adults were the ones who had learned the best ways to deal with dolphins. Toshio had always assumed he'd be one of them, if he didn't make it into space.

Now that was all over. If he got back to *Streaker* he'd have to hide in his stateroom . . . for at least the few days it took for the victors of the battle over Kithrup to come down and claim them.

On his sonar screen another fuzzy line of static was approaching from the west. Toshio shrugged and let the sled slip a little deeper. Not that he cared. He continued to whistle but he felt like crying.

where - where - where child is? - where child is? where

Primal delphin! Nearby! Almost, he forgot his shame. He mimicked the basic distress call as well as human lips could form it.

He fingered the rope in his right hand, one of those left from Krookida's lashings, and kept whistling, although he felt the urge to grin savagely.

A streak of gray twilight shot down past him in a flash. Toshio gathered his knees under him and took the rope in both hands. He knew Keepiru would circle below and come up the other side. The fin loved that maneuver. When he saw the first hint of gray skin hurtling upwards, Toshio launched himself off of the sled.

The bullet body of the dolphin twisted in an abrupt, panicky attempt to avoid collision. Toshio cried out as the cetacean's tail struck him in the chest. But it was a cry more of glee than of pain. He had timed it right!

As Keepiru twisted around again, Toshio flung himself backwards, allowing the fin to pass between himself and the rope he held in his hands. He wrapped his feet around the slick tail and pulled the rope with all of the will of a garrotist.

"Got you!" he cried.

At that instant the afterwave hit.

The cycloid clutched at him like the swelling pull of a thousand tugging fingers. Bits of jetsam bounced against him as the suction tossed him about—in apparent alliance with the mad, bucking dolphin he held onto.

But this time Toshio felt no fear of the wave, or even of the island, though it was to be hoped he had stopped the sled far enough out that the aftershock would not beach them. He was filled with a fierce battle lust. The adrenalin seared through him like a flux of hot mercury. It pleased him no end, to save Keepiru's life by physically punishing him for weeks of humiliation.

The dolphin writhed in panic. The rope hurt, as did the harness to which Toshio soon transferred his grip. As the wave rolled past them, he squeaked the basic call for air.

Desperately, the fin arched and drove for the surface.

They breached, and Toshio just missed getting blasted by the spume from Keepiru's blowhole. Keepiru then commenced a series of leaps, gyrating to shake loose his unwelcome rider.

Each time they went underwater Toshio called out.

"You're *sentient,*" he gasped. "Damn you, Keepiru . . . you're . . . you're a *starship pilot*!"

He knew he should be doing his coaxing in Trinary, but it was no use even trying, when all he could do was hold on for dear life.

"You peabrained . . . phallic symbol!" he screamed as the water slammed against him. "You overrated *fish!* You're *killing* me, you goddamned. . . . The ETs own Calafia by now because you fins can't hold your tongues! . . . We never should have taken you along into space!"

The words were hateful. Worse. Contemptuous. At last Keepiru seemed to have heard. He reared out of the water like a stallion enraged. Toshio felt his grip tear loose as he was flung away to hit the sea with a splash.

Only ten cases were known, in the

forty generations of dolphin uplift, in which a fin had attacked a human with murderous intent. In each case every fin related to the perpetrator had been sterilized. Still, Toshio expected to be crushed at any instant. He didn't care. He had realized, at last, the cause of his depression.

It hadn't been the inability to go home that had hurt, these last few weeks. It was another fact that he had not allowed himself to think even once since the battle off Morgran.

The eatees . . . the extraterrestrials . . . the Galactics of every stripe and philosophy which were chasing *Streak* . . . would not settle for hunting down the dolphin-crewed ship.

At least one ET race would have seen that the *Streak* might successfully go into hiding. Or they might imagine, erroneously, that her crew had succeeded in passing the secret of her discovery to Earth. Either way, the logical next step for one of the more amoral or vicious Galactic races would be coercion.

Earth might be able to defend herself. Probably Omnivarium and Hermes, as well. The friendly Timbrimi would defend the Caanan colonies.

But places like Calafia . . . or Atlast . . . they must be captured by now. They were hostages, his family and everyone he knew. And Toshio realized that he blamed the fins.

Another afterwave was due any minute now. Toshio didn't care.

Pieces of jetsam were floating all about nearby. Not more than a kilometer away Toshio could see the metal mound. At least, it looked like the right one. He couldn't tell if there were fins stranded on the shore or not.

A large piece of jetsam drifted near him. It took him a moment to realise that it was Keepiru.

Toshio tread water as he opened his faceplate with one hand.

"'Well,'' he asked, ''are you proud of yourself?''

Keepiru turned slightly to one side as one dark eye looked up at Toshio. The bulge at the top of the cetacean's head, where human meddling had created a vocal apparatus from the former blowhole, gave out a long, soft, warbling sound.

Toshio couldn't be certain it was just a sigh. It might have been an apology in Primal delphin. The possibility alone was enough to make him angry.

''Can that crap! I just want to know one thing. Do I have to send you back to the ship? Or do you think you can stay sentient long enough to help me? Answer in English and it had better be grammatically correct!''

Keepiru moaned in pure anguish. After a moment of heavy breathing he finally spoke, quite slowly.

"Do not send me back," he hummed unhappily. "They are still calling for help-p-p! I will do what you ask-k-k!"

Toshio nodded gruffly. He tried to look to the west but could not tell if the next shock was near. It didn't matter much.

"All right. Go down and find the sled. When you've found it, put on a Breather. I don't want you hampered by need for air, and you need a constant reminder with you, too!

"Then bring the sled up near the island, *but not too close!*"

Keepiru flung his head up in a huge nodding motion.

"Yes-s-s!" he cried. Then he flipped and dove into the water.

Toshio turned to face the west as he dogged his faceplate. It was just as well Keepiru had left all the thinking to him. The fin might have balked if he'd caught on to what Toshio had in mind.

A kilometer to the island. There was only one way to get there fast and avoid a long slow scramble up the slanting, abrasive, metal-coral surface. He checked his orientation one more time to be sure he wouldn't miss—then a drop in the water level told him that the latest wave was coming.

The fourth wave seemed the gentlest by far. He knew the feeling was deceptive, though. He was in water deep enough that the swell came at him as a gentle lump in the ocean rather than a crested breaker. He dove down into the hump and swam against the direction of motion for a time before rising to the surface.

He had to gauge it just right. Swim back too far, and he wouldn't reach the island before the following trough arrived and pulled him out to sea again. To remain at the front of the wave would be asking to body surf a vicious breaker onto the beach, undertow and all.

It was all happening too fast. He swam hard but couldn't tell if he had passed the peak of the wave or not. Then a glance told him that it was too late for remedial measures. He flipped around to face the giant, foliage-topped mound.

The breaker started a hundred yards ahead, but the slope rapidly ate away at the wave as bottom dragged the cycloid into a crested monster. The peak moved backwards towards Toshio even as the wave hurtled upward onto the beach.

The boy braced himself as the crest reached him. He was prepared to look down on a precipice, and then see nothing more.

What he saw was a cataract of white foam, as the wave began to die. Toshio cried out, to keep his ear channels open, and started swimming furiously to stay on top of the churning, driving tide of spume and debris.

Suddenly there was greenery all around. Trees and shrubs which had withstood the earlier assaults now shook under the attack of the weaker sister. Some tore loose of their moorings even as Toshio flew past them. Others stood and flailed at him as he hurtled through.

No sharp branch impaled him. No unbreaking vine garroted him as he passed. In a tumbling, tossing confusion he finally came to rest, somehow hugging the trunk of a huge tree.

Miraculously, he was on his feet . . . the first man to stand on the soil of Kithrup. Toshio stared dazedly

at his surroundings, briefly not believing his survival.

Then he became the first man to lose his breakfast on the soil of Kithrup.

IV

He found Ssattatta by the bole of a giant drill-tree. The fin had been thrown against the monstrous plant and crushed. Her harness was a jumble of broken pieces.

Toshio stumbled through the ruined undergrowth, whistling a Trinary call when he felt able. Mostly he tried very hard to stay on his feet. He hadn't walked much since leaving Earth. Bruises and nausea didn't help much, either.

He found K'Hith lying on a soft bed of grasslike growth. His harness was intact.

But the dolphin planetologist had already bled to death from three deep gashes in his belly. Toshio made a mental note of the spot and moved on.

Closer to the shore he found Satima. The little female was bleeding and hysterical, but alive. Toshio bound her wounds with fleshfoam and repair tape. Then he took the manipulator arms of her harness and used a large rock to pound them into the loam. It was the best he could do to bind her to the ground before the fifth wave hit.

It was more a flooding than a wave. Toshio clung to a tree as it flowed past, tugging at him with insistence and rising almost to his neck.

As soon as the wave began to recede, he let go and floundered over to Satima. He groped until he found the release on her harness, then punched her free to float in the growing backtow. He pushed hard to join the flood and keep from being left behind.

He was struggling to shove her around a clump of shrubs, against the growing pull of the receding tide, when a swift motion in the tree overhead caught his eye. The movement didn't fit into the overall pattern of swaying subsidence. He looked up and met the gaze of a pair of small, black eyes.

There was little time for more than a startled double take before the tide pulled him and Satima straight through the obstruction and into a small, recently made marsh.

He had to pull Satima down the last few yards of slippery sea-plant, taking care not to reopen her wounds. In the last few minutes it had seemed she was more lucid. Her delphin squeakings were starting to take on form and sound like Trinary words.

A whistle brought Toshio's head up.

Keepiru was only forty meters offshore, driving the sled toward him. The fin had on a Breather, but he could still signal using the sonar cavities under his skull.

"Satima!" He shouted to the wounded dolphin. "Go to the sled! Go to Keepiru!

"Lash her to an air dome!" he called to Keepiru. "And keep your eye on that sonar screen! Get back out there when you see a wave coming!"

Keepiru tossed his head. As soon as Satima was a hundred feet out he used the sled to herd her toward deeper water.

"Watch out for dazed fins floating free!" Toshio called, hoping Keepiru had heard him.

Five accounted for. That left Hist-t and Hikahi. Toshio climbed back up the sea-plant shoreline and stumbled into the undergrowth once again.

As he searched, Toshio found himself thinking. The territory of his mind seemed as torn up and desolated as the island he trod upon. He had seen too many corpses for one day—too many dead friends.

He realised, now, that he had been unfair to the fins all along.

It had been unfair to blame them for teasing him. They couldn't help the way they were built. All of mankind's meddlesome surgery notwithstanding, dolphins had been dealing with humanity on a level of good-natured derision since the first person paddled a log canoe out to sea. That pathetic image had been enough to set a pattern that uplift could only alter, not eliminate.

And why eliminate it? With a new perspective Toshio now saw that those humans he had known on Calafia, who worked best with dolphins, had had a special type of personality . . . generally featured by a mixture of a thick skin, firmness, and a willing sense of humor. No one who hadn't earned their respect worked for long with fins.

He hurried over to a gray form that lay in the underbrush. But no. It was Ssattatta again. She had been moved by the last wave. Toshio stumbled on.

Dolphins were quite well aware of what mankind had done for them. Uplift was a painful process, especially when not yet finished. But none of them would go back to the Whale-Dream if they could help it.

The fins knew, as well, that the loose codes that ruled behavior among the Galactic races . . . rules established in the *Library* for aeons . . . would have let humanity demand a hundred thousand years of servitude from its clients. Man had collectively shuddered at the thought. *Homo sapiens sapiens* himself was less than that age. If mankind *did* have a patron out there—one strong enough to lay claim to the title—that species wasn't going to pick up *Tursiops amicus* as an added bonus.

There wasn't a fin alive who wasn't aware of Earth's attitude. There were dolphins on the Terragens Council, as well as chimpanzees.

No, Toshio knew at last how he had hurt Keepiru with his words during the struggle at sea. Most of all he regretted the remark about Calafia. Keepiru would willingly die a thousand times to save the humans of Calafia.

If he had it to do over again Toshio would never have said those things, even if it had meant watching Keepiru dash himself against the rocks in rescue fever, and himself dying at sea. His tongue would fall off before he said such things again. Ever.

He staggered into a clearing. There, in a shallow pool, lay a Tursiops dolphin, three meters long.

"Hikahi!"

The fin was scratched and battered. Tiny bloody tracks lay along her sides. But she was awake, apparently. And as Toshio started forward she called out, shrilly.

"Stay there, Sharp-eyes! Don't-t move! We have c-company here!"

Toshio stopped in his tracks. Hikahi's command was specific. Yet the need to go to her was urgent. The dolphin's

scratches did not look pleasant. If there were slivers of metal coral lodged under the skin they had to be removed soon before blood poisoning set in. And it wasn't going to be easy getting Hikahi out to sea.

"Hikahi, there'll be another wave soon. It may reach this high. We've got to be ready for it!"

"*Stay*, Toshio. The wave will not reach here. Besides, look around. See how much more important this is-s-s!"

For the first time Toshio noticed the clearing. The pool was set near one side, with scratch marks all around indicating that it had been recently dug. Then he saw that the manipulator arms from Hikahi's harness were missing—probably snapped off in the first impact with the shore.

Then who . . . ? Toshio's perception shifted. He saw the twisted debris at the far end of the clearing, scattered through the undergrowth, and recognized the fragments of a ruined, shattered village.

In the chronic shimmering of a Kithrupan forest he saw rude, torn woven nets, scattered pieces of wrecked thatching, and bits of sharp metal crudely bound to wooden staves.

In the tree branches he saw fleet little movements. Then, one by one, small, splayed, web-fingered hands appeared—followed by slowly peeking, shining black eyes that peered back at him from under low, greenish brows.

"Abos!" he whispered. "I saw one earlier, then forgot completely! They look fully pre-sentient!"

"Yes-s-s," Hikahi signed. "And this makes secrecy even more vital to preserve. Quickly, Sharp-eyes! Tell me what-t has happened!"

Toshio told the dolphin officer what he had done since the first tsunami hit, leaving out the details of his battle with Keepiru. It was hard to concentrate, with the eyes in the trees first staring down at him, then skittishly darting under cover when he glanced their way.

He barely finished as the last wave arrived.

He stood up to peer over the undergrowth. The breakers could be seen driving up the sloping bottom, with a loud roar and a white foaming. But clearly Hikahi was right. The water wouldn't rise this high.

"Toshio!" Hikahi whistled. "You have done very well. You may have saved these people as well as ourselves. Krookida will succeed. He will bring help-p-p.

"So saving me is not-t that important. You *must* do as I say! Have Keepiru dive at once! He must stay out of sight and remain quiet as possible as he searches for bodies and debris. You must bury Ssattatta and K'Hith and gather the fragments of their harnesses-s-s. When help comes we must be able to move quickly!"

"Are you sure you'll be all right? Your wounds . . ."

"I'll be f-fine! My friends keep me wet-t. The trees overhang to keep me hidden. Watch the skies, Sharp-eyes! Don't be seen! When you are finished I hope to have coaxed our friends into trusting you."

The fin sounded tired. Toshio was torn. Finally he sighed and turned back to the forest. He forced himself to run through the broken foliage, following the receding waters to the shore.

Keepiru was just emerging as he ar-

rived. The fin had removed his Breather and wore an air dome instead. He reported finding the body of Phip-phit, the dolphin supposed lost earlier to the killer weed. The sucker-bruised body must have been torn loose during the tsunami.

"Any sign of Hist-t?" Toshio called.

Keepiru answered negative. Toshio passed on Hikahi's command and watched as the sled sank below again.

For a moment he stood there, looking out over the west.

Kithrup's reddish sun was setting. The dark chromospheric filaments were like a fingerprint's whorls against the brighter crimson of the photosphere. Arranged differently, they might have resembled eyebrows and a moustache on a grizzled old face.

A few stars poked rays through the scattered clouds overhead. In the east the clouds were beginning to look ominous. There would be rain during the night. Toshio decided against taking off his drysuit, though he compromised by pulling the rubberized headpiece off. The breeze was chilling, but a huge relief.

He glanced to the south. If the battle in space continued, Toshio saw no sign of it. Kithrup's rotation had taken them past the shining globe of plasma and debris that must be drifting out there now.

Toshio lacked the will to shake his fist, but he grimaced toward the southern sky, hoping the Galactics had wiped each other out.

It wasn't likely, though. There would be victors. And they would be looking for dolphins and men.

The boy threw his shoulders back, in spite of his fatigue, and walked with deliberateness toward the forest, and the protecting, overhanging trees.

V

They found the boy and dolphin shortly after landing. The two were huddled together under a crude shelter that dripped warm rain in long rivulets. Lightning flashes drowned out the muffled yellow light from the lamps the rescuers brought. In the first flash, Thomas Orley thought he saw a half dozen small squat figures clustered around the Earthling and the Calafian. But by the time he and his partner had shoved through the undergrowth for a better view, the animals—or whatever they were—were gone.

His first fear that they had been carrion eaters disappeared when he saw Toshio move. Still, he kept his right hand on the butt of his needler and held up the lantern to allow Hans Suess to pass underneath. He looked carefully around the clearing, taking in the smells and the sounds of the living surface of the metal mound and memorizing details.

"Are they all right?" he asked after a few seconds.

"Shh, it's okay, Toshio. It's just me, Hans," he heard the engineer mutter. The fellow sounded downright maternal. "Yes, Mr. Orley. They're both awake, but not in much shape for talking."

Thomas Orley took in the clearing once more, then set the lamp down beside Suess. "This lightning would cover anything," he said. "I'm going to call

up the mechanicals so we can get these two out of here as quickly as possible.'' He touched a button on the rim of his faceplate and whistled quickly in perfect Trinary. The message lasted three seconds. It was said that Thomas Orley could speak Primal delphin, though no human had ever witnessed it.

''They'll be here in three minutes. They have to cover their tracks.'' He squatted down next to Toshio, who was sitting up now that Suess had moved over to Hikahi.

''Hello, Mr. Orley,'' the boy said. ''I'm sorry we dragged you away from your work.''

''That's all right, son. I've been wanting to have a look around up here, anyway. This gave the captain a good excuse to send me. After we get you started back toward the ship, Hans and Tishit and I will be going on to look over that ship that crashed . . . before the other scavengers start arriving.

''Now do you think you can lead us to Ssattatta and K'Hith? We want to comb this island clean before the storm passes.''

Toshio nodded. ''Yessir. I should be able to stumble around that long. I don't suppose anyone's found Hist-t?''

''No. We're worried about that; but nowhere near as worried as we were when Krookida got back. Keepiru's told us most of the story. That fin thinks rather highly of you, you know. You did quite a job here.''

Toshio turned away, as if ashamed to receive the praise. Orley looked at him curiously.

He had never given much thought to the middie before. During the first part of the voyage, the boy had seemed

bright but a bit irresponsible. Later, after they had found the derelict Fleet, he had begun to turn morose, as their chances of ever going home diminished.

Now there was this new note. It was too soon to tell what the longterm effects would be, but this had obviously been a rite of passage for Toshio.

Humming sounds drifted up from the beach. Soon two spider-like mechanicals strode into view, a hammocked and harnessed dolphin piloting each of them.

Toshio sighed a little raggedly as Orley helped him up. Then the older man stooped to pick up an object from the ground. He hefted it in his left hand.

"A scraper, isn't it? Made from bits of metal fish spine glued to a wood handle. . . ."

"I guess so."

"Do they have much of a language yet?"

"Nossir; well, the rudiments. They seem to be stabilized. Strict hunter-gatherers. Hikahi guesses they've been stuck for half a million years."

Orley nodded. This species looked ripe, at first glance. A pre-sentient race at just the right stage for uplift. It was a miracle some Galactic patron hadn't snapped them up already for client status and an aeon of servitude.

Now the men and fins of *Streaker* had an obligation in addition to survival, and secrecy was more important than ever.

He put the artifact in his pocket, then laid his hand on Toshio's shoulder.

"Well, you can tell us all about it back on the ship, son. In the meantime, you have some pondering to do."

"Sir?" Toshio looked up in confusion.

"Well, it isn't everybody who gets to name a future space-faring race. You know, the fins will be expecting you to make up a song about it."

Toshio looked at the older man, uncertain if he was joking. But Thomas Orley had on his usual, enigmatic expression.

Orley glanced up at the rainclouds. As the mechanicals moved in to claim Hikahi, he stepped back and smiled at the curtain which, temporarily, hung across the theater of the sky. ■

THE NEW NEUTRINOS

Richard Matzner & Tony Rothman

Is most of the universe invisible?

In April of 1980 a wave of excitement swept through the physics community which, unlike many such tremors of the past, actually spilled onto the front pages of major newspapers and into the clutches of *Newsweek* and *Time* magazines.

The April event, of course, was the announcement that the elementary particle called the neutrino was not, as had been suspected for at least 30 years, massless. As it is wont to do, the popular press tried its best to transform a tentative result into reality: "New View of Universe." "Revolutionary changes in physics theory will be necessary." "Theological consequences."

In this article, we would like to take a more sober approach. We will explain what a neutrino is, why it was previously thought to be without mass, and why some physicists now think otherwise. We will also discuss some implications massive neutrinos have for physics. We warn the reader that experiments involving neutrinos are notoriously difficult, and that in another five years the next generation of experiments may refute the current findings. In which case we will be relegated to obsolescence. We leave it as an exercise for the reader to discuss theological consequences.

The existence of the neutrino is intimately connected with the phenomenon of beta decay, and it is therefore impossible to understand one without the other. The reader may recall that radioactivity was discovered in 1896 by Henri Becquerel. He found that photographic film became exposed when placed in contact with various uranium compounds even when both the film and the ore were housed in a completely dark drawer. We now know that Becquerel's film was exposed by photons given off by the decaying uranium. Today such high-energy photons are com-

monly produced by X-ray machines for medical purposes.

Over the next few years, work by Becquerel, Rutherford, the Curies, and others showed that various substances, particularly radium, emitted three distinct types of radiation: alpha, beta, and gamma. These designations, which survive to the present day, were then not so much scientific labels as measures of ignorance. Alpha radiation was stopped by a piece of paper, beta rays by a thin sheet of metal, and gamma rays by a centimeter or so thickness of lead. At the time, nothing else was known about them and certainly the nature of their constituents was a mystery. Several decades of fumbling about were necessary to identify alpha rays as helium nuclei (two protons and two neutrons), beta rays as electrons, and gamma rays as high-energy photons.

The beta radiation always posed a special problem. Energy seemed to be vanishing entirely in beta decay—the radioactive process in which decaying nuclei emit beta particles (electrons). To understand this problem, let us place ourselves in the position of an experimental physicist of that time period.

We know that beta particles are electrons being emitted from decaying radioactive nuclei. Take a Geiger counter and place it near a radium sample. Each click of the Geiger counter represents one beta particle being given off by the radium. Furthermore, a modified Geiger counter connected to an "energy spectrometer" can be used to detect beta particles of many different energies. Thus, we can find out how many betas are given off at one energy, then a second energy, a third, and so on. If we plot the number of emitted particles versus the energy at which they are emitted, we obtain a result like that shown in Figure 1. This graph is called a beta decay *spectrum*, and will be central to much of what we have to say. The x-axis simply gives the energy of the measurement and the y-axis tells us how many particles were emitted at that energy. One sees that at low energies a few particles are emitted; the number of particles climbs to some most probable energy, and then declines until, above a certain energy labeled E_{max}, no electrons are emitted at all. Being good 1920 physicists we are very surprised at this result. Why?

In a uniform sample all the radioactive atoms have the same energy to release in atomic disintegrations. In fact, the energy available for release is just E_{max} in Figure 1. E_{max} is the energy of the most energetic electrons ejected from the sample; no electrons with higher energy are emitted. Thus it seems likely that those electrons are carrying off *all* the energy the atom has available for disintegration. Therefore 1920 physicists at least tentatively identified E_{max} with the total energy available for release.

This brings us to the surprising point: If the nucleus decays, giving up E_{max} worth of energy, and only emits one particle—the beta—then simple arguments based on conservation of energy and momentum show that all the betas should be emitted with precisely the same energy, E_{max}. After all, there is no place this energy can go, except into the betas. Hence, the spectrum should not

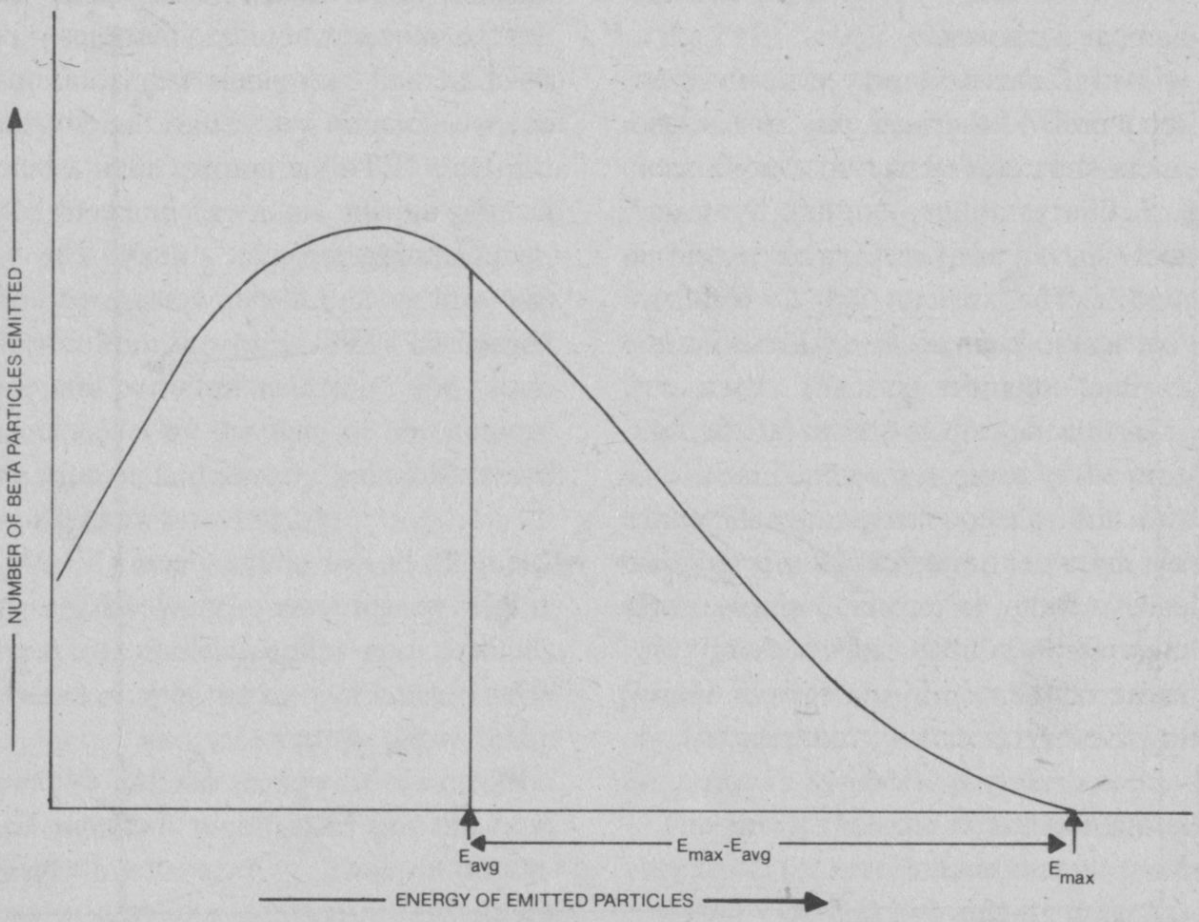


FIGURE 1.

A typical beta decay spectrum. Electrons are emitted from the radioactive sample at all energies up to E_{max}. Those electrons emitted at E_{max} carry away all the energy available for decay. Ellis and Wooster trapped the escaping electrons in a calorimeter and found their average energy to be E_{avg}. Thus, the energy E_{max} - E_{avg} seemed to be vanishing.

look like what we found in Figure 1, but something like Figure 2, a spike at E_{max}. This means that in the real life spectrum (Figure 1) the electrons with energy less than E_{max} have carried away only a fraction of the available energy. There seems to be a substantial amount of energy simply disappearing during radioactive decay.

The first thought might be that we are simply not measuring all the electron energy with our Geiger counters, that we have overlooked some. However, an experiment published in 1927 by Ellis and Wooster makes us suspect this hypothesis. Ellis and Wooster placed a radioactive sample inside a calorimeter with very thick lead walls to be sure to capture all the electrons. The idea is simple. Electrons smash into the walls of the calorimeter, transferring their energy in the process, and thus cause the temperature inside to increase slightly. The experimental results indicated that

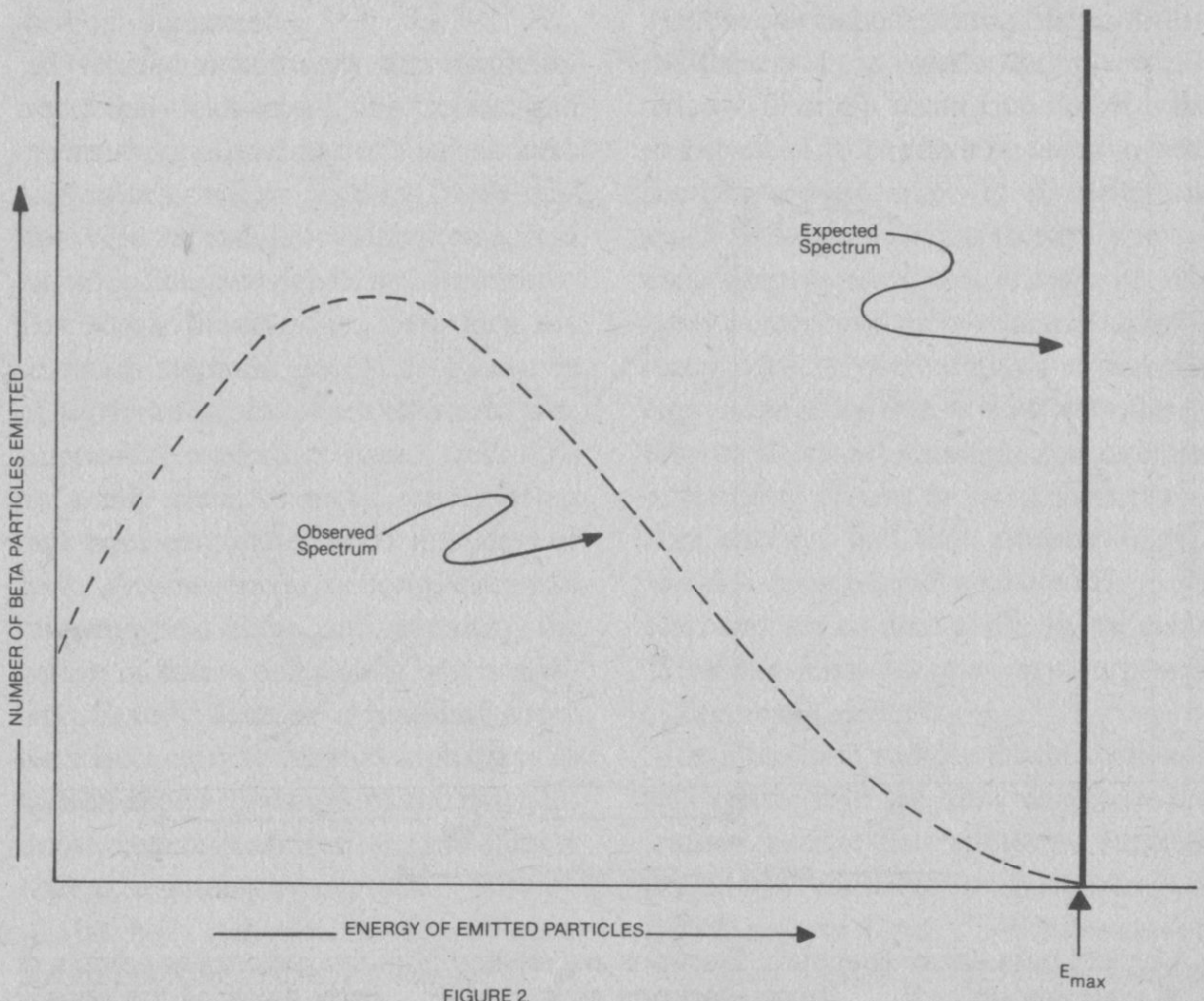


FIGURE 2

Conservation of energy and momentum led physicists before 1930 to expect all the electrons to be emitted at E_{max}, giving a spectrum like that shown here. Instead, they observed a spectrum as in Figure 1, indicated here as a dashed line. This was one of the central puzzles in physics at that time.

most of the electrons captured in the calorimeter wall had an average energy much less than E_{max} (see Figure 1). The difference between E_{max} and E_{avg} is the amount of energy which is vanishing into thin air.

The reader might get a feeling for the seriousness of the dilemma if he realizes that Niels Bohr himself suggested abandoning the conservation of energy in beta decay! The situation was saved in 1930 when the eminent physicist Wolfgang Pauli wrote to his colleagues explaining he would not attend a conference at Tübingen because he planned to attend the annual ball at the Swiss Federal Institute of Technology. In this letter he also happened to mention that the above problems could be resolved if one assumed the decaying nucleus emitted a *second* particle along with the electron. Nowadays, this might seem like a sim-

ple idea, since physicists are familiar with hundreds of elementary particles. But one must remember that in 1930 only *two* elementary particles were known—the proton and the electron. Not surprisingly, many people refused to take Pauli's suggestion seriously. Among those who did believe him was Enrico Fermi, who in 1934 christened the new particle "neutrino" for "little neutron." (By the date of christening, the neutron had already been discovered by Chadwick in 1932.)

Pauli's new particle solved the missing-energy puzzle very neatly. If the decaying nucleus emits *two* particles instead of one, the laws of conservation of energy and momentum allow many ways to add the energy of the electron and neutrino together to get the total energy available, E_{max}. Thus, in the decay process, the electron gets whatever it gets (call it E_e) and the neutrino takes up the slack, $E_{max} - E_e$. This, then, explains the continuous nature of Figure 1. The electrons may now be emitted at any energy E_e up to E_{max} with the neutrino carrying off the rest.

At the same time, the existence of the neutrino explains why the calorimeter experiment did not detect as much energy as expected—the neutrinos simply carried off the excess. But notice, here is the first indication that the neutrino must be a very weakly interacting particle. It was not stopped by the heavy lead walls of the calorimeter. If Ellis and Wooster had trapped it in their apparatus, they would have accounted for all the decay energy. Contrast the neutrino's behavior with that of the alpha particle, which can be stopped by a piece of paper.

By 1950 further experiments showed more directly the neutrino must be massless or very nearly so. When a nucleus decays, not only energy must be conserved, but momentum as well. Experimenters measured the recoil (momentum) of the nucleus during beta emission and the momentum of the electron itself. The two momenta did not quite add up to zero as they should have. The missing piece was given to the neutrino. The important point is that this missing momentum was, *to within the experimental accuracy of about 10 percent, given by the relativistic formula for the momentum of a massless particle*, (momentum) = (energy/velocity of light), or in symbols, $p = E/c$.

The result that the neutrino mass is very small (or zero) means that we were essentially correct in assuming the maximum electron energy, E_{max}, is the total energy available in the disintegration. In the decay process, which also emits a neutrino, the electrons ejected at E_{max} are usurping all the decay energy, leaving none for the neutrino. In the language of relativity, this implies the neutrino is massless.

We must pause here to explain away a bit of confusing terminology which often leaves the layman bewildered. Relativity tells us the energy inherent in a body—say a rock—is composed of two parts. The first is called the rest mass or the rest energy, two terms denoting the same thing (remember $E = mc^2$). The rest energy is just the energy which would be released if the entire rock were converted into energy while it sat at rest on a table. When the rock

is moving, the energy of motion, or kinetic energy, is added to the rest energy. Hence, $E_{total} = E_{rest} + E_{kinetic}$. When a physicist says a particle is massless, he means that the rest energy—or equivalently the rest mass—is zero. This implies the particle is never at rest, which means, according to relativity, that it must always be traveling at the speed of light.

Now, the reader might object that since $E = mc^2$, even if a particle has no rest mass and only kinetic energy, it should then have a mass given by $m = E_{kinetic}/c^2$. This is true; all moving particles have, in some sense, an "effective" mass associated with them. However, the problem lies not in the physics but in the terminology. When a physicist says "massless particle," he means a particle with zero rest mass, always traveling at the speed of light.

Leaving the world of semantics for that of physics, we return to the 1950s. Although by this time experimentalists had established that neutrinos had very small or zero rest mass, no one had ever actually detected a neutrino. It is not hard to see why. Using a few basic equations, it is easy to show that, before being stopped by a collision with an atom, a typical neutrino would travel through roughly four light years of lead! Is it any wonder Ellis and Wooster missed them in a calorimeter? One might think it hopeless to detect neutrinos in a mere earthbound laboratory. Occasionally, however, physicists are clever. If one could produce massive numbers of neutrinos, then the odds of detecting a single neutrino would be increased. This was the basic idea behind the classic experiment of Clyde Cowan and Frederick Reines of the 1950s. In the experiment, which took the better part of the decade, they set up detectors near a nuclear reactor and observed certain nuclear reactions inside the detectors which required that neutrinos be produced by the nuclear reactor. Their first results appeared in 1953, with refinements in 1956 and 1959.

So finally, by the late 1950s, neutrinos were an established fact: particles emitted along with electrons in beta decay and which, to experimental accuracy, always traveled with the speed of light and had zero rest mass.

The flurry of excitement this past April would have the public—and indeed physicists in other specialities—believe that since the 1950s everyone believed neutrinos to be massless and then suddenly changed their minds. After all, within the space of a week, research groups from France, Switzerland, the Soviet Union, and the United States all announced the advent of massive neutrinos.

Several points should be made. First, nothing in the theory itself specifies the neutrino mass; it could be zero or it could be the mass of a baseball. However, the beta decay experiment shows it must be less than E_{max}, presumably much less; for, in addition, the early work described above showed the neutrino to be massless to within the 10 percent accuracy of the experiments. Nonetheless, this does allow for a small but finite neutrino mass. Second, it is not correct to say that for 30 years physicists have assumed the neutrino mass to be zero. History is always more com-

plicated than that. For instance, in 1952 Langar and Moffat published a paper which put an upper limit on the neutrino mass. Specifically, their experiment showed the neutrino mass could not be greater than .05 percent of the electron. But note the date: 1952 was before the neutrino was detected! Physicists were not taking zero mass neutrinos for granted.

By 1969 Karl Bergkvist had improved Langar and Moffat's results by a factor of four. It should be understood that neither of these results *implied* a mass for neutrinos; they only showed that the mass could not be above a certain value. (We will go into a few details of these experiments below.)

This, to a large extent, explains the excitement of April. For the first time experimenters claimed their results implied the necessity of a neutrino mass, and that they knew what this mass was.

Most public attention has been focused on the "neutrino oscillation" experiment of Reines, Sobel, and Pasierb. (Reines, it will be recalled, was the co-discoverer of the neutrino in the 1950s.) Neutrino oscillations were considered as long ago as 1957 by Bruno Pontecorvo, who later extensively developed the theory, and are thus often referred to as "Pontecorvo oscillations." By any name, a full understanding of the phenomenon requires very advanced quantum physics. We can, however, give a close analogy to make the oscillations seem plausible.

Consider two closely tuned piano strings or organ pipes which are sounded together. Each is emitting a wave with a frequency that is slightly different from that of the other. Our ear perceives a very slow rise in volume, followed by a decrease, followed by another rise, the entire cycle taking a second or so. This common phenomenon is known as beats (see Figure 3). The beating occurs at the frequency which is the *difference* between the frequency of the two piano strings or organ pipes. If the two pipes are exactly in tune, the frequencies are the same and the beating disappears.

A very similar thing happens with neutrinos. To see this, we must first mention that there are actually several different types of neutrinos. For the purposes of this discussion we first consider only two types, traditionally called the electron-neutrino and the muon-neutrino. Now, it is known from quantum mechanics that particles behave like waves; each particle has associated with it a wavelength and a frequency. Thus, we can consider the electron and muon neutrinos to be waves.

Now, pretend there are two *other* types of neutrinos, more basic than the electron- and muon-neutrinos. These two basic neutrinos will behave just like the waves emitted from the organ pipes. If the frequencies of these two waves differ slightly, they will interfere and cause a beat frequency as before. We interpret this beating as the response of a detector designed to detect electron-neutrinos. When the "volume" is high, the two basic neutrinos have combined to form an electron-neutrino which is detected. When the volume has gone down, the electron-neutrino has disappeared and a muon-neutrino has replaced it. At that point, a muon-neutrino detector would give a large response,

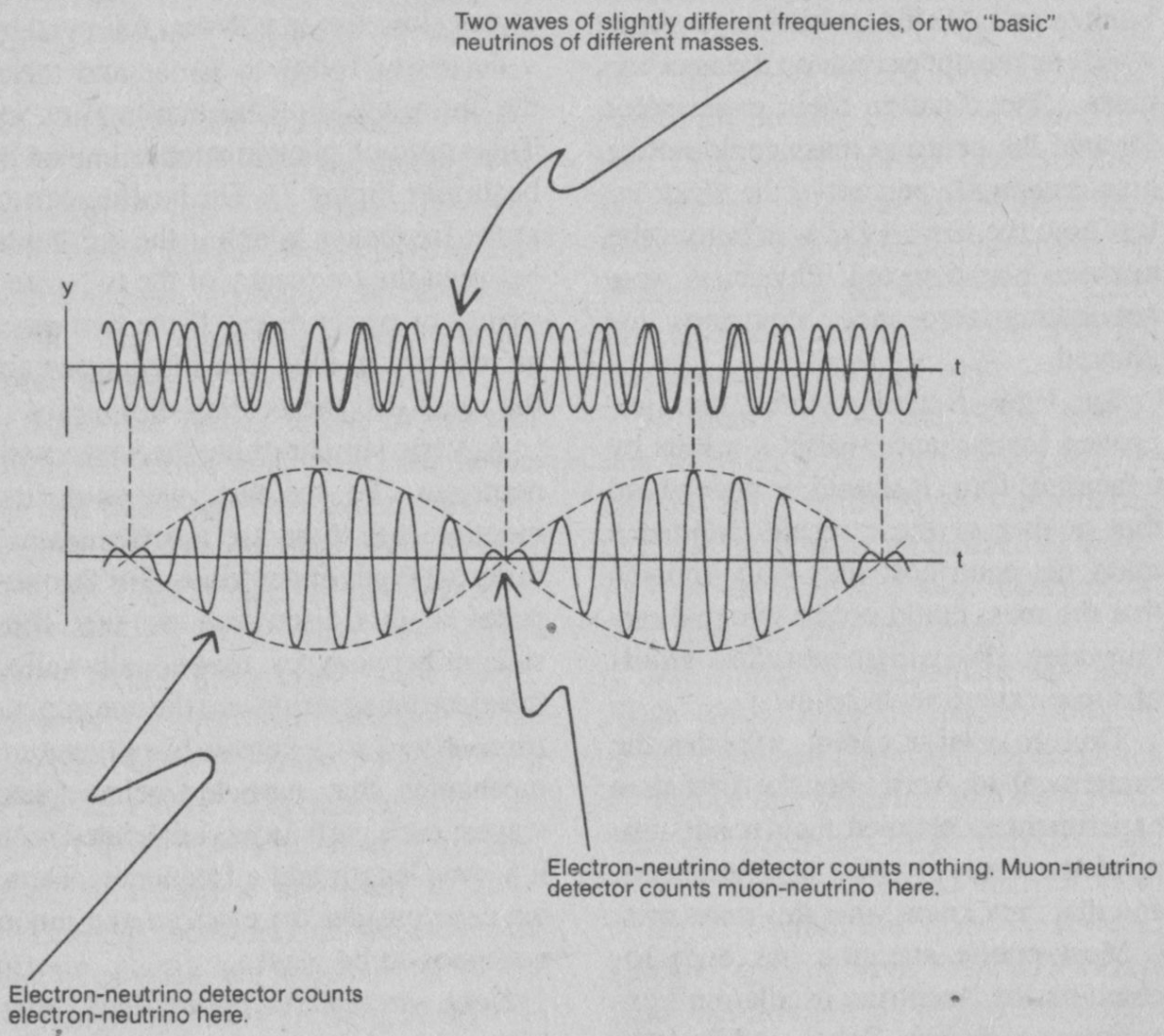


FIGURE 3.

The phenomenon of beats. Two sound waves of slightly different frequencies combine to produce a third wave with a beat rate given by the difference of the two original frequencies. A similar phenomenon occurs with neutrinos. Two basic neutrinos beat together to form an electron neutrino. Schematically, an electron-neutrino detector would detect the electron neutrino when the amplitude is large. When the amplitude is small the electron-neutrino detector would not record any neutrinos, but a muon-neutrino detector would.

and the electron-neutrino detector none. Thus, electron-neutrinos are changing into muon-neutrinos and back again. This phenomenon is the so-called neutrino oscillation.

The above analogy is actually quite close to the real story. We assume that the ordinary electron- and muon-neutrinos are composed of two more basic, unobservable neutrinos which are beating together. Now, we know from quantum mechanics that the frequency of a

particle's wave is a measure of the particle's mass. (This isn't quite correct but will do for the purposes of this discussion.) Thus, the beat frequency, which is the difference in frequency between the two basic neutrinos, is really the difference between their masses. If the masses of the two basic neutrinos were zero, their frequency difference would be zero and there would be no oscillations. Consequently, if neutrino oscillations *do* exist, neutrinos are necessarily massive. (Note, however, that the converse is not true: lack of oscillations does *not* imply massless neutrinos. The neutrinos could have the *same* nonzero mass and the beat frequency would still be zero.)

Reines *et al.* claim to have detected such oscillations as follows: They placed a detector near a nuclear reactor which was emitting electron-neutrinos (technically, electron *anti*neutrinos). In the detector two reactions could take place, the first of which could use either the muon- or electron-neutrino, the second of which required the electron-neutrino. If the electron-neutrinos were changing into muon-neutrinos, the rate of the second reaction—which required the electron-neutrino—would go down relative to the rate of the first reaction. This behavior is, in fact, what the Reines group has reported observing.

Unfortunately, although a CERN group performing a similar experiment feels that neutrino oscillations may exist, a Caltech-Grenoble-Munich collaboration has failed to confirm Reines's results. In addition, analysis of the data by Feynman and Vogel has resulted in a controversy over whether the data is as good as originally claimed. In light of these criticisms, Reines has evidently revised his original paper and the revision has been published in *The Physical Review Letters*. At the time of this writing, no one is in a position to say for certain whether neutrino oscillations really exist.

Recall that the beat frequency depends on the differences in mass of the basic neutrinos. Thus, although the existence of oscillations requires the neutrinos to have mass, the frequency of oscillations does not specify the individual masses, but only a mass difference. To actually determine a number for an individual neutrino mass, one needs a different type of experiment. It is the experiment performed by the Soviet team of Lyubimov, Novikov, Nozik, Tretyakov, and Kosik which has actually claimed to put a value on the neutrino mass. Interestingly enough, their experiment is just a refined version of that of Langar and Moffat and Bergkvist: all nothing more than a highly accurate measurement of the beta decay spectrum, in particular the beta decay spectrum of tritium.

We are already well acquainted with this spectrum from Figure 1. This figure was drawn for massless neutrinos. If we now assume the neutrino has a small mass and calculate what the spectrum should look like, we arrive at Figure 4. We see that the two spectra look almost identical but for a departure at the high energy end. The departure is not difficult to understand. More energy is required to emit a massive neutrino than a massless one. This energy must come

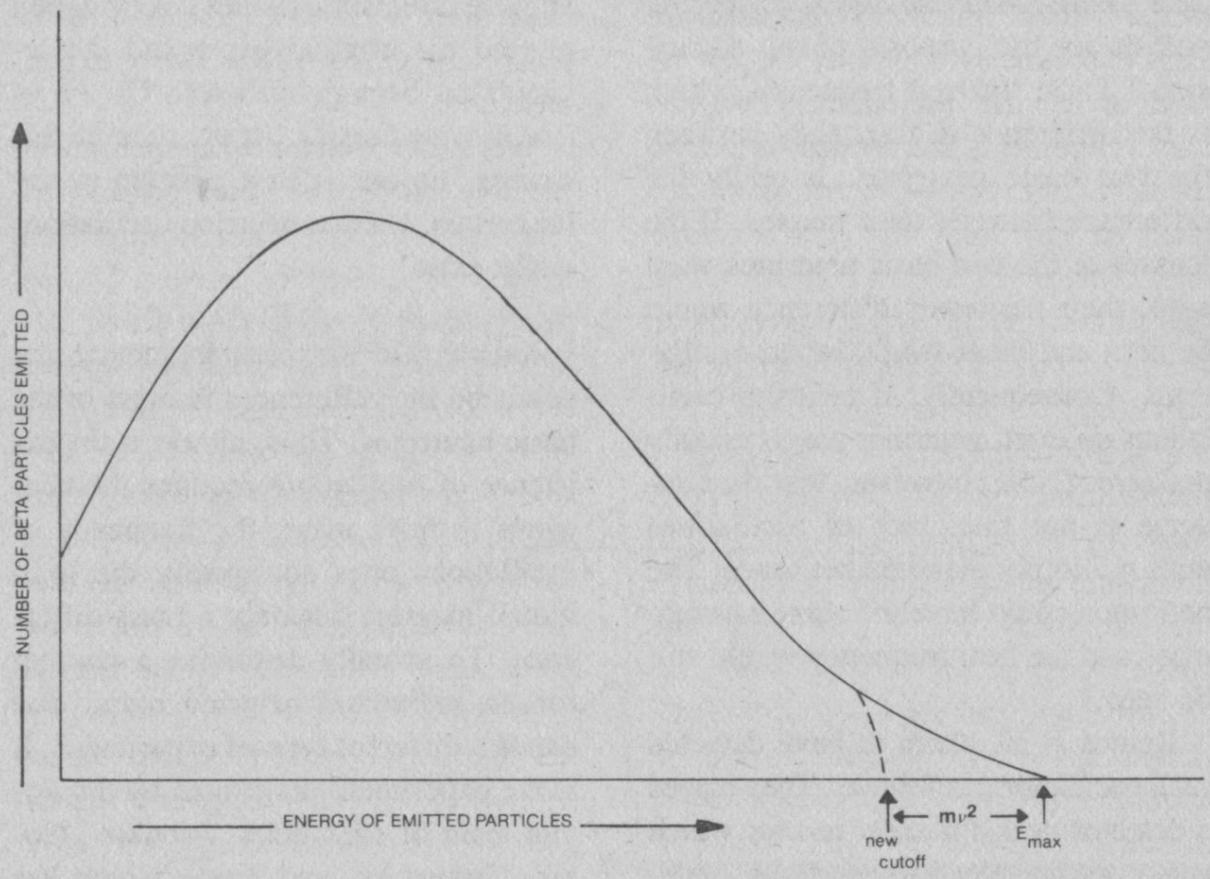


FIGURE 4.

A beta decay spectrum showing the effect of massive neutrinos at the high energy end. The cutoff point has moved down from E_{max} to $E_{max} - m_\nu c^2$. The shape has also distorted slightly. The effect as drawn here is greatly exaggerated.

from somewhere and so is taken away from the electron. Recall that previously an electron emitted with energy E_{max} usurped all the decay energy available and left none for the massless neutrino. If, however, neutrinos are massive, the neutrino must then be ejected with an energy corresponding to at least its rest mass, m_ν. This means the electron, which formerly received E_{max} worth of energy, now only gets $E_{max} - m_\nu c^2$ worth. The upper end of the spectrum has thus been shifted by an amount corresponding to $m_\nu c^2$, the rest energy of the neutrino. This shift is indicated in Figure 4. (The reader might wonder why the entire spectrum has not been shifted to the left by the same amount. To answer this, one must look at the equation which quantum mechanics say describes the spectrum. This equation also shows the distortion of the spectrum for energies near E_{max}, shown in the figure, in addition to the shift already mentioned.) The job for the experimenter then is simply to determine whether the spectrum looks like Figure 1 or Figure 4.

We should not, however, leave the reader with the impression that these are easy experiments. In order to get the kind of accuracy required, extraordinary refinements are needed in the apparatus. For example, the tritium source must be no more than one molecule thick. Otherwise, electrons emitted from the bottom of the source would lose energy just by traveling through the tritium sample. This energy loss would be mistakenly interpreted as the mass of the neutrino. In addition, sophisticated focusing techniques are employed to make sure *all* the electrons emitted from the extended source will reach the Geiger counter. Otherwise, too few electrons will be counted to gather sufficient data. (Anyone who knows a bit about the theory of mass spectrometers should ponder the difficulties in this.)

The Soviets, who have been making these measurements for the past five years, claim their observations put the mass of the neutrino between 14 and 46 electron volts. Here, we are using the standard physicist way of talking about the mass of elementary particles—in electron volts, a unit of energy. One electron volt corresponds to a mass of about 10^{-33} grams. Hence, the mass of the proton, which is about 10^{-24} grams, is also about a thousand million electron volts. The mass of an electron is about 500,000 electron volts.

We see that, even if neutrinos do have a mass, it is fantastically small, roughly one ten-thousandth the mass of an electron. If a new type of penny were minted from neutrinos instead of copper, one would require a face value of $1,000,000 of them before their weight equaled that of a standard Lincoln head. Here then is another indication of the sensitivity of the tritium decay experiments.

We might wonder what such an incredibly small mass could possibly affect. At first glance there does not seem to be much difference between 14 electron volts and zero electron volts. Yet, it turns out, as always, that big surprises come in small packages. The rest of this article will be devoted to exploring some consequences of massive neutrinos.

One immediate result of the neutrino oscillations themselves is a partial explanation of the famous "solar neutrino paradox." The puzzle is simply put: conventional theory predicts that the sun should emit a certain number of neutrinos, while experiments by Davis *et al.* on earth observe one fifth to one third the predicted number. What is so paradoxical is that the experiment seems sound and the theory seems to be correctly applied. We should mention, however, that some physicists feel the experiment is not quite as accurate as claimed, while others feel the theory is incorrect. If either is the case, the "paradox" dissolves. If the paradox is genuine, an explanation must be found outside conventional solar physics. Many colorful hypotheses have been advanced: the sun does not burn by nuclear reactions; neutrinos are unstable and decay enroute to Earth; a black hole resides in the sun's center, presumably capturing neutrinos.

Neutrino oscillations are a natural solution to the paradox which allows us to both keep the sun as we know it *and*

experiment. It turns out that the detector used by Davis *et al.* in their heroic experiment can only detect electron-neutrinos. But if electron-neutrinos are spending half their time as muon-neutrinos, then the detector is only half as likely to catch them. (Notice: this reasoning is similar to that employed in the Reines experiment.) In consequence, the recorded neutrino flux is only one-half the true value. This correction brings the experiment closer to the theoretical value but does not fully close the discrepancy—especially if there really is a factor-of-five difference. So it seems after all that neutrino oscillations may be only a partial solution to the paradox and another mechanism will have to be found for a full resolution. Perhaps the answer is that there are oscillations among more than two types of neutrinos.

Apart from their influence on solar physics, it is doubtful that massive neutrinos would play much of a role in any process which took place on a scale smaller than that of entire clusters of galaxies, tens to hundreds of millions of light years across. This is because the neutrinos would be moving with a velocity too high to be captured by the gravitational field of a mere galaxy, and would thus pass by this galaxy hardly realizing it was there. Yet the larger gravitational fields of clusters of galaxies would tend to make the neutrinos clump in their vicinity, and effects would be noticed.

For a long time it has been known that there is a "missing mass" problem with regard to clusters of galaxies. The orbital speeds of individual galaxies in clusters is apparently too high to be due to the gravitational attraction caused simply by the other galaxies in the clusters. To produce the observed velocities, one evidently needs three to ten times the observed mass. That is, if the observations of the galactic velocities are correct, most of the mass in a galactic cluster is invisible. Since no one has yet directly observed it—the way one can observe a galaxy—the name "missing mass" has been applied to this invisible source of gravitational attraction.

Now, if the neutrino mass is in the range 3 electron volts to 50 electron volts, then the random velocities of neutrinos would be slow enough to allow them to fall into the cluster under the cluster's gravitational pull. As David Schramm and Gary Steigman, among others, point out, these neutrinos offer a very plausible explanation of the missing mass. At least it is plausible if you think massive neutrinos are plausible.

Researchers at the University of Texas Center for Relativity—Charles Evans, Nigel Sharp, and we—have noticed a further effect that massive neutrinos would have on the evolution of a galactic cluster. The process is simple and was discovered in 1943 by the distinguished astrophysicist S. Chandrasekhar. It is called dynamical friction and is closely analogous to the effect of air resistance on an orbiting satellite: say, the ill-fated Skylab. The space station is much more massive than the individual air molecules it collides with, but we all know the final result of such collisions: there are so many air molecules and the collisions occur so relentlessly

that the spacecraft—alas—loses energy and starts to spiral toward the Earth's surface to become the victim of *Time* magazine.

In Chandrasekhar's model of dynamical friction it is not Skylab but an entire galaxy under consideration. Chandrasekhar investigated the effect of drag on the galaxy in question due to the gravitational force exerted by other galaxies in the cluster. Following Chandrasekhar's work, we examined the drag on a galaxy caused by the gravitational attraction of any massive neutrinos which might be in clusters. If the total mass of these neutrinos in galactic clusters is great enough, we expect to see very strong evidence of dynamical friction working on the galaxies. Theoretically, the result could be a massive clump in the center of the cluster where all the galaxies—but for a few stragglers—have spiraled in.

Well, real clusters of galaxies don't look like this at all. They are more or less uniform in terms of distribution of the galaxies contained in them. Hence, they cannot contain *too* much mass in the form of invisible small objects, be they black holes, massive neutrinos, or *Time* magazines. How much mass is allowed before the effects of dynamical friction become evident? Roughly enough to explain the missing mass for the clusters which we discussed above. Expressed in terms of neutrino mass, the upper limit is about 10 electron volts per neutrino. This is consistent with both the Soviet experiments and the missing mass estimates, but since it is an upper limit only, it is also consistent with massless neutrinos.

We now turn to the most exciting implication of massive neutrinos—their possible effect on the evolution of the entire Universe. Presently, there is a great debate over whether the Universe is "open" or "closed." We will see the question is not so simple as commonly supposed and that the addition of massive neutrinos does not make it any simpler.

The General Theory of Relativity allows for many possible universes. The so-called standard cosmology is the well known Big Bang model: the Universe began sometime in the past at arbitrarily high temperatures and densities. Since then it has been expanding and cooling down. Its expansion has also been slowing down due to the gravitational attraction of all its constituents—galaxies, dust, hydrogen and anything else. The question is whether the Universe is slowing down enough to eventually recollapse in the Big Crunch or whether it is expanding with a velocity greater than the escape velocity of the system, in which case the Universe will expand forever. The former case is called a "closed" universe, the latter an "open" universe.

The question of whether the real Universe is open or closed can only be settled observationally. There are several avenues of attack, all of which have several levels of complexity. One can first measure the Hubble constant, a number which relates the distance to a galaxy to the velocity with which it is receding from us. This in itself is a difficult measurement because distance measurements are difficult, and it is unclear whether the constant is known

to better than a factor of two. The Hubble constant is also a measure of the gravitational potential energy needed to stop the Universe from expanding. Consequently, once the Hubble constant is known, we can calculate the amount of matter needed to close the observable Universe. This theoretical value is given the label "critical density." The next step is experimental: we must decide whether the density of matter in the real Universe is greater than the critical density. If so, the Universe is closed.

This determination can be made by counting up all the material mass—the stuff in galaxies, typically—and deciding whether it exceeds this magic number. But this method always errs on the side of too little mass because there must be *some* invisible mass out there that was not counted. Nonetheless, most studies of this sort indicate the density of the Universe is roughly twenty times too little for closure, if one accepts the Hubble constant as being a certain value. On the other hand, P. J. E. Peebles has recently claimed his studies of galaxies indicate there may be almost enough mass contained in them to do the trick.

A second method is to measure the so-called "deceleration parameter." Because of the finite time needed for light to traverse the Universe, the light we see from distant galaxies was emitted earlier in the history of the expansion than light emitted from nearby galaxies. We can measure the velocities of recession of each of these galaxies by observing its redshift. By comparing velocities of distant galaxies to those of nearby ones, we can thus determine by how much galaxies have been slowing down over the last few billion years. If the amount of deceleration is greater than a certain critical number, the Universe is closed. This measurement is fraught with difficulties and, at the present time, measurements of the deceleration parameter cannot be used to say anything about the closure of the Universe.

There is yet a third method by which to decide the question. This method hinges on the ability of theory to calculate the nuclear reactions which presumably occurred shortly after the Big Bang, when the Universe was about three minutes old and its temperature was one thousand million degrees Kelvin. If we assume that the elements currently observed in space were all formed in the Big Bang—with later contributions from nuclear processes in stars a minor correction—then we can compare theory with experiment to deduce some of the properties of the Early Universe. We find, most importantly, that in order for the theory to produce the observed amounts of cosmic deuterium, we are forced to two significant statements about the Universe.

The first conclusion is that there must have been about 10^9 photons for every proton at the time of element synthesis. This conclusion is important because it implies the number of neutrinos is also about 10^9 per proton. Because the number of neutrinos has not changed since that time, nor has the number of protons, there are still at present 10^9 neutrinos per proton, or about 200 neutrinos for every cubic centimeter of space. The second conclusion is that the density of

ordinary matter is now much less than needed to close the Universe, by a factor of 15 to 50, depending on what value of the Hubble constant you choose to believe.

As in most astrophysics problems, there is some dispute about these conclusions. Recently, there has been some sharp criticism leveled at the standard model by Stecker, who claims that it is fundamentally inconsistent. Thus, it cannot be used to predict the deuterium abundance. Furthermore, and perhaps farther out, work by Zel'dovich *et al.* and by us shows that small black holes exploding during nucleosynthesis would completely change the above conclusions. Specifically, the observed deuterium could be produced even if there *is* sufficient matter to close the Universe. Because the possible presence of black holes adds such complications to the deuterium question, most researchers assume—without direct evidence—that the black holes were not there. This may or may not turn out to be justifiable. Only further research will tell.

The previous arguments, which are already complicated enough, were made under the assumption of massless neutrinos. It is on this littered stage that we now consider the opposite case: neutrinos with rest mass. As a recent award-winning essay by Schramm and Steigman emphasizes, the open Universe conclusion drawn from the deuterium argument—even without black holes—cannot now be taken at face value. What changes? The statement that there must be 10^9 neutrinos for every proton remains valid. However, the previous estimates we have mentioned indicate the probable neutrino mass is roughly 10 electron volts, or 10^{-8} times the proton mass. This, then, implies that the Universe contains ten times as much mass concentrated in neutrinos as protons. This may be just enough to bring the matter up to critical density and thus close the Universe.

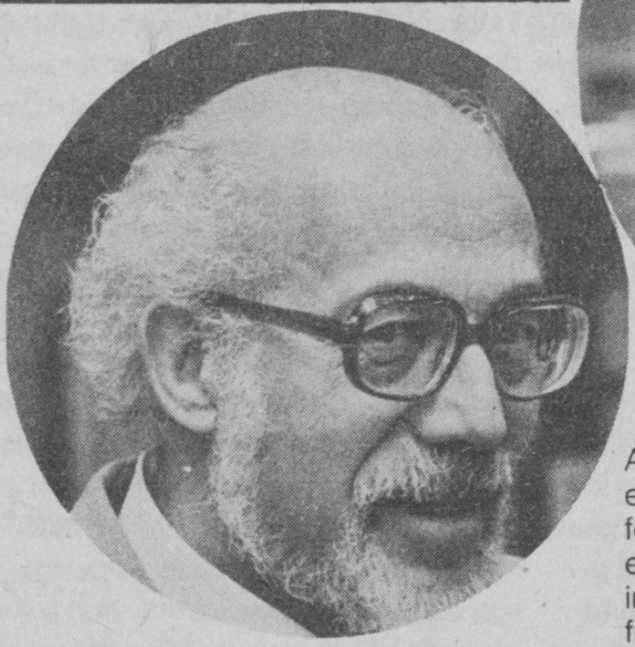
We have belabored the debate to show that the question of openness or closedness of the Universe is not a simple one. The answer depends, as we have seen, on the amount of matter in galaxies, on the cosmic deuterium abundance, on the value of the Hubble constant, and maybe even on black holes. The Universe may even be closed without the addition of massive neutrinos, although most studies indicate the contrary. Indeed, some studies indicate the Universe is so open that perhaps even massive neutrinos will not close it. The question is obviously a difficult one which may not be resolved for some time. In any case, those who thought the debate was closed are now forced to reopen it.■

● Let both sides seek to invoke the wonders of science, instead of its terrors. Together let us explore the stars, conquer the deserts, eradicate disease, tap the ocean depths, and encourage the arts and commerce.

JOHN F. KENNEDY

Jay Kay Klein's

BIOLOG



Milton A. & Tony Rothman

As Isaac Asimov never tires of telling us, the Golden Age of Science Fiction was ushered in with the July 1939 issue of this magazine, in which he and A. E. van Vogt appeared for the first time. A month later Robert A. Heinlein and Milton A. Rothman also appeared for the first time. The latter published under the pseudonym of Lee Gregor in collaboration with Frederik Pohl. While the others continued to write for a living, Milton went on to experimental work in fusion, only occasionally producing fiction or popular scientific articles. Before retiring from a lifetime of university teaching and advanced research, he participated at the Princeton University Plasma Physics Laboratory in developing the Model C stellarator, which led to the present-day tokamak designs.

Born and raised in Philadelphia, Milton first majored in chemistry at the city's College of Pharmacy and Science. He switched to physics in graduate school, receiving an M.S. and a Ph.D. at the University of Pennsylvania. In between, he attended George Washington University and Oregon State College, receiving a B.S. in electrical engineering. All along, he was one of the leading science fiction fans, managing the singular feat of being chairman of two world science fiction conventions, at Philadelphia in 1947 and 1953. Retiring two years ago from a professorial chair at Trenton State College, Milton started to write fiction and popular articles again, and a year ago joined the staff of Philadelphia's Franklin Institute to work on the documentation for inspection and licensing of nuclear power plants.

Now appearing in print as well is the second generation of scientific and science fiction-writing Rothmans. Tony is following in his father's footsteps, with a B.A. in physics from Swarthmore and a semester of advanced mathematics at Cambridge. He is now completing work for a Ph.D. at the University of Texas Center for Relativity. He also has studied at the Leningrad State University to perfect his Russian, which has become quite good following several extensive trips to the Soviet Union and a summer in Afghanistan. He had considered a career in music to become a professional oboist, as well as the possibility of professional sports (he turned down an athletic scholarship in fencing offered by an Ivy League college).

Like his father, Tony has been writing science articles for both *Analog* and *Isaac Asimov's Science Fiction Magazine.* He too has a fondness for science fiction, publishing a novel, *The World Is Round* (Del Rey, 1978).

THE ANALYTICAL LABORATORY

Once again, thanks to all voted on our 1980 stories. Your numbers weren't much different from last year, and our numbers are somewhat smaller, so I think we'll stay with an annual poll. But this feedback is extremely helpful to us and ultimately to you, so please keep voting when we ask you at year's end.

We again used the scoring system in which, in the initial tally, a first-place vote counted as three points, a second as two, and a third as one. The final scores (such as those reported below) were normalized to a scale of 0 to 10 by dividing each entry's total score by the score it would have had if everybody had ranked it in first place, and multiplying that fraction by 10. Thus, in general, a higher score indicates higher popularity, within a single category. However, you should note that this method causes scores to tend to be lower in categories with large numbers of entries. To help you make allowance for this, I've indicated in parentheses after the name of each category the score each item in that category would have received if all had been equally popular.

As usual, serials caused a bit of confusion: a few of you voted for *Shuttle Down*, even though only one instalment appeared in 1980. We'll try to remember next time we announce the voting to specify that *Shuttle Down* really belongs in 1981, and anything we may have under-way at the end of this year should be voted on next year, when it is completed.

The results:

Serials (5.00)

1. *One-Wing*, Lisa Tuttle and George R. R. Martin (6.47)
2. *Anasazi*, Dean Ing (5.84)
3. *World in the Clouds*, Bob Buckley (4.97)

Novelettes (including novellas) (0.83)

1. "Nightflyers," George R. R. Martin (3.68)
2. "The Cloak and the Staff," Gordon R. Dickson (2.33)
3. "Savage Planet," Barry B. Longyear (1.89)
4. "Scholar's Cluster," George O. Smith (1.25)
5. "Have You Heard the One . . . ?", Spider Robinson (1.15)

Short stories (0.65)

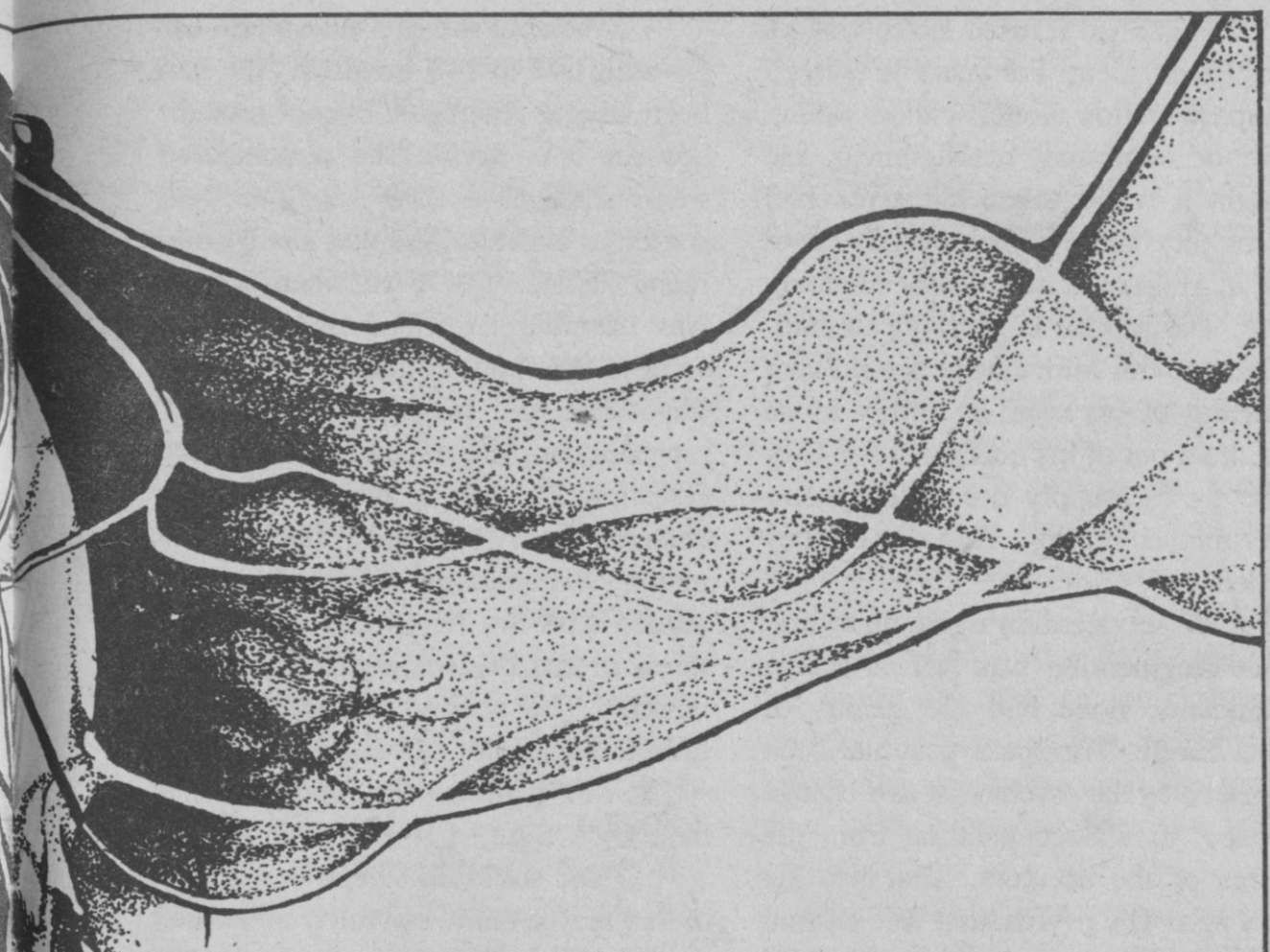
1. "Grotto of the Dancing Deer," Clifford D. Simak (2.86)
2. "The Touch of Their Eyes," Steven Gould (2.19)
3. "The Bully and the Crazy Boy," Marc Stiegler (1.35)
4. "Meeting of Minds," Ted Reynolds (1.16)
5. "Scrooge in Space," Sam Nicholson (1.13)

Articles (1.54)

1. "Demythologizing the Black Hole," Richard Matzner, Tsvi Piran, and Tony Rothman (3.09)

Continued on page 104


Artifact
Studios



Jayne Tannehill

LAST WORDS

There are times when security looks most inviting.
But those times, too, must end...

James Engle had refused to see visitors since his accident. For years he worked the space station alone, without taking leave or requesting reassignment. He thought it was a token job given him out of pity and he resented having to take it. He would not beg for anything more. The service kept trying to communicate with him, but he would shut them out of his mind as firmly as he shut them out of his quarters when they came by for supply drops. The computer relayed reports. That was all they needed.

But the service didn't give up trying. Space Engineering was full of design technicians; none had the genius of James Engle. The space post had been suggested by the psychiatrist as a change of pace, to aid recuperation from the trauma of the accident. That was six years ago. The psychiatrist had assured the powers-that-be that unpressured time alone, with simple tasks, would help the designer get back his creative urge. Engineering was getting impatient. Now willing to try anything, they had approved a visit by a civilian who claimed to be a friend of the family.

Engle sat opposite the old man he barely remembered from his childhood. Morey Todd had requested permission to come aboard and then his ship had docked at the space station before Engle had time to decide to refuse. Now the old man would not stop talking.

"Let's see now, when did it begin? I'd say your mother was about thirty-two at the time. She lived with your father then. Yeah, you were just an upstart then, Jimmy. Your mother, she was my philosophy teacher. My, my, that was a long time ago.

"I remember the first time I told her I would live to two hundred. She had been talking about past lives. I remember she was saying she remembered when she was a slave, and we both started to chuckle. She was always into racial justice raps, even when no one was listening. A friend of mine said something about reincarnation being impossible and she started in on cell reproduction; she mentioned that every cell replaced itself so that all our cells changed every few years. Mini-reincarnation, she called it. I remember Skip argued with her for awhile and then I threw in that I was going to live to two hundred. He scoffed at me. But she didn't. She didn't say anything.

"I don't think she believed me then. . . . Sure, I'll just help myself . . . . No, she didn't believe me. She didn't really know anything about cell reproduction. She just repeated what she heard. She had her gaps in knowledge, but she didn't let them show, not often, not to everyone . . . . This isn't bad. I suppose you get used to the inconvenience. . . .

"She was a rebel then. She used to come into class and throw a fit, just to wake everybody up. She got off on all of us eating up every word, just because we felt so bad about her being upset. It was an act. And I remember how annoyed she was with me when it didn't work on me anymore. I always thought it was a waste of time; she had enough charisma to make it without the show. But maybe she didn't know that. She didn't use her power very effectively then.

"I remember she introduced me once as the student who was going to live to

be two hundred. That was to the next guy she married. I remember he asked why I was planning to stop at two hundred. I think he was serious. I know it was only a couple years later before she learned about longevity. She wrote me once: 'If between one hundred and thirty-five and a hundred and fifty you decide you'd like an older woman for a change, look me up.' She must have known something by then.''

Engle watched as the old man slid withered hands over the hard plastic and metal arms of the chair, his eyes distant, searching for memories that would increase the accuracy of his tale.

''Yes . . . she must have known something by then. Let me see now, that must have been back in the early eighties. They were doing a bunch of research on longevity pills then. And the yogis were still teaching people how to stop aging. They started that on the west coast back in the sixties.

''Yeah, I think he had to be serious. He must have known about it even then, her husband. She didn't, though. I'm pretty sure of that. Your mom, I mean. She kept talking about adulthood and maturity in all the old ways. —No, I'd prefer water . . . miss that the most out here. I really don't think she knew. Not then.

''Funny, nobody asked me how I was going to do it, live to two hundred, I mean. I guess that goes along with not believing I was serious.

''It wasn't really a decision for me, Jimmy, any more than it is for you. I didn't take any pills or do any exercises, and I don't suppose you did either. . . . Didn't think so. As for me, I just knew by the way I was growing that I'd never get to adolescence till I was thirty. I didn't hit my stride, if you know what I mean, until I was close to fifty. So it only seemed reasonable I'd live to at least two hundred. After all, a man's entitled to use what he learns, isn't he?''

The old man winked at Engle and wagged his arms as if to nudge James in the side, but James was not beside him. The gesture remained isolated in the space between them.

''I tried to be a part of that freaky society. I tried to think the way they did, learn their special words, let me see . . . lang? . . . no . . . slang, that's what they called it, that fouled me up. You never did that, so you just slid through. She gave you that, your mom, I mean. She must have known that much about it anyway, that how you think determines how long you live.

''Or maybe she just figured she was raising you to think for yourself. Maybe you just skipped all the social stuff like monogamy, and social rituals, and raising kids to be copies of yourself, and the family unit, and insurance; maybe you just never picked up on those thought patterns. I always thought she'd laid the new patterns on you, but maybe you got them yourself . . . Do you ever feel cramped up here? . . . Yeah, but that's out there. I guess I just don't adjust to small places very easy. Feel like taking a nice long walk. . . . What was I saying? . . . Oh, yes, patterns.

''Come to think of it, she didn't know how those things worked back then, herself. You'd have been close to say twenty or so before she got that straight in her own thinking. So I guess you came by it yourself.

''I guess you don't remember much

of what it was like to be programmed the old way . . . No . . . I used to laugh about it a lot. People used to figure I'd latch onto one of my classmates and promise to be true till death parted us, and raise a family. And I was supposed to be concerned about whether this one liked me or that one didn't. I remember they used to make a big fuss about whether the classmate you liked was a boy or a girl, too. As though that made any sense to me at that age.

" 'Course everyone dressed alike so it was a real challenge to figure out which one qualified, but they seemed to have a code they followed. I think it had something to do with voice and movements and body parts. They were really interested which body parts were the most prominent. It all seemed silly to me, at the time."

The old man shook with silent laughter, amused at his own memories, images of himself that Engle saw as he pictured them, but did not share significantly. Engle waited for the laughter to subside.

"Silliness, all of it. But I tried to play their games; you never really were exposed to them. We'd changed the patterns a little more by the time you had to deal with them. . . . Don't you get lonely up here? . . . Back there, did you have a woman? Family man? No, I suppose by the time you came along we'd enough of a perpetual population going we dropped the obligatory family programming. Oh, sure, there was the surge of cloning and test-tube growths in the eighties and nineties, you remember that, and then having a child became such a rarity that it was suddenly given the reverence it deserved in the first place. I remember when I was a hundred and twenty being given the honor of watching a baby's slumbers, to guard it if it waked. I got my four-hour shifts every night for a year. Those hours are some of my fondest memories. What faces those little tykes make as they sleep! And once the child waked and I got to look into those copper eyes for a few minutes. I wish I'd known the art. I'd have loved to know what it was thinking.

"Your mom now, she had all the old programming. It was a real fight for her. She was into monogamy when I first met her, even if it was serial monogamy. Even by then she'd had three husbands. But she did it one at a time. It wasn't till the mid-eighties or so that she really got into oligamy. She had the ideas before that though. She used to talk about everybody responding to a whole matrix of people, but only choosing to express their love physically to one. She was aware it was a choice, but it took her awhile to realize that people didn't have to make that choice: that they only got into the choosing pattern because they were programmed into fidelity.

"I'll bet you don't even remember what jealousy is, do you? That was an old die-hard. You'd think with all the hell it gave people they'd have dropped it first. But it was the last barricade that had to go. Your mom was on to that early. She used to talk about how unnecessary jealousy was way back when I was in her philosophy class.

"She tried to teach you social rituals though. I remember a few of those attempts. For instance, she kept wanting you to say good-bye to people. What

a useless piece of dialogue! As though you were ever away from people just because they were out of sight or out of the body or off planet! I never could understand that one myself. But I said the words and smiled. You never did get into that trap.

"Oh, and she warned you in the most obtuse way ever about not talking to strangers; as though anyone could mislead you after you had probed them. But I guess she didn't know how to do that. She learned it later on. I remember the first time she probed me. It was like the rest of our friendship came into focus at last.

"I didn't see her for a long time. I got interested in telekinetic transmissions and she was into standard electronic and prototype transmissions. She wrote one of the books that's been transcribed for the archives. . . . Oh. I thought you knew that. . . . Yeah, she focused on a lot of the new technology that was trying to manufacture the future.

"That's how she found out about longevity pills. And it was only in character that she volunteered for the experiments on humans. They kept experimenting on animals and getting mixed results. For that matter, some of their work with humans didn't work either. Your mom pointed out that they needed to combine the pills with training in new ways of eating, living, and thinking; especially thinking. Oh, they knew it before she crystallized it. But the volunteers didn't know how to go about it. It's quite a change to think in three- or four-hundred-year gaps instead of decades. At least for people locked into old patterns.

"I hadn't seen her while she was teaching in the clinic. In fact, it was after she left teaching altogether that I saw her again. She had taken up juggling and was working in a small-time circus. She was in conjugation with two of my friends at the time. I'd just turned a hundred and thirty-five, so she must have been close to a hundred and fifty. But then, she'd always been good at predicting the future. That one amused her more than most of her hits . . . no, about the letter she'd written me . . . no, about looking to try an older woman . . . yeah, that had been a joke when she wrote it. Anyway, I joined the marriage mainly to be with her for a while. And that tripled the size of the conjugation because I brought with me a marriage of eight."

There was a long pause while the old man again drifted in memories. James watched him, still disinterested, a little annoyed at the intrusion. He wanted to tell him to leave, but he still didn't know why he'd come. Only curiosity kept him listening, waiting. The old man began again.

"When your mother left the body last year, she asked me to look you up. She knew you'd been following her patterns for over a decade. But she wanted you to have this, and she was never sure of her sending. She had to confirm hits on telepathy right to the end. It wasn't one of her strong points. I was never a good sender either. I've always depended on words. I guess that comes from being raised in a technological communications network. I'm a pretty good receiver though, which comes in handy now that my hearing isn't what it was. But I must sound like I'm babbling to someone like you.

"Jimmy, the main reason she insisted I come out here was to make sure you understood. Sort of her last words to you. That was an important ritual to the old ones.

"She wanted you to remember about words. Their importance. Not just ideas—the specialness of the words themselves. She used to say, there are no synonyms, no two words that say exactly the same thing. That's why she loved them so much. She even used to read dictionaries.

"Your mom once read a book that said the two things that made us human were our hands and our speech. She told me our hands allowed us to develop technology and art forms, and speech let us get cultured. That's why she was always proud of the things you made. She'd watch your fingers play over the circuits or over the metals with the same delight most people get from watching a musician or a sculptor. She said it sort of made up for your silences. But that's what worried her, after your accident, that you wouldn't have anything left, no way to let out the art magic in you. Not having your hands anymore.

"She said, your mom, I mean, that a long time ago, before you got into thought transmission and got so good at it, way back then, you used to recite plays and poems and things like that. She said you learned lines faster than any of the actors she ever worked with. She wanted you to know you could do it again. She had an old recording, the most recent one she made when you were a kid. It's in the box there." He pointed to the box he'd set down when he came in. "She thought it might help if you could hear your own voice, help you get started learning speech again. Maybe you could inspire people with your voice as much as you have with your designs and craftsmanship.

"It isn't hard, Jimmy, talking I mean. Oh, your throat gets dry sometimes, and it's a lot slower. And some people figure it's a waste of time. But the vibrations are great. Like music, if it's done well. . . . Yeah, I know, but it's becoming a lost art. There hasn't been a new play performed in years.

"Anyway, Jim, think about it. It was real important to her. I think she thought it might give you back some sense of your uniqueness . . . mothers are like that.

"It's been good to talk with you this afternoon. I'm sorry I had to intrude on you this way, but it sort of relieves me of my responsibility to your mom. She's very proud of you. But I suppose you know that already. . . . Yeah, but it's nice to hear it anyway . . . I know.

"Jimmy . . . I know you didn't want me to bring up the accident and all . . . I know, you've kept people away because of that . . . okay, I'm leaving . . . but keep the box, son. And think about it."

The old man slid through the tunnel to the hatch of his own craft. He grabbed hand-holds as he drifted, not trusting his own momentum or his orientation.

Engle sat alone as the shuttle closed the tunnel and disengaged. He monitored the board lights as they signalled each step of the procedure, sealing his world once more against intruders. He watched as the ship drifted slowly away.

Before him on the console sat the small black box. He was familiar with

the voice transcriber. He'd played with one as a child. He had forgotten the recordings his mother had made. Forgotten the play rehearsals. Forgotten.

There was silence around him once more. Silence that was comfortable, familiar, customary. He let the routines put him in motion, the readout here, the adjustment in attitude there, the deposits of waste and rearrangement of supply. Silence comforted him. The box nagged him.

In a few days he glanced at the plastic window and through it read on the disk: "Henry's final speech; *The Night Thoreau Spent in Jail,* by Lawrence/Lee." He puzzled for some reference in memories, found none.

Ground control used the open window of his revolution to request audibly the new observation report. Without responding personally, Engle switched on the computer readout for automatic transmission. He could not switch off the persistent voice from the ground, but he did not have to listen to it. He could return to his quarters, return to his chores, maintain the simplicity, the naturalness of his routines.

After a week, he found he was resting his metal tongs on the black box every time he passed the console. He decided to move it to a less distracting place, and found a storage bin just large enough to hide it inside. He put it there.

That night he could not sleep. There were no differences in his routine to disturb him. There was just the hidden box.

He chose to end the restlessness and went to get the box from its storage bin. He sat with the transcriber on his lap and investigated its operation, remembering gradually the sequences to activate the sound. A child's voice, not soprano, but not much lower, began the words, pausing dramatically, lisping slightly on otherwise unnoticeable sibilants.

"I may not be there at the 'pond place,' Bailey. Seems to me I've got several more lives to live. And I don't know if I can spare any more time for *that* one."

There was a pause in the recording as though the child were waiting for another voice that was not there to speak the next cue line.

"That's the trouble. If I live there much longer, I might live there forever. And you have to think twice before you accept heaven on terms like that. You ever take a boat trip, Bailey?" There was another pause. "When you buy a cabin ticket for an ocean passage, they give you the liberty of the whole ship. It's a privilege that should be *used*. Man shouldn't stay the whole voyage just in one place, below decks, no matter how dry and cozy it is. And warm. I think I'll have to roam the whole ship. Go before the mast! Stand out there on the foredeck. Bailey, I tried to escape. But escape is like sleep. And when sleep is permanent, it's death." A shorter pause. "I must leave Walden. It's not necessary to be there in order to *be* there."

The recording ended there. The transcriber automatically tested for further recordings on the disk, and finding none, disengaged, ready for the next performance.

*I must leave Walden. It's not necessary to be there in order to be there.**

**By permission of the authors.*

The words formed in Engle's mind as though he were speaking them, even imitating the over-emphasis the child-Engle had placed on the next to the last word.

He returned the box to the console and went back to bed. *I must leave Walden. I must leave Walden. I must leave* . . . the words echoed in dreams, in almost wakings. He woke ahead of schedule. There was nothing in the routine to do that early and he could not go back to sleep. He sat at the console and took the black box on his lap once more. "I may not be there . . ." the child's voice began again, faithfully. Engle listened again . . . found the jarring words again. ". . . Man shouldn't stay the whole voyage just in one place, below decks, no matter how dry and cozy it is. And warm. I think I'll have to roam the whole ship. Go before the mast! Stand out there on the foredeck. Bailey, I tried to escape. But escape is like sleep. And when sleep is permanent, it's death . . ." *It's death . . . It's death* . . . "I must leave Walden . . ." *I must leave Walden . . . I must leave Walden . . . I must leave* . . .

The box stayed on the console for days untouched. But it was not put back into the storage bin. Engle pursued his routines around it, aware of it, but not responding to its presence. In time he forgot that it was there, concentrating on the comfort of his routines, his responsibilities. He thought of it only when a radio transmission from Earth included a vague reference to a computer named "Mother." At the word his eyes flashed to the box.

Once more he picked it up. Once more he activated the controls so that the voice would begin. Once more the words echoed in his thoughts as words. He played it again and tried to recite the words mentally with the child. He missed the timing, missed a word or two. Played it again, then tried again to think the words with the recording. That time he got them. He set the transcriber on automatic repeat and finished some of his maintenance detail with the voice repeating as his thoughts repeated. Then the calculations were due and his attention had to be diverted from the speech. He turned off the box and went to his work absently.

He did not sleep well. There were visions of places he had lived as a child, pictures of places only his mother had told him about, others he'd heard about in school.

When he woke, he tried to remember the words from the play without reinforcing his memory with the recording. His thoughts replayed the transcription perfectly.

And then he tried his voice.

There is a time in the early morning when the window has been left open a little too far and the night has grown colder than the nights before, when a person opens his mouth to answer the telephone and finds he can only growl at the caller in gravelly hoarse whispers that do not resemble his voice. But in a very few moments saliva coats the membranes and the tension returns to normal and one can once again recognize himself. James Engle began in the gravel of unaccustomed vocal cords rising to use after a long sleep. He swallowed and began again, took a drink and began again, finished more of the speech each time until his voice lost the

raspiness and began to respond once more to the conscious direction of thought and will. But his voice never reached familiarity. The voice of the child was no more. And the voice of the adult was as foreign to him as the lands on Earth he had never visited.

He spent the day listening to himself. He selected words that he had heard from the radio transmission, words that he remembered from the old man's visit, words from the speech rearranged in a thousand ways. His throat grew tired. His voice regained the huskiness of the first attempts of morning, and he grew disappointed.

The next day he began again with growls to greet the day, and whispers to summon the night. The third day was easier. The fourth his tongue became less thick and moved more willingly around the air that vibrated into language. The fifth, he radioed Earth.

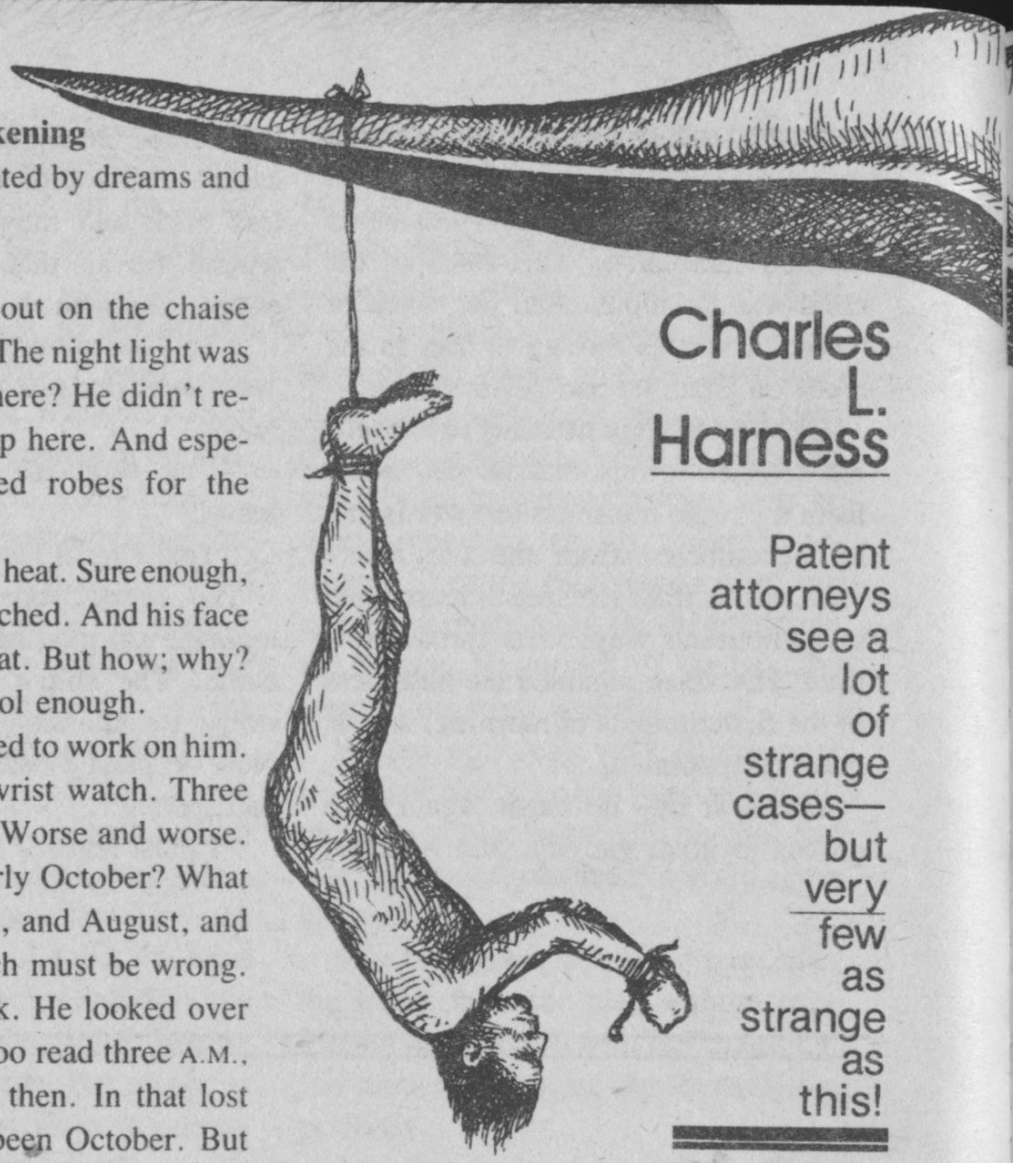
"Tell the admiral 'A man shouldn't just stay in one place.' Tell him, 'I must leave.' "

"You want me to ask him for a leave?"

"Yes. I must leave."

The words were awkward, but the message was transmitted. The rest would come. The ship's transcriber logged every transmission from the station. Now he played back the last words he had spoken:

"I must leave." ■



Charles L. Harness

Patent attorneys see a lot of strange cases—but very few as strange as this!

H-TEC

1. A Rude Awakening

He woke up, disoriented by dreams and nightmares.

It was the phone.

He was stretched out on the chaise longue, in his study. The night light was on. How did he get here? He didn't remember falling asleep here. And especially not in his red robes for the defense.

He remembered the heat. Sure enough, his armpits were drenched. And his face was beaded with sweat. But how; why? The room air was cool enough.

The phone continued to work on him.

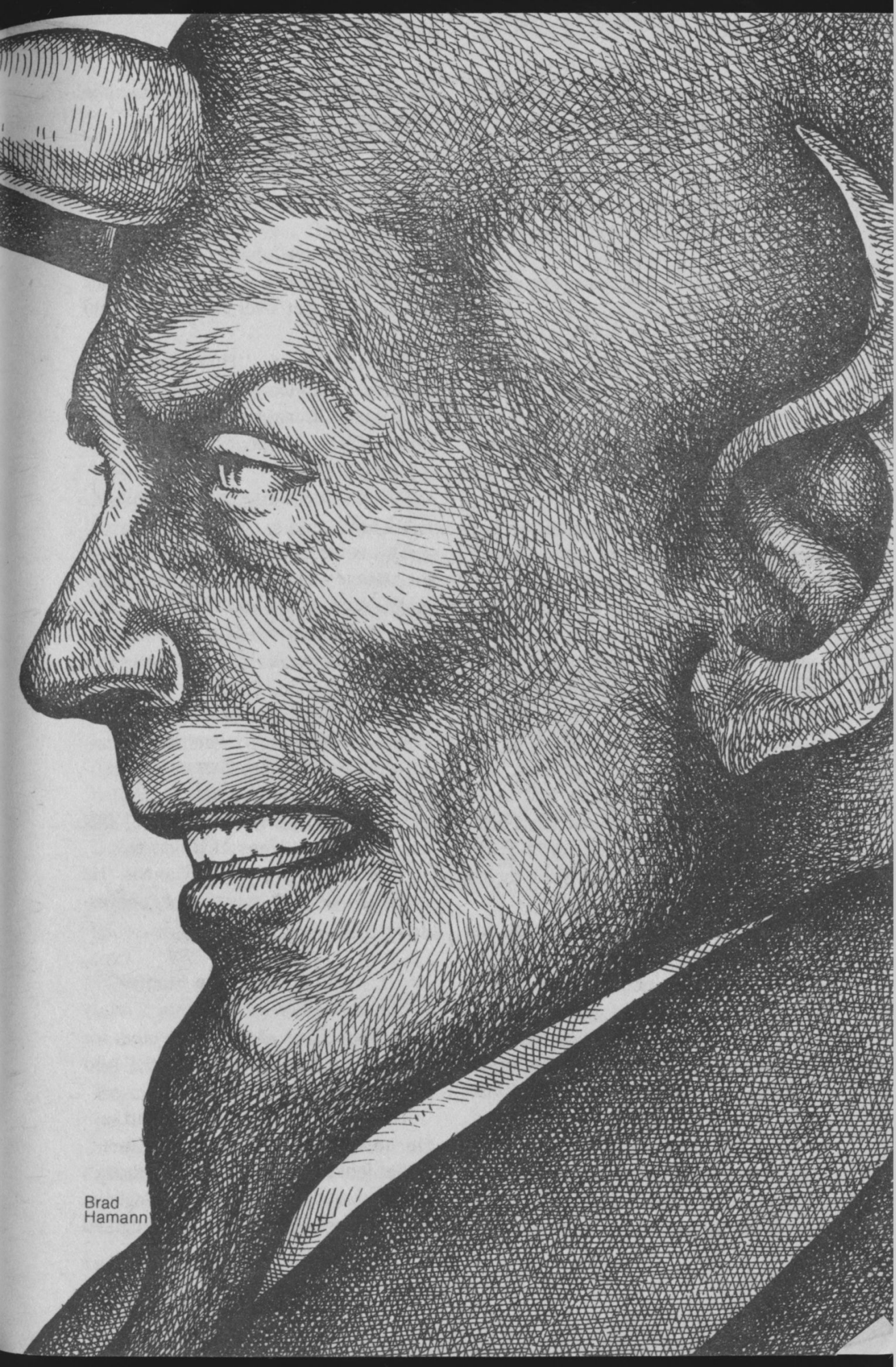
He looked at his wrist watch. Three A.M., June 10. *June?* Worse and worse. Wasn't it actually early October? What had happened to July, and August, and September? His watch must be wrong. Easy enough to check. He looked over at the wall clock. It too read three A.M., June 10. Very well, then. In that lost dream world it had been October. But here, in this room, in the real world, it was June. He had to accept it.

So, how about the phone?

The phone was a voice response unit. If, from where he sprawled, he said, "Quentin Thomas, law offices," the device would open the circuit, more lights would come on in the room, and the automated notetaker would indicate its readiness by a tiny green light.

On the other hand, if he said (perhaps a bit grumpily), "Recorder," the phone would stop ringing, and the caller would listen to: "This is a recording. Quentin Thomas is not presently available. At the sound of the beep, please leave your name and number."

His deepest instincts told him not to answer. That the consequences would be catastrophic. He saw all this with an eerie sense of *déja vu*. He saw images reflected back and forth, as between mirrors within his mind. If he could only *remember*. *Flames*. Was he trying to remember something about flames?


Brad
Hamann

He saw flames dancing. They turned into musical notes. The notes turned into a symphony.

His nightmare was continuing.

The perspiration was evaporating from his clothes, and he was beginning to feel chilled.

With mechanical patience, the phone persisted.

He had to get hold of himself. Well, there was certainly one way to do it.

"Quentin Thomas, law offices," he croaked.

"Quent? Quentin Thomas, the great lawyer?"

"Who are you?"

"Carl Miller. Remember me?"

Carlton Miller! Indeed he did remember! They had been great friends in college. They had played together in the orchestra: Thomas on piano, Miller on violin. Miller had starred in the university's presentation of Tschaikowsky's *Violin Concerto*, and had toyed with the idea of a musical career. Instead, he had done graduate work in physics. His basic patent in synergics had been granted the day he received his Ph.D. (The degree had been delivered *in absentia*. Miller was giving a Bach recital that evening.)

Somewhere along the line, they began to lose touch. Rumors filtered back. Miller was in a recital circuit. Miller had left music and had opened an electronics lab. Miller had gone bankrupt and was in the second violins in the Cleveland Symphony. Miller had married. . . .

And now what?

"Carl," he said, "of course I remember you. How are you?"

"Fine, Quent. I, ah, you might be wondering why I called you at this time of night?"

"It never occurred to me," said Thomas dryly.

"I have a great new invention."

"Ah?"

"You wouldn't believe it. Not over the phone, anyway. You'll have to see it. Can you get over to my lab right away?"

Thomas sighed. "How about after breakfast? Say ten o'clock?"

"I guess it can wait that long. Take this down: 110 Rider Street."

"Got it."

"Now, Quent, just one more thing."

"Yes?"

The voice became diffident. "I had the strangest dream. More like a nightmare. We were in court together. You were defending me. It was hot. Now, Quent, I have to ask a silly question. . . ."

"Sure, Carl, go ahead." Quentin Thomas was suddenly very alert.

"Are you wearing your red robes?"

"Yes," said the lawyer.

"Amazing," mumbled Miller. "Not real, of course. None of it was real."

"See you soon," said Thomas. He shook his head. It was all very confusing.

2. H-TEC Amid the Flames

Carlton Miller greeted him warmly at the door. They studied each other for a moment. "You're looking well," said Miller, almost enviously.

The lawyer didn't know what to say. He couldn't return the compliment. Miller looked worn and gray, as though teetering on the edge of some indecisive mental abyss. Anxious lines corrugated

his forehead and supplemented a tic in his left eye. The lawyer finally said, "Good to see you again, Carl. It's been too long. What have you been up to? Heard you got married. Any children?"

"Married? Ah, yes. Denise is, ah, out just now. No children. Well, why don't we go down to the lab and take a look?"

"Of course."

"This way."

Miller led him downstairs to a big room in the basement. Thomas looked around at the cluttered work benches. The room could have modeled as The Alchemist's Chamber in some old print. He then noticed the musical equipment: A Baldwin upright piano. A violin case (presumably with a violin inside). A covered harp. And around the walls a complete multi-stereo unit. He counted ten speakers of different sizes.

And now it hit him. This room was familiar. But it *couldn't* be. He had never been here before. Nor had Miller described it to him. If he had been here before, there would be a rifle rack over the far door, and in the rack would lie, waiting in icy impassivity, a

Mossberg laser rifle.

And there it was. He shivered. This had to stop. He had to get back on the track. "You've been busy," he said.

Miller seemed to relax a little. "Yes, several things going at once." He walked over to a slate-surfaced table. "I guess I'd better explain why I called you in the middle of the night."

"I *am* a little curious."

"You're familiar with acoustical flames?" asked Miller. "We had a demonstration in freshman physics lab."

"I seem to recall something," said the lawyer dubiously.

"Let me refresh your recollection." The inventor led Quentin Thomas to a lab bench. "Here's a Bunsen burner, with a special narrow tip, about half a millimeter in diameter. Now we turn on the gas . . . and light it . . . so." The flame leaped up. "Not too much," said Miller. "It has to be just on the edge of 'roaring'."

Quentin Thomas pulled out a set of keys and jangled them beside the flame, which began to jump and dance.

"Ah, you remembered," said Miller. He walked across the room to a mahogany cabinet and returned with a violin. He put the base under his chin and pulled the bow across the strings. The flame began to dance again. He lay the instrument aside. "You can do it with just about anything: strings, woodwinds, brasses, tympani, the human voice. All old stuff."

"But you said you had something new?" said Thomas.

"And I do. Watch." The inventor turned back to the flame. Ridges formed on his forehead as he concentrated.

The flame began to vibrate again.

The lawyer watched all this carefully. He refused to believe it. There was a cheap trick somewhere. His old friend ought not to be doing this to him.

The fluctuations faded. Miller turned back to his visitor in triumph. "Did you see?"

"I saw *some*thing," conceded Thomas. "What's the trick?"

"No trick. Psi. Telekinesis."

"*Mental* control? You willed the flame to agitate?"

"Yes. Now, watch again." Miller

brought another piece of apparatus to the bench. "This thing breaks down into three basic components. First, this collimator and lens constitutes a compound photo pick-up. It 'reads' ten areas of the flame and converts them into ten electric currents in this record unit, which feeds to this third unit, an amplifier, which activates ten speakers placed at various points in the lab." He smiled at the lawyer. "You *still* don't believe?"

Thomas shrugged. "I'm listening."

"That's all I ask." He turned back to the bench, flipped a switch on the musical module, and began to stare at the flame.

The sounds of music swelled up and filled the room. Quentin Thomas thought he recognized . . . Strauss? *The Blue Danube? Tales of the Vienna Woods? The Emperor's Waltz?* Indeed, all of them at once! Evidently Carlton Miller 'heard' three waltzes in his head, and he was giving them all to the flame simultaneously! Incredible.

But now Quentin Thomas had to think. Was it sorcery, or was it patentable subject matter? He visualized a hypothetical Claim 1 in a hypothetical patent:

1. The method of forming audio signals comprising the sequential steps:
   a) forming an acoustical flame;
   b) imposing a telekinetic pattern on the flame to agitate same;
   c) exposing said agitations to a photo-electrical pick-up, thereby to translate said agitations into at least one varying electric current; and
   d) converting said current into audio signals.

Hmm. Telekinetic pattern. There's the rub.

The music ebbed away.

Miller turned and looked at the lawyer expectantly. "Well? Can I get that patented?"

"No," said Thomas, gently but firmly.

"No?" Miller was too astonished to be disappointed. "Why not?"

"It requires a mental operation. Psi is a crucial element of your invention."

Miller was silent for a long time. "I see. Too bad. I thought I might raise some money with my singing flame. I need the money for a couple of other projects."

"More inventions?" asked Thomas.

"One is, one isn't. As regards the invention, I have a business partner, a fellow named Victor Higgins. I'd like to buy him out, get rid of him. But I guess it isn't going to happen. Not that way, at least." His mouth tightened into a bitter line, and he looked away momentarily.

He's looking at the rifle, thought Quentin Thomas. Something nasty is afoot. He said, "What's the other project? The non-invention?"

"Ah, *that*." Miller turned back to face him. "It involves my lifetime secret ambition."

"Tell me."

"I will. Let's start with last summer. I was in Vienna, just sniffing around. Just as a start. I visited the Beethoven-*haus* and the Beethoven-*archiven*. And several of the other places where the amateurs and gawkers come. I found nothing."

"What were you looking for?"

"The Tenth, of course," said Carlton Miller. "It is known that he was work-

ing on it when he died. Fragments have surfaced.''

''A Tenth Symphony? You expect to find pieces of paper after two hundred years?'' Quentin Thomas was astonished.

''There are problems,'' admitted Miller. ''And, of course, others have looked. And undoubtedly the scores are pretty well scattered. But, with enough time, money, and effort, a goodly portion of the work can probably be recovered.''

''Indeed!'' murmured Thomas.

''Indeed,'' Miller countered. ''Look at the facts. It is known that he was working on the Tenth in 1825–26. He fell sick in the fall and winter of 1826 and died March 26, the next year. All Vienna turned out for his funeral. The schools closed. Then—horror of horrors—nearly everything he had was promptly auctioned off: his books, notes, sketches, scores . . . God! It was incredible! Some things have been found again, of course, including even a fragment or two of the Tenth, just enough to be tantalizing.''

Thomas waited. He felt shock waves from an overwhelming monomania. He did not know how to respond.

Miller impaled the lawyer with rapier eyes. ''Hundreds of Beethoven scholars have looked for the Tenth. And they all came up with nothing. And yet it's there . . . dancing in front of their eyes, all these years!''

''Where?'' said Quentin Thomas.

''The pallbearers,'' said Miller. ''Eight musicians and orchestra conductors carried his casket to the grave. Hummel, the famous pianist, was one. Schubert was a torchbearer. Grillparzer, the greatest dramatist of the day, wrote the funeral oration. Everybody of any importance was there. And after the funeral, do you know what they did?''

''No. What did they do?''

''They all came straightway back to the house. And they had the first choice of whatever they wanted. And the Tenth was there, on top of everything: the desk, the piano, the kitchen table, notes everywhere. I have the names of those men. It's just a question of contacting their descendants. That will take money, of course. That's why I had hoped we could patent my dancing flame idea, maybe make some money.''

Quentin Thomas shook his head. ''No, Carl, but let's not give up. You said that your other project was a real invention, the one this man Higgins is financing . . . ?''

''It's over there,'' said Miller.

The lawyer looked across the room. His eye fell on a square head-tall tubular framework facing the far wall. It seemed to be tied in to pumps and plumbing. Thick electric cables spaghettied out to a big dynamo . . . or was it a motor?

''What's *that?*'' demanded the lawyer.

''H-TEC.'' The inventor pronounced it 'aitch-tec.'

''H—what?''

''H-TEC,'' repeated Miller. ''As in OTEC, except with an 'H'.''

''And just exactly what is H-TEC?''

''A new energy source. And I rather imagine it will make most existing energy forms obsolete.''

''Really?''

''I see I have to convince you. Let's start with OTEC, which is short for 'Ocean Thermal Energy Conversion.'

Are you familiar with OTEC?''

''In a general way. I know we now have several off-shore units in commercial operation.''

''Well, my invention is similar to OTEC. Let me start by explaining OTEC. Step 1, the warm surface waters of the ocean are used to vaporize liquid ammonia. Step 2, the ammonia vapors drive a turbine, which drives a dynamo to generate electricity. Step 3, cold water is pumped up through a three-thousand-foot pipe from the ocean depths. Step 4, that cold water is used to condense the ammonia vapor back to liquid ammonia. And then you simply repeat the steps.''

''And you generate power the same way?'' said Quentin Thomas curiously.

''Just about. I use the same steps: ammonia vaporization to drive a turbine/dynamo, then chilling the ammonia to condense it and start over again.'' He walked over to a side-bench and pointed to a little red truck. ''Here, look at this. This is a much smaller model, but it has everything. See? There's the ammonia vaporizer. There's the turbine/dynamo. There's the ammonia condenser. It's all geared down to drive the truck.'' He held up the toy and punched a button in the dashboard. The wheels began to rotate. ''Four-wheel drive,'' said Miller. ''Also drives a winch mounted in the back.'' He shifted a lever in the front seat. The winch began to turn. ''Actually, it's amazingly strong,'' he said.

Quentin Thomas surveyed all this noncommittally. He was trying to decide whether his intelligence was being insulted. He said carefully, ''Now *here*,'' he pointed, ''you vaporize the ammonia?''

''Yes.''

''And *here*, you condense?''

''Quite so.''

''I think you will agree, Carl, you need a considerable temperature differential between the two units?''

''Oh, yes, of course. Just as in the OTEC process, only I use a much greater temperature spread.''

Quentin Thomas's eyes gleamed. He had him. ''But you *don't* have a temperature difference. Both your vaporizing and condensing units are at room temperature. And I think you must concede, it is absolutely impossible to create available work under isothermal conditions. You *must* have a heat source and a cold sink.''

''Oh, certainly, Quent. And I do. Here's the cold sink.'' He pointed to the finned coil of tubing in the bed of the little truck. ''The ammonia vapors from the turbine condense here and return straightway back to the vaporizer, which can be very hot indeed. Watch out! Don't touch!''

Quentin Thomas noticed for the first time that the vaporizer chamber was radiating heat. The little unit probably accounted for the faint burning odor that he had noticed earlier. ''Ah,'' he murmured. ''But how do you heat it? Butane? Alcohol?''

''Oh, no, no, Quent. No fuel at all. It's like OTEC. I use a remote heat source. OTEC heats with surface ocean water. I heat with. . . .'' He faltered and studied the lawyer's face. ''Are you with me so far?''

Why not? said Thomas to himself. ''I'm with you. What do you heat with?''

The inventor seemed to hesitate. ''I

tap a rather unusual heat source," he said finally.

The lawyer waited.

"The heat frame," said Miller, "is positioned in a, well, space-time continuum considerably hotter than local ambient conditions. When the heat frame is activated, it actually *moves* into this other area." He looked at Thomas quizzically. "Hard to believe?"

"Yes," said Thomas. "It's hard to believe. Where is this space-time continuum?"

Miller looked uncomfortable. "The exact geographical location I'm not too sure about. Nowhere on Earth, though. That much I'm certain about. Do I—you—really have to know?"

"No, probably not, just so long as you can explain to one skilled in the art how to tap into it."

"I can certainly do that."

Quentin Thomas visualized claim language.

1. An energy source comprising, in combination:

   a) a first space-time frame;
   b) a second space-time frame, said second frame being at a different temperature from that of said first frame;
   c) means connecting said first and second frames for the flow of heat therebetween; and
   d) means associated with said heat flow means to generate available work.

Would it fly in the Patent Office? He didn't really know.

Miller studied his friend's face. "You look skeptical. Not that I blame you." He walked to the other side of the room. "See over here? This is another heat frame: a big one. Big enough for me or you to walk through. See, I'm walking through it." He ducked as he stepped through the square of metal tubing.

"But you didn't step out into another space-time continuum," said Thomas. "You're still right here in the lab."

"Of course. It's not turned on." He stepped back through the frame, flipped a switch on the right side, and then stood away from the device.

As Quentin Thomas watched, wondering, the frame blurred, then solidified, as though going in and out of focus. "What's happening?"

"The frame is now in . . . that other continuum," explained the inventor. "That's why you can't see it clearly. And now watch. I turn this valve. Liquid ammonia flows into the frame, and then it vaporizes. The vapor comes out *there*." He pointed. "And then into this turbine—where it generates about a thousand horses." The floor began to shudder as the massive rotor began to turn. "You'll never believe the trouble we had getting the thing into the basement. But there it is. Merely pilot scale, of course. But it's simple to scale it up to power an aircraft carrier or supertanker. It uses no fuel, conventional or nuclear. No pollution. No radioactivity."

"How hot is it—out there?"

"It seems to vary, depending on when and where we plug in. Two hundred centigrade is typical. There's a thermocouple embedded in the heat-frame, wired back to this meter." He studied a dial on the control panel. "Yes, two-oh-five. About midway between boiling water and a dull red heat."

Quentin Thomas rubbed his chin. And are you, Carl Miller, he thought, midway between madness and genius? He pulled a coin from his pocket. "Suppose," he said, "I toss this quarter through the heat frame. What would happen?"

Miller shrugged. "You mean, would it hit the wall beyond the frame?"

"Well, would it?"

"Throw the coin."

Quentin Thomas picked out the very spot on the opposite wall where the coin should strike, and then, with a deft underhand motion, he threw it.

It vanished. There was no sound.

Very delicately, the lawyer began to perspire. "What's on the other side?" he asked quietly. "*Why* is it hot?"

"I told you, Quent. I don't know for sure. I've never been through the frame."

"You suspect, though, don't you?"

"Yes, I guess I do."

"A time warp?" mused the lawyer. "The earth was much hotter two or three billion years ago. Maybe you've plugged in to three billion B.C."

"No, I don't think so. Whatever's out there, it's there in our local time. It's just the *place* that's different. And hotter."

Quentin Thomas reflected. An inventor was not required to know *why* his invention worked. He didn't have to understand the mechanism. In fact, he could completely *mis*understand the mode of operation. But he had to explain enough to permit one skilled in the art to reproduce the invention.

Miller turned the switch off. The turbine slowly droned to a halt. Quentin Thomas watched the heat-frame slowly come into sharp focus. He could sense the heat from where he stood. And—could he smell it? Was there a faint sulfurous odor?

The inventor broke the silence. "Can I get a patent?"

"I really don't know. The crux of the whole thing will probably be your heat-frame. If you can explain by drawings and the written word how to construct that thing, I'd say you have a substantial chance. Are you in fact able to explain your heat-frame so that one skilled in the art can make one?"

"Certainly."

"Also, the Patent Office may call it a perpetual motion machine and call us in for an actual demonstration."

"No problem there. I can pack up the little truck."

Something still bothered the lawyer. "Suppose," he said, "I walk through the heat-frame—while it's on?"

"Don't do it, Quent."

"But if I did?"

"I think it would kill you. Two breaths on the other side—maybe one—and that's it."

"You ought to put up a screen."

"Yes. Good idea."

"Well, let's get to work. Start by making a free-hand perspective sketch of the overall apparatus. We'll number the parts, and I'll take notes as to their function as we go along. Later on, I'll turn the sketch over to my draftsman, and he can prepare the formal drawings."

"Okay." The inventor leaned over the work table. "Here's the heat-frame. It's a square element formed from a chrome alloy tube. The part of the tube on the floor carries a uranium coil, plus this displacement element. . . ."

At various times during the discussion the inventor seemed to lose his way in mid-sentence. This puzzled the lawyer. During the semi-interruptions Miller cocked his head upward. Is he listening to something upstairs? thought the lawyer. Did *I* hear something? The front door opening? Closing? Voices . . . low, secret voices? And now he remembered. Of course. Carlton Miller was married. Perhaps his wife had come in. An innocent return from the supermarket. But who was with her?

None of his business. Get back to the invention. "You were saying, Carl? This line exits from the turbine exhaust to the ammonia vapor compressor?"

"Ah? Oh. Yes, then from the compressor back to the heat-frame, as liquid ammonia once more, to repeat the cycle."

The lawyer picked up the sketches, put his notes in careful order, and reached for his briefcase. "That about does it. I'll get a rough draft over to you in a day or two."

Miller mumbled something, then walked to the acoustical flame bench and turned off the burners. He was in the act of replacing the box of matches on the shelf when apparently he had a sudden thought. He took a match from the box, struck it, and peered at the flame.

More flames? thought Quentin Thomas. Are we back to square one? He suppressed a groan.

"With a little talent—and practice," said the inventor, "one can learn to 'read' a flame. Rather like a musician reading a score. He hears all the notes in his head. Beethoven was specially good at it—*had* to be, in his closing years, when he was going deaf. Now just look at this." He turned and held the match up. "A chemist sees a burning match and thinks $C + O_2 = CO_2$. A physicist thinks in terms of Charles's law of the effect of temperature on gas volume, with perhaps a contemplative nod to photons generated when electrons shift orbits."

"What do *you* see?" asked Thomas.

"*Hear,* Quent. Not see. This little flame *sings* to me—ouch." He tossed the glowing stub in the ashtray. "I hear a song of a great Georgia white pine. This little match was chopped out of the heartwood, along with millions of companions. It has sensed the ebb and flow of the seasons. It's older than you or I. Birds have nested in its parent tree. It lived exuberantly. That's what the flame sings to me." He paused. "You're looking at me very peculiarly. You don't believe me, do you?"

Quentin Thomas lifted his shoulders delicately. "So you hear the match sing, Carl. It's odd, but who am I to say?" He smiled. "Do all flames affect you this way?"

"No. Actually, some are rather prosaic. The Bunsen, here, for example. It has vague memories of decaying prehistoric reptiles in the Permian basin. On the other hand, a grain alcohol lamp has a lot to say about seas of waving wheat and the intricate biochemistry of fermentation."

Quentin Thomas smiled.

The inventor looked hurt. "You think I'm crazy."

"No. Just wondering whether your will provides for cremation."

Miller looked over at the square heat-

frame. (Why did he do that? wondered the lawyer. What connection between his will and that framework?)

"No, there's no express provision for cremation," said the inventor.

"You ought to have a will."

"I have one. All of my meager assets, including this house and lab and contents, are properly disposed of. I'll take care of my corpse myself."

Quentin Thomas thought about that. Was his friend going to dig a hole, then pull the dirt in over him? He was missing something here. He hoped it wasn't something vital. Well, no matter. He had to wrap it up and get out. "Carl, put this acoustical flame gambit out of your mind. Let's concentrate on H-TEC. That's where the money is. Incidentally, I gather H-TEC means 'H-Thermal Energy Conversion'?"

"Right."

"So, what does 'H' stand for?"

"Well, I . . . good question. This way out."

So he won't answer, thought the lawyer. Does it really matter? Let it be his secret. The muzzle of the Mossberg rifle seemed to leer at him as they passed under the rack. The inventor led the way up the stairs to the first-floor hallway.

Quentin Thomas forgot about 'H'. He found himself straining to listen, but all that he heard were the subdued sounds of a house at rest. No doors opening or closing. No voices.

Miller walked him to the front door.

Then the lawyer remembered. The inventor had an associate. The man who was financing H-TEC. He closed his mind tightly. He had to stop this idle speculation. It was an insult to both the Millers as well as to that shadowy sponsor—whom he would probably never meet.

He walked over to the metro stop.

On the way home Quentin Thomas began a careful re-examination of the events of the morning. He did this because he sensed that something was highly askew. True, he had picked up a good workable description of a remarkable invention. He would certainly file a patent application on it, and the chances of patentability were very good. Oh, he'd have his problems with the patent examiner, but eventually Carlton Miller would get his patent. And maybe make a fortune—if he had a modicum of business sense. And, even if he didn't, he had that financial partner.

His brows creased. Just who was Miller's partner?

And now he thought back. When they were in Miller's basement lab, the street door had opened. They had heard footsteps overhead. He remembered that Miller had listened intently. Ah. There had been *two* sets of footsteps. And two muffled voices. Female—presumably Denise Miller? And male—the partner?

Back up once more. Miller had got him out to the lab ostensibly to look at the musical flame invention, but knowing full well that the great incredible step forward was H-TEC. Miller would never have mentioned H-TEC if he, Thomas, hadn't specifically asked him about it. But why not? Miller certainly knew its importance. Hadn't Miller really wanted to push it? Had Miller made it for some non-commercial reason? Did Miller have some hidden sinister fate in store for H-TEC? (And what did 'H' stand for, anyway? Had he

asked? Yes, he had, and Miller had been evasive.)

It was weird, baffling.

How had it begun? Only this morning, he had awakened on the chaise longue in his study. Three A.M. The phone, ringing, ringing. . . . And he had been in his red robes for the defense. And he couldn't remember putting them on.

All quite insane.

3. Perpetuum Mobile

Mr. Tepples read the memo attached to the case folder. Actually it was a printed form, and there were just a couple of blanks that had been filled in by the clerk.

Mr. G. K. Tepples
Special Administration

This application is referred to your office because it appears to deal with a perpetual motion machine.

Classification Division
United States Patent Office
(illegible initials)

The inventor was somebody named Miller. Mr. Tepples had never heard of him. The interesting thing was that the attorney was Quentin Thomas. Well, well; the great Mr. Thomas! And how, Mr. Thomas, did this Miller person talk *you* into filing a perpetual motion case? Or did you do it for the money? On the theory that if you didn't take the fee, some *unscrupulous* person would?

He pushed back his swivel chair, laced his fingers behind his back, and made a silent visual tour of his little office. He paused and studied the device under the glass case on his credenza. One of his earliest victories. A clock that wound itself up. The inventor had slunk away in shame when Tepples had found the secondary rubber band motor. An insult to his intelligence, really. On the wall behind the clock was a series of framed patents—all covering various perpetual motion machines (he called them 'permos') that in years past had somehow got through the mechanical art groups. No more. All that had stopped when the commissioner had given him this special assignment.

Next was a painting of the famous oilcloth-covered "over-balancing" wheel of Councilor Orffyreus (1680– 1745), which had been demonstrated in the castle of the landgrave of Hesse-Cassel. It had turned for eight days, apparently of its own power. Whereupon, overcome by curiosity, the landgrave tore away a section of the oilcloth cover, and a dwarf ran out.

Nearby hung a photograph of a water wheel that fed its own millstream, and next to that, an old print of Congreve's continuous weighted sponge belt. And then the flow diagram of the liquid air machine: vaporizing liquid air drives a pump, which provides available work and, in addition, liquefies more air.

Mr. Tepples smiled to himself. Take your pick, Mr. Miller, Mr. Thomas. Which of these classics will you duplicate? Or do you propose to break with tradition?

He turned back to his desk. He didn't even have to read the application. It would be a total waste of time. He pulled a piece of paper from a pad and scribbled, "Form 21." He tossed the file in his outgoing box.

Quentin Thomas, Esq.

Mailed 9-25-2023
S.N. 123,456, filed July 1, 2023
Engine and Energy Source Therefor

Carlton Miller

Dear Sir:

This application has been received.

The alleged invention appears to be directed to a perpetual motion device. The Patent Office will not examine such applications. 35 USC 101; Manual of Patent Examining Procedure 706.03 (p).

If you wish to contest this decision, an actual demonstration of a working model will be required. Com. Notice Jan. 30, 1918; and see Ex parte Payne, 1904 C.D. 42.

Respectfully,

G.K. Tepples, Examiner
Phone 557-1111

Address all communications to Commissioner of Patents, Washington, D.C.

Form 21

The lawyer smiled grimly. He had expected nothing else. And he didn't have to open the big looseleaf MPEP to know what Section 706.03 (p) said. He had explained all this to Carlton Miller in the beginning. "Carl, the Patent Office will look at this, and they'll call it a perpetual motion machine. Which means that, about three months after we file, the P.O. will mail me a Form 21. And then we'll have to take your little red truck in and demonstrate it to the Examiner."

"I'll be ready."

So now was the time. He put in a call to Miller.

* * *

"Denise, my dear," said Miller, "I have to go to Washington. Business with the Patent Office."

She was sitting at her vanity in the master bedroom, brushing her long dark hair. She looked back at him through the mirror, without turning, and without missing a stroke. "Oh, really? How long?"

"Two or three days. I'll be at the Americana in Arlington."

"What could possibly take three days in the Patent Office?" She sounded thoughtful, yet edgy.

"Interviews with people on my new motor. I have to take a model down. Maybe demonstrate it. Quentin Thomas is making the arrangements."

"But you'll be back Friday at the latest?"

"Yes, most likely."

"Or Thursday, at the earliest?"

"Yes."

"If your plans change, call me."

"Of course."

4. The Demonstration

"How does it work?" asked Mr. Tepples. He leaned forward over his desk and studied the little red truck.

"The principle is quite simple," said Carlton Miller. "The machine juxtaposes a heat source and a cold sink. Work is extractible from this contact in accordance with the Carnot heat cycle and the second law of thermodynamics: $W = q(T_2 - T_1)/T_2$."

"Rather like the process for extracting work from the ocean," mused Mr. Tepples. "OTEC, I think they call it. The warm upper water layer creates available energy when it is brought into contact with the colder water below."

"Same idea," agreed Miller. "You don't call OTEC perpetual motion, do you?"

"No, of course not," said Tepples. "In the first place, theory requires that the water will eventually become isothermal, whereupon the work content of the system becomes zero. Secondly, the whole thing is dependent on the warming effect of the sun, and not on the inherent internal perpetuities of the system. OTEC is completely subject to $E = A + TS$, where A, the available work, must in theory drop to zero when all the ocean strata reach the same temperature. When that happens, E, energy, equals TS, entropy, which is just another way of saying you may have some energy present, but there's no way to extract it."

"Our device is subject to the same limitations," said Quentin Thomas.

"Not really a perpetual motion device?" said Tepples with a crafty smile.

"Not really," said Miller.

"Could it run for a hundred years?" said Tepples.

"Yes, if it is maintained properly," said the inventor.

"A thousand . . . ?"

"With replacement of worn parts, yes."

"A million years?"

"Still yes, if parts are available, and if somebody is still around to keep it in repair."

Mr. Tepples touched his fingertips together. "Most interesting. Let's get into a little more detail. What is your heat source, and what is your cold sink?"

"The cold sink is easy," said Miller. "It's locked into the present. The heat source—well, that's not as easy to describe. It's a different space-time continuum. I'm not even sure it's located on our local planet. In sum, I don't know for sure."

"Would you care to speculate?" asked Mr. Tepples.

"I'd prefer not to."

"Well, no matter, so long as you're able to describe how to put it all together." He reached over and patted the hood of the little vehicle. "Does it really work?"

"Yes; when I bring the hot and cold frames together, I produce available work."

"A lot?"

Considerable," said Miller.

Mr. Tepples studied the little machine. The energy device itself appeared to be mounted in the bed of the truck, and had a general cubic configuration about three inches on a side. There was a little switch on top of the cube marked "on-off." On the side was a little crankshaft carrying a braided metal line.

He had figured it out as soon as they brought it in, of course. A hidden capsule of compressed air. Or maybe one of the new hydrazine batteries. Not much of a challenge. He even wondered whether he should feel insulted. "Nice-looking toy," he said. "What can it do?"

"A couple of things," said Miller. "For one thing, it can run under its own power. Watch." He pointed the little vehicle toward the far wall and pushed the switch.

The truck leaped forward. It banged into the wall, then stopped.

"Impact turns it off," explained Miller.

Mr. Tepples smiled. "Rather cute. The skeptical mind, however, might be inclined to wonder whether the demonstration vehicle has an auxiliary engine tucked away under the hood or under this cube in the back."

Quentin Thomas sighed. "We propose a further test, Mr. Tepples."

"Such as?"

"Note the winch and cable on the back of the truck. We'll take the machine down to the lower level in the parking garage under the building. We'll loop the cable around two support pillars, with the winch in the middle. We'll turn the machine on. It'll take up the cable slack in a hurry. Then—"

Mr. Tepples interrupted with a frown. "But the pillars are some yards apart. To take up the cable slack would require several hundred pounds of pull."

"Quite so, Mr. Tepples."

"Let me see if I understand this," said Mr. Tepples. "We're going to take this little bitty truck down into the basement parking garage. There, you'll take this line, wound up on the little winch here, and you'll loop it around a couple of pillars, with one end and this hook in front of the truck, and the other on the winch, and the winch will turn, and take up the slack. Is that about it?"

"That's exactly it, for the start," said Quentin Thomas. "Actually, we expect the demonstration to go a little beyond that."

Mr. Tepples carefully refrained from smiling. He could already write up his Examiner's Interview Report. "Examiner accompanied Applicant and Counsel to Parking Garage to test ability of claimed device to stretch metal cable between adjacent concrete support pillars, using device to power take-up winch. After looping cable around posts and attaching device to winch, Applicant discovered that frammis adaptor (accidentally left in basement lab back home) was required, but pointed out how the device would have worked had this element been available. Recommendation: Demonstration a failure. Application rejected."

"Let's go," he said.

In smooth concert lawyer and inventor took the cable around two neighboring pillars and hooked the ends to the winch of the little truck, which sat on the concrete floor. Mr. Tepples watched non-committally.

"I think we're ready, Mr. Tepples," said Quentin Thomas. "Stand back."

"What for?"

"In case the cable snaps."

Mr. Tepples smothered a laugh. Ostentatiously he stepped back a couple of feet.

"Turn it on, Carl," said Quentin Thomas.

Miller bent over and flipped the little switch.

The winch began to turn, slowly, at first, then faster. The slack in the cable vanished. With a crunch and a clang the metal line tightened into total rigidity.

Mr. Tepples's eyes opened wide. "Turn it off."

Too late. More crunching. And rumbles. The concrete floor vibrated. Clouds of dust floated in eerie wraiths from the ceiling.

Then a clang, as of a shrill bell sounding: the cable snapped. One of the ends whipped within inches of Mr. Tepples's nose, and he caught a whiff of red-hot metal.

Whap whap whap whap. The winch continued to turn, slapping a cable end on the floor with each frenzied rotation.

They looked about them. A part of the cable was buried several inches into the farther pillar, with ends sticking out.

"Figured that might happen," said the inventor. "Brought my oxyacetylene torch just in case. I'll cut the ends out in a jiffy."

Mr. Tepples ran his finger around his collar. "Gentlemen, there are those—including GSA and Building Services—who might misunderstand your little exhibition here." He thought a moment. Should he pass the application on to Group 220 for consideration of nuclear energy? And if he did, would he have to give 220 a report on the rejection under 706.03 (p), and provide a full report of this horrible, horrible, unexplainable demonstration? It was unthinkable. He said, "I'm going back up to my office. You'll get the formal Notice of Allowance in a few days. Meanwhile, gentlemen, I recommend that you tidy up here as quickly as you can, and then get the hell out."

5. The Rifle

Carlton Miller was considerably less burdened when he finished his Washington trip than when he started it. For he had left his little valise and his model case in the baggage pickup at La Guardia airport. So certain were his expectations for the remaining hours of the night that it seemed utterly foolish and superfluous to carry an extra thirty pounds to the subway and up these three blocks to his home. So let the luggage be stolen or the police find it afterward, or whatever. He didn't really care.

He looked at his watch. One A.M. glowed back at him.

From half a block away he saw Victor Higgins's car parked under the street light near the front of his brownstone.

Miller didn't react. He neither skipped a step, nor speeded up, nor did his heart beat faster. No more. All that was in the past.

He walked on by the car, turned in to the side entrance of his home, and walked down the concrete stairs to his laboratory door. This he unlocked soundlessly. He pushed the door inward on well-oiled hinges, walked inside into the darkness, and then closed the door behind him. He held the latch so there would be no click of metal on metal.

He took off his jacket, hung it over the back of a nearby chair, then sat down in the chair and took off his shoes. From underneath the chair he pulled a pair of silence-slippers.

In the darkness he walked over to his workbench, felt for the i.r.-goggles, slipped them over his head, and pressed the button.

The room sprang into definition. Off to the side was the great engine, sleeping. The space frame stared back at him with its square Cyclopean eye. Slowly, in dead silence, he walked over to the frame and flipped the switch on the uranium coil. In about three minutes the frame would activate. Time enough.

He walked now to the door that led to the upstairs hallway. He tried the handle. Dead-bolted on the other side. As he expected. He returned to the main work bench, opened a lower cabinet door, and pulled out the remote-key case. He returned to the door, held the case opposite the deadbolt, and listened

to the clicks. In a moment the door swung free.

He turned back into the lab, took down the laser rifle from its rack over the doorway, checked the charge, and held the weapon briefly against his shoulder. The sight circles lined up beautifully with the right-eyed lens of his i.r.-goggles.

He walked out on the basement landing and looked up the stairwell. All was dark, silent. He began the ascent with measured steps.

When he reached the first-floor hallway he stopped and listened.

Nothing.

He started up the stairway to the second floor.

And down a little hallway to the master bedroom.

The door was very slightly ajar. He paused for a moment before pushing it open.

He stepped quietly inside.

The emperor-size waterbed lay in a semi-alcove to the right. On the bed two nude forms stood out starkly in his goggle receptors. Not even a sheet pulled up over them. He was amazed at the amount of heat radiated by the naked human body. Their clothes, evidently removed in haste, were scattered about the floor near the bed.

They looked so innocent, like sleeping children.

He raised the rifle, lined up the sights on Victor Higgins's head, and squeezed off a soundless shot.

The prone figure jumped, then relaxed. The slow rhythmic movement of the chest ceased. There was a momentary acrid odor of ozone.

The woman shifted her heavy limbs so that she lay on her back. Her breasts settled back as pliant half moons against her chest, and the nipples sparked red on her husband's vermilion/indigo i.r. screen.

Carlton Miller's knees trembled. He gritted his back teeth. He had to wait a full thirty seconds before he could bring the rifle up again.

6. The Inquest

"Please come in, Lieutenant," said Quentin Thomas. He ushered the officer into his little waiting room. "I'm not sure I was wide awake when you phoned. You said Mrs. Miller had been found dead in bed—with another man?"

"A guy named Victor Higgins," said Lieutenant Dirken. "We identified him. Retinal pattern. Fingerprints. Wallet in his pants. Other things. Miller's business partner, I understand."

"You say you got a phone call?"

"Yup. At one-fifteen A.M. Fellow said he had just killed his wife and her lover with a Mossberg 409. The rifle would be found in the bedroom, and he'd leave the front door unlocked for us."

"Carlton Miller?"

"The same. We just finished checking the tapes. Voice analysis picked up a couple of hundred ID points in a comparison with a known sample."

"Which was?"

"His oral will. He left it in a cassette in his basement lab. In his phone call he told us where to look. We'd have found it anyhow, of course."

"Of course," mused Quentin Thomas.

"He left everything to you."

The lawyer didn't know what to say

to that. He didn't think Carlton Miller had much to leave. Just debts. And the Machine.

"As an attorney," said Lieutenant Dirken calmly, "I'm sure you realize that any assistance you might give Mr. Miller at this stage will make you an accessory after the fact."

"Yes," said Quentin Thomas, with equal calm. "But why are we standing? Please sit down, Lieutenant."

"Thank you." They took facing chairs. The officer quickly got down to business. His eyes bored into those of his host. "When did you last see Mr. Miller?" he asked gently.

"Yesterday. We took the shuttle down to Washington, D.C., together, on business with the Patent Office. He returned on the same flight. We went our separate ways from the airport." He studied the officer's face. "You knew all that, already."

"Pretty much. Still, I wanted to hear it from you." He got up, grimaced, pressed his hands to the small of his back, then began to pace the room. He stopped for a moment before the portrait of Sir Francis Bacon, then turned and hurled his question at the lawyer. "Where is he now, Mr. Thomas?"

"I don't know, Lieutenant." (Ah, but I *suspect!*)

"If you could get him to give himself up peacefully, you might save his life."

"You said you were in his basement laboratory?"

"Yes."

"Did you notice a square metal framework facing the north wall?"

"Let's see." The lieutenant pulled a limp leather notebook from his jacket pocket, licked his thumb, and flipped through a couple of pages. "Here we are. Floor plan. Exits. Walls. North wall. Two-inch electrical pipe heater. Square. That it?"

"That's it. Was it glowing?"

"Let's see. No, doesn't say. *Bright* glow?"

"You might not be able to see it if the ceiling lights were on. But you mentioned electrical heater. You sensed *heat,* Lieutenant?"

"Yes, I did. It *was* a heater, wasn't it?"

"It gave off a certain amount of heat, but it wasn't primarily a heater."

"What was it then, Mr. Thomas?"

"Right now it *is* a very dangerous piece of equipment. We'll have to get over there and turn it off. You've got a man at the door?"

"Yes. A couple, for both entrances."

"Call them, tell them not to let anybody in the basement. Come on, I'll explain on the way."

They stood before the heat-frame. "When it's on, it's stuck out into a place where it's a lot hotter," explained Quentin Thomas. "The heat vaporizes liquid ammonia, which drives a turbine. The cooler ambient conditions reliquefy the ammonia, which is pumped back into the heat frame to repeat the cycle."

The officer listened to this with covert skepticism.

Quentin Thomas turned a valve. "This feeds the liquid ammonia into the heat-frame."

They heard a *whoosh*. Then the floor began to vibrate. "The turbine rotor is starting up," explained Thomas. "Generates about one thousand horsepower."

The lieutenant's mouth dropped. He licked his lips, and had to raise his voice to be heard over the increasing rumble. "Okay! Great invention. Turn it off."

"Just one second," said Thomas. "I want to show you something special about the heat-frame." He looked about the benches, found a piece of scrap copper tubing, and walked toward the square frame. "Will you join me here, Lieutenant?"

The officer stepped across the room. Quentin Thomas handed him the copper pipe. "Toss it through the frame."

"But—"

"I can do it," said Thomas, "but it'll be more convincing if you do it."

The lieutenant took the pipe, took careful aim, and tossed the piece of scrap at the empty middle of the metal square.

The pipe vanished.

The officer's eyes widened. "Where is it? What happened?"

"It's now in another space and perhaps another time," said Quentin Thomas. "Beyond that, I don't really know much about it. But I think that's where Carl Miller is—or what's left of him."

"You mean he walked through—*there*—?"

"I think it quite likely, Lieutenant."

"I see." The officer was thoughtful. He said, "How hot is it in there, Mr. Thomas?"

"About two hundred degrees Centigrade. That's nearly four hundred Fahrenheit."

"He'd live about one minute."

"Or less."

"*If*—he really went through."

"Of course."

"Double murder, then suicide. Interesting. We'll have to run that through our psychographs."

"Meanwhile, I recommend we turn it off."

"But suppose he wants to come back through . . . ?"

"If he went through, Lieutenant, he won't come back. He's dead."

"Yeah, I guess so. *If*. . . . All right, turn it off."

7. The Burning Sea

In his dream there was this brilliant luminescent moth, fluttering, trembling, trying to escape its prison. Light flashes from its wings reflected from his bedroom ceiling down into his eyes.

Quentin Thomas woke up. It was his bedroom TV. Those white flashes on the screen. Something was wrong. Was it on fire? He sniffed for smoke as he sat up and moved to the edge of his bed.

And then he recognized the imprisoned creature: a talking flame . . . on his TV screen.

Carl Miller. The inventor was calling him . . . from . . . ?

Chills rippled up and down his cheeks.

Then he got hold of himself. He started to turn on the night lights, then decided against it. Light might affect the dancing flame. He focussed uncertainly on the luminous dial on his clock. Three A.M. Why did it always have to be three in the morning . . . the hour when babies are born and sleepy lawyers get that one permitted phone call from the client in dire trouble.

Now then, how to convert the flame into intelligible sound? That shouldn't be too difficult. He had a psychodelic converter on his set, rarely used, but at

least it was there. There were various programs that put varying visible patterns on your screen. You could convert the patterns into sound simply by punching a button on the side of the set. He leaned over and pressed the psychodelic button.

"Hello, Carl," he said.

The flame momentarily filled the screen. "Quent! What a relief. I didn't know whether this would work. But they let me jump a flame image into your TV. It was my only chance."

"Carl," said the lawyer firmly. "Just exactly where are you?"

"I'm in hell. I thought you knew that."

"And you want me to get you out?" In his mind he ran down the headings in the State Criminal Code, Chapter IX, Post-Conviction, Grounds for Appeal. He doubted that Chapter IX was applicable. What *was* applicable? One of the ancient common law writs? Lords of the netherworld, I present you with this writ of *habeas corpus*.

This was madness. But perhaps he wasn't really hearing this. Perhaps he was dreaming again.

"Out? Get me *out?*" said the faraway voice. "No, Quent, you don't understand. I want to stay *in*."

Thomas's first thought was that the sound circuits in his TV set had gone awry. He leaned over and was about to fiddle with the dials when his friend spoke again.

"Quent, I guess it sounds peculiar. You're asking yourself, why would anyone want to stay in hell? For me, the answer is, everything is here, absolutely everything. And all because I can read flames. Lots of flames down here, Quent. *That* is true, about what people say about this place. And each flame *sings*. And I can read the music. Songs you people up there never dreamed existed. It's all here: I've heard the songs the sirens sang to Ulysses, and those that the Lorelei sang to ships on the Rhine. All the lost fragments are here. Wagner's first two operas, which he wrote in his teens; one lost in a fire, the other he deliberately destroyed. They're here. And do you remember that marvelous passage in Thomas Wolfe's *Of Time and the River:*

> Play me a tune on an unbroken spinet
> And let the bells ring, let the bells ring.

"*That* tune is here. I've heard it. And the bells. And do you recall the murder-suicide of Marie Vetsera and Rudolph of Hapsburg at Mayerling?"

"Vaguely," said Quentin Thomas.

"The valet played the concertina for them in the hunting lodge, late that night. A chapel stands there now; nuns pray for them around the clock. The concertinist improvised. And the music is here."

"Fascinating," murmured Quentin Thomas.

"Everything winds up here, Quent, indexed and flame-registered. It's the ultimate archives. Just as in Swinburne's *The Garden of Proserpine*. All the rejects, the unfinished, the things forever lost—they all come here. And they burn eternally."

The TV flame seemed to die down a little as the inventor relaxed. "I've listened to the missing movement of Schubert's *Unfinished Symphony*. He made a rough sketch before he put the work aside in 1822. Ah, marvelous!

And then, guess what else is here?''

''What?''

''I've heard Bach's *Art of the Fugue,* complete, and Mozart's *Requiem,* and Bruckner's Ninth, Mahler's Tenth. It's endless.

''Schumann heard weird melodies in his head that drove him to attempt suicide; and I've heard them, too.

''I've listened to the things David played on his harp, to allay King Saul's melancholy. I've heard Sullivan's *Lost Chord,* and the hymn they sang at the Last Supper.

''But all that is just frosting on the cake. The thing I'm leading up to is the absolute ultimate. Let me tell you about, well, I guess you would call it a sort of sea, or ocean.''

''Tell me about the sea,'' said the lawyer.

''I will. But first, you have to understand certain invariables about this place. There's no sun to give light, or to rise and set, to mark off days. What light there is comes from the sea. And the days . . . well, you make up your own. They stretch off endlessly, into the past, and off into the future, forever and ever. We're talking about eternity. Quent.''

''I understand.''

The flame voice continued evenly. ''I walk down along the dunes in the morning. (Call it morning.) The sand is probably quite hot. Hellishly hot—to coin a phrase. But the feeling left my feet long ago. I'm not even sure I have feet. And so on down to the sea. It's blue because it's burning. Liquid sulfur. $S + 0_2 = SO_2$, with millions of little blue flames.''

''Fire and brimstone?'' said Quentin Thomas.

''Yes. Just as in the Bible.''

''Doesn't the sulfur dioxide bother you?''

''It used to. But whether it does or not is all in your mind. If you decide it doesn't, it doesn't.''

''I see.''

''So, I like to come down to the beach, sit on my haunches, hug my knees, and just stare out over the blue. Just me, the sands, and the marvelous music.''

''Just a minute. You said—*music?* What music?''

The Tenth, Quent. Beethoven's Tenth Symphony! My lifelong ambition. I never really thought I'd realize it. But I have! I've finally found it! It's the burning sea. Every flame is an instrument, a contrapuntal sound. The Tenth is here! *Right here!*''

Quentin felt the air slowly exhale from his lungs. He vaguely realized he had been holding his breath. ''Beethoven's Tenth . . . in *hell?*'' he said aloud to himself.

''Exactly,'' confirmed the unseen speaker. ''The whole thing. And when—if—you could hear it, you'd understand why the great man couldn't hope to finish it.''

''Why?''

''Because it was mentally, physically, and spiritually impossible to finish. Because it had no beginning, and no end. How do you finish something that never ends . . . that goes on forever and for eternity? Somehow, Beethoven was in touch with the music of the burning sea. He *sensed* the music. The individual flames are acoustical.

They provide the music, if you can read it. God only knows how Ludwig tuned in. But he did, at least partially. He tried to get it down on paper, and it killed him. He must finally have understood that it was beyond the ability of any mortal human being. Why? Because it is a comprehensive definition of the entire universe! As such, it was beyond the efforts of the greatest musician who ever lived. And his inability angered him. During the storm that night, as he lay dying, he awoke in a daze, shook his fist at the skies, and then he fell back dead."

Quentin Thomas was silent for a long time. He needed to review some things in his own mind. "So, then, you're in hell," he said slowly. "And that's what the 'H' in 'H-TEC' stands for. And all along, you planned to walk in, right after the double murder. Right?"

"Right," agreed the inventor-musician matter-of-factly.

"And you like it there."

"Right again."

"But somebody doesn't want you there, and they're trying to evict you."

"You're batting one thousand, Quent."

"So you called me . . . to fight the eviction."

"Will you take the case?"

"Not so fast," said the lawyer. "*Why* are they trying to get rid of you?"

"Well, Quent, as it turns out, they don't let just everybody in here. You have to qualify, and be on the list. You can't just arbitrarily walk in through the back door, as I did."

"Did you tell them you wanted to stay?"

"Of course. But my pleas fell on deaf ears. And then they began to pressure me. Dirty tricks you wouldn't believe."

"Such as?"

"You remember my business partner, Victor? He was in bed with Denise when I shot him."

"So I understand."

"He's here, Quent."

"I'm not surprised."

"No, I mean *here*, right here beside me. Say hello to the lawyer, Victor."

The flame flickered as though shifting to a different wave length. "Hello, Mr. Thomas."

"Hello, Victor. How are you?"

"Warm."

"And now *I'm* back, Quent."

"So they gave you Victor Higgins to keep you company?" said Thomas. "Diabolical."

The flame shook a little. "Down here," admonished Miller, "we don't use words like that."

"I'll watch it. Go ahead, Carl."

"The point is, I'm entitled to my very own private hell. And so is everyone here. Don't ask me how they can manage that, considering the millions of souls they have here. Something about an isolato-continuum. But they certainly have the power to do it. They normally do give you total privacy. The isolation is supposed to be part of the punishment. With me, it's a little different, of course. I think I'm the only one here who can read flames. I need the peace and quiet to work with the Tenth. They shouldn't inflict Victor Higgins on me, Quent. It's morally wrong."

"Who's *they?*"

"Mr. Jones, and his assistants."

"The devil?"

"That's an inflammatory emotion word here, Quent. Don't call him that at the hearing."

"Ah, a hearing. When?"

"Very soon. In fact, one hour from now. Gives you time to get over to the old lab."

"Why should I go over to the lab?"

"Well, Quent, don't you see, that's how you get to the hearing. You activate the heat-frame, then you walk through. You'll reappear in a special courtroom, all set up and ready for you."

Quentin Thomas was silent. Granted, Carl was still his client. Granted, he had a continuing duty to his client. On the other hand, duty did not require risking his life and/or his eternal (if he had one) soul. He had a queasy feeling that if he were able to pass through that infernal portal, Mr. Jones, by whatever name, just might insist on extending a perpetual hospitality.

On the other hand, there was the challenge . . . a unique opportunity.

Something to talk about at the bar association smokers? Hah!

He knew he was being merged into Miller's madness. He listened to the words coming from his mouth, as though from a stranger: "Okay, Carl, hang on, I'm on the way."

8. A Writ of Ejectment

As he took the metro over to those fatal chambers (now *his!*), he struggled with a sense of overpowering bewilderment.

What had begun a few weeks ago as a courteous, if skeptical, visit to an old friend had turned into a nightmarish farce, a *sturm und drang* between heaven and hell, with eternity at stake, possibly including his own.

But even the issues were weird, topsy-turvy. It would make sense if his client was in hell and wanted out. But the idiot wanted to stay.

Why couldn't he ever get a case that made sense?

And so he was thinking, as he entered the imprisoning darkness of the basement laboratory.

He turned on the lights.

Across the room the far frame of H-TEC stood out in grim beckoning relief.

Quentin Thomas noticed that he was trembling. He clenched his fists, strode over to the main switch of the great machine, and turned it on. Then he pulled his red robes for the defense from his attaché case and got into them. At least he could dress the part. He looked at the wall chron: three fifty-seven A.M. He turned off his mind and waited. Three minutes was required to activate the heat-frame.

At four A.M. he took a deep breath and walked through the frame.

He was in a courtroom. To his considerable astonishment, it was rather an ordinary courtroom. The judge's bench (presently empty), a witness stand, two tables for opposing counsel, a jury box (but no jurors). One little difference: no benches for the public. It was warm, verging on the uncomfortable. He would soon start to perspire. What had he expected? Smoke? Flames? The fumes of burning sulfur? None of that was evident.

Well, where was his client?

As if to answer his question, Carlton Miller materialized, standing at defen-

dant's table, next to the jury box. The look on the man's face (Quentin Thomas decided) justified the trip. The lawyer hurried over and shook hands with the inventor.

"Thank you, Quent," said Miller. "I'm very grateful."

"For you, I did it," said the lawyer. "Not sure I'd do it for anybody else." They sat down. "You seem solid enough. Are you really real?"

"Yes and no. Mr. Jones handles all that. Sort of a special appearance situation. It's mostly for your benefit, I think."

"Speaking of the devil, where—"

"Ssh!" said Miller nervously. "We have to watch our language down here."

"Ah, of course. Well then, where is, ah, Mr. Jones?"

A figure materialized in front of the judge's bench. The creature appeared to Quentin Thomas to be about man-size. But it clearly wasn't a man. Its face was clothed in scales, and its mouth was something hard-edged. It wore a long purple tunic. Claws peeped out through the sleeves, and a tail trailed out from under the bottom of the garment.

"All rise," said the newcomer. "This honorable court is now in session. His sublime majesty, Judge Jones, presiding. All who have business here are invited to draw nigh and give their attention."

"I guess that's the bailiff," Quentin Thomas whispered to the inventor.

"Huh? No, Quent, that's Mr. Jones."

"But—"

The "bailiff" vanished.

A figure appeared, seated behind the bench. It was the identical creature, except that now it was dressed in long black judicial robes.

"You see," whispered Carlton Miller. "It's still Mr. Jones. He's also the judge."

Hm, thought the lawyer. I have a feeling this is going to lead to a certain amount of confusion. What other roles is *Judge* Jones going to play?

The judge scanned through some papers on the bench. "The case at bar," he said, "is Jones v. Miller. Ejectment. Defendant to show cause why he should not be ejected. Counsel for defendant will open." The voice was serene, beautifully modulated. Almost Oxonian, thought Thomas.

The lawyer stood up. "Your honor," he began slowly, "Quentin Thomas, attorney for petitioner Carlton Miller. May I ask the court a couple of preliminary questions?"

The judge looked down at him. Flames lit up in his eyes, and the hard lines forming his mouth seemed almost to smile. He said, "Within reason, Mr. Thomas."

"If we fail to show cause to remain, your honor, does this court in fact have the power to eject Mr. Miller?"

"The court has the power, Mr. Thomas."

"And may we further presume, your honor, that this court, if it so chooses, has the power to give Mr. Miller the sole and exclusive occupancy, possession, title and seisin, to the shore of the Burning Sea in fee simple absolute, free of all liens and encumbrances, forever and ever?"

"You may so presume, counselor," said Judge Jones impassively.

The lawyer paused a moment. He wanted to ask Mr. Jones one more question. He wanted to establish "for the record" one very elemental fact concerning the identity of Judge Jones. "Who—"

"Don't ask," said the judge gravely.

Thomas was jolted. Could the judge read their minds? And if he could, how far beyond that did it go? Did the judge know the outcome of this hearing? And if he did, why go on with it? His mind was blurring. It was profitless even to think about such things. He had a client to serve—if he could.

"Are you done with your preliminary questions, Mr. Thomas?"

"Yes, your honor."

"Do you have an opening statement?"

"I do, your honor."

"Please proceed."

"Your honor, one night last July, the defendant took a gun and in cold blood murdered his wife and business associate, a Mr. Victor Higgins. And then the defendant walked through the activated heat-frame of his H-TEC machine. And so he arrived here in, ah, in. . . ." He realized he was fumbling.

"Are you trying to say 'hell', Mr. Thomas?" said Mr. Jones softly.

"Well, yes, your honor. Mr. Miller found himself here in, ah, hell. And he wants to stay here."

"A most unusual attitude," murmured Judge Jones.

"Yes, your honor. But this isn't all. He wants exclusive possession of the seashore."

"He doesn't like company?"

"No, your honor, he doesn't. He wants Mr. Higgins to leave. He feels that Mr. Higgins's presence is cruel and unusual punishment, far above and beyond any reasonable retribution for Mr. Miller's crimes."

"He doesn't feel that Mr. Higgins alleviates the solitude?"

"No, your honor, quite the contrary."

Judge Jones peered over his gold-rim spectacles as he shuffled through the papers in his file. He paused and pondered one of the documents. "I must tell you, Mr. Thomas, that we have already very carefully considered Mr. Miller's presence here, *ex parte*, of course. So far, you've brought up no new argument, nothing in law or in fact, that isn't already in the record. In short, his dossier contains a recommendation of transfer, and you haven't shown any reason or cause why we shouldn't move him out immediately."

"If it please your honor," said Quentin Thomas blandly, "I believe your honor may be overlooking a couple of primary points of law."

"Ah, indeed, Mr. Thomas? Then will you kindly proceed to enlighten the court?"

"Not *enlighten*, your honor. Let us say, rather, refresh the recollection of the court."

The harsh mouth opened wide in a slow yawn. "Whatever, Mr. Thomas. Please get on with it."

"First, an action of ejectment can be brought only by the true owner of the property. I venture to suggest, your honor, that there is nothing in the record as to the identity of the true owner of the seashore, or that the action is brought by him, whoever he may be. Will your honor please confirm this as fact?"

Judge Jones blinked at the lawyer. The gold-rim spectacles de- and re-materialized a couple of times. The flamelets in his eyes flew up, then settled down as he leafed through the documents in front of him.

"Your honor . . . ?" prodded Thomas.

"Yes, I suppose you are correct, both as to the law and the facts. Thank you for calling this to my attention, Mr. Thomas. We will remedy the omission immediately." He pounded on the bench with his gavel. "I now call the first witness, namely, myself." He stepped ponderously down from the bench and took the witness stand. The black judicial robes now changed to blue.

"Your honor!" protested Quentin Thomas, "I must object!"

"Really, Mr. Thomas? Why?"

"In the first place, I wasn't through with my opening statement. Secondly, a show-cause hearing is an appellate proceeding on an *existing* record. New evidence is not permitted. And finally, a judge cannot be a witness in his own court!"

"Overruled," observed Judge-witness Jones mildly. "As these proceedings continue, you may detect certain differences in our trial methods, as compared to those in your country. As a student of comparative jurisprudence, you should be the first to accept and excuse our little variations.

"In your courts you love a display of characters, a perplexing parade of lawyers and witnesses, like *dramatis personae* in a play. The poor litigants must find so many faces confusing, and they surely have difficulty in keeping such a varied cast of characters straight. Here our procedure is stream-lined: one face for all roles. The defendant doesn't have to stop and wonder, 'Now, who's *that?*' We relieve him of this mental strain. He knows it's I."

"Very considerate," murmured Quentin Thomas.

"We're glad you agree. May I now proceed with my testimony?"

The lawyer shrugged and took his seat. After all, it meant nothing. Nothing was real. Except that everything was very real indeed to his client, whose case he had undertaken to pursue with all the skill at his command.

"With that out of the way," said Judge-witness Jones, "let us establish certain facts for the record. I own this place. My permission is required for entry. I never gave it to Mr. Miller. He sneaked in through the side door, so to speak. These are background facts." He shifted heavily in the chair. "But worst of all is the fact that Mr. Miller lacks the proper personal qualifications for permanent residence here. His so-called crime is not a real crime. He was defending his hearth and home. He doesn't fit in with the rest of the group. He strikes a dissonant note. He creates unrest, disharmony. He's dragging the neighborhood down." He looked over at the defendant. "Nothing personal, Mr. Miller. But that's the way it is. Sorry." He got up.

"Just a moment, your honor," said Quentin Thomas. "Could I ask a couple of questions?"

"What do you mean, questions?"

"I'd like to cross-examine you."

"Oh, that. Very well, just don't

waste a lot of time.''

''I'll try to keep it short. You say you 'own this place'. Do you have a deed showing transfer of title to you?''

''No, of course not.''

''Do you have *any* indicia of title?''

''None.''

''Who owned it before you did?''

''Irrelevant.''

''Who selects your tenants?''

''They do, and I do. We both have to agree.''

''Suppose you are successful in this action, just how would you eject Mr. Miller?''

''I have my methods. You might think them peculiar, and I don't propose to explain them just now.''

''No further questions,'' said Quentin Thomas. He sat down.

Judge-witness Jones got to his feet and stepped down from the witness chair into the court room. ''I have another witness.'' His robe turned from blue to green. ''I'm now the prosecutor. And spare us your objections, Mr. Thomas. As witness for the prosecution I call Mr. Cauchon.''

A man in faded denims and wearing a hard hat materialized into the witness chair.

''State name, residence, occupation,'' said Judge-prosecutor Jones.

''Pierre Cauchon, local, chief engineer, thermal maintenance.''

''You are familiar with defendant's new engine, H-TEC?''

''Yes, sir.''

''Would you predict, Mr. Cauchon, that Terra will soon begin to manufacture and utilize these motors in large numbers?''

Quentin Thomas jumped up. ''Objection! That's a leading question! You're telling the witness the answer you want!''

Judge-prosecutor Jones smiled faintly. ''I know. He works for me.'' He turned back to the witness. ''Your answer, Mr. Cauchon?''

''If somebody doesn't do something,'' said Mr. Cauchon, ''the motors will soon be the predominant energy source in Terra.''

''And if that happens, what will be the effect, *here?*'' asked the Judge-prosecutor.

''There will be a tremendous and continuing heat drain. Local temperatures will be expected to drop at the rate of about one-half degree Fahrenheit per year. In a couple of centuries local temperatures will level off at, say, eighty to eighty-five degrees F . . . like sort of a pleasantly warm summer's day on Terra.''

''No further direct.'' The Judge-prosecutor stood aside. ''Your witness, Mr. Thomas.''

The lawyer stood up. ''Mr. Cauchon, what qualifies you to be chief engineer for thermal maintenance? Please state your credentials.''

''Of course, Mr. Thomas. I was formerly Bishop of Beauvais. In that function I acquired considerable skills in the heating and combustion arts.'' He folded his arms across his chest in a gesture of complacent pride. ''I burnt Joan of Arc in 1431.''

''I see. Thank you, your grace. No further cross.''

''You may stand down, Bishop,'' said the Judge-prosecutor. When the cleric had dematerialized, the green-robed figure said, ''I call the defendant,

Mr. Carlton Miller."

The inventor looked at his lawyer nervously. "Do I have to testify?"

"I'm afraid so. Just get up there and answer Jonesie's questions the best you can."

"All right, if you say so." Miller walked up and climbed into the witness chair.

"State your name, residence, and occupation," said Judge-prosecutor Jones.

"Carlton Miller. I live here, whatever you call it. Inventor."

"Did anyone invite you here?"

"No."

"How did you get here?"

"I stopped through the heat-frame of my energy machine, and well, here I was. Or am."

"You stepped through deliberately?"

"Yes, but I didn't know where—"

"Strike everything after 'yes' as nonresponsive." The green-draped figure was thoughtful for a moment, then continued. "Do you own this place, Mr. Miller?"

"No, of course not."

"And you have no seisin, right of possession or occupancy, license, or easement here?"

"I guess not."

"No guesswork, Mr. Miller. Do you or don't you?"

"No."

"No further direct, Mr. Thomas. Your witness."

Quentin Thomas felt dizzy. He supressed an urge to shake his head to clear the cobwebs. He said: "Since you have been here, Mr. Miller, have you said anything to anyone?"

"Not a word."

"Nothing, shall we say, *offensive?*"

"Nothing at all."

"Have you *done* anything to anyone?"

"No. I haven't really seen anybody, Mr. Thomas, except Mr. Victor Higgins. You know about him."

"I'm going to object to this line of questioning," said the Judge-prosecutor. "Totally irrelevant."

"I was showing that nothing my client has done *here* requires his ejection," said Thomas.

The Judge-prosecutor vanished, and Judge Jones, black-robed, materialized at the bench. "I will sustain the prosecutor's objection."

"You're speaking now as the court?"

"Of course."

The lawyer turned back to the witness. "Mr. Miller, how long have you been here?"

"I don't know. Sometimes it seems like a hundred years, sometimes only yesterday. I don't know how to measure time here."

"Could it be twenty-one years?"

"Easily."

"No further questions."

"You may stand down, Mr. Miller." Judge Jones looked over at Quentin Thomas. "Is that your case, Mr. Thomas?"

"I'd like to call a witness on my client's behalf, your honor."

"Just whom did you have in mind?"

"Yourself, your honor."

"*Me?*"

"You."

"And what questions would you be inclined to ask me?"

"Just a couple. First, explain in rational terms why you won't leave Carl-

ton Miller in peace to walk the shore alone and listen to the sea symphony. Second, if you decide adversely to us, what, if any, is the appellate procedure?''

The judge's cheek scales became a luminous red. ''This is an incredible piece of impertinence, Mr. Thomas. You are asking the court to be a witness!''

''I remind your honor, you already are a witness—for the prosecution.''

''Silence, Mr. Thomas! I may have to hold you in contempt!''

''Just what would a contempt citation involve, your honor? Does that mean you would keep me here?''

''Perhaps. Perhaps not. Actually, Mr. Thomas, you'd not be any great catch. We've got thousands of lawyers here. But of course we could make room for one more.''

''Aren't you getting a little ahead of the game, your honor? I'm not dead yet.''

''A mere technicality, Mr. Thomas.'' Judge Jones rubbed his scaly chin with cupped talons. ''In any case I refuse to be called as your witness. Too, too demeaning. And I won't answer your questions from the bench.''

Quentin Thomas was silent.

''So then, Mr. Thomas, I think that leaves us with closing arguments. I waive the privilege for the prosecution. Do you want to close, Mr. Thomas?''

The lawyer sighed. Madness. But what could he lose? ''Your honor, in this litigation you have elected to serve as plaintiff, bailiff, judge, prosecuting attorney, and witness. I have no complaint as to your being bailiff. But I have certain comments as to your function in the other roles.

''First, as to plaintiff. This case is in the nature of a writ of ejectment. You are trying to eject Mr. Miller. But can you legally eject him? It is a basic prerequisite in a writ of ejectment that the plaintiff prove title in himself. Plaintiff recovers possession by showing the strength of his own title, not the weakness in defendant's title.''

Judge Jones yawned. ''Do hurry it along, Mr. Thomas.''

''Next,'' said the lawyer imperturbably, ''you have elected to be a witness in your own case. This alone warrants a dismissal of the case. If you want to be a witness, you'll have to find some other—*impartial*—judge.''

''None available, Mr. Thomas. Next point?''

''The same objection applies to your function as prosecuting attorney.''

''Noted. Anything further?''

''At no time during these proceedings, or for that matter, during your earlier determination that Mr. Miller had to be ejected, has he received the benefit of a jury.''

''But I simply combined the function of judge and jury. I have been the trier of fact. This is done in your American judicial system, I understand?''

''Only when both parties deliberately waive a jury. This, Mr. Miller has never done.''

''Oh, very well, then, you can have a jury.''

''But the hearing is *over,*'' protested Quentin Thomas. ''A jury can function only by listening to *all* evidence, from the very beginning.''

"A deficiency easily remedied, Mr. Thomas. I'll assemble a jury and give each juryman a thumbnail sketch of everything that went on."

"God!" whispered Quentin Thomas.

"Eh? What?" said Judge Jones sternly. "Watch your language, Mr. Thomas!"

"Sorry," clipped the lawyer. "Well then, where's my jury?"

"I'll give you a jury of four good men and true." As he spoke, four figures appeared in the jury box.

"I'm entitled to *twelve*."

"Oh come now, Mr. Thomas. Stateside juries can be any number. There's no constitutional requirement that a jury have twelve members."

"I see. Who are these four?"

"One you've already met. Pierre Cauchon."

"Who's also a witness," observed Quentin Thomas dryly.

"Makes for efficient use of manpower. Next, the Ayatollah Khomeini, late of Iran."

"Likewise unacceptable, your honor. The ayatollah is a former oil minister. He is totally biased in favor of oil."

"Shall I continue, Mr. Thomas, or do you wish to waive a jury?"

"Please continue."

"Next, Mr. John L. Lewis."

"Former chief of United Mine Workers. Totally dedicated to coal. And totally biased." He added grimly, "One more. How about someone representing nuclear energy?"

Judge Jones shot a suspicious glance at him, then smiled. "Excellent suggestion, Mr. Thomas. As a matter of fact, I offer you Mr. Martin Birnheim—"

"Chairman, United States Department of Nuclear Energy," finished Thomas. "Now, your honor, just one question for the record."

"Of course, Mr. Thomas."

"Is it the court's position that each of these men is neutral to the defendant and to defendant's invention? That Mr. Khomeini, for instance, doesn't care whether or not Mr. Miller's invention completely displaces oil as an energy source throughout the world?"

"No, Mr. Thomas, I don't mean that at all. Quite the contrary. Each of these four jurymen is vehemently opposed to Mr. Miller and his invention. Perhaps I should have warned you to expect some slight differences in your jury system and ours. You strive for disinterest. We, on the other hand, require our jurymen to take a vital interest in the case, and have a stake in the outcome."

Quentin Thomas passed his hand over his brow. "I see. So my client is really no better off than before."

"True."

"And possibly worse."

Judge Jones held out scaly palms in helpless frustration. "But it was *your* idea, Mr. Thomas."

"Defense waives a jury, your honor. We accept the record as heard without a jury."

"Not so fast, Mr. Thomas. I've been at some trouble to bring up these fine gentlemen. *I* don't waive a jury. Let's hear what they have to say. And I appoint the Ayatollah Khomeini as jury foreman." He turned to the four standing figures. "Gentlemen, have you reached a verdict? Mr. Khomeini?"

"Your honor," said the white-robed, turbaned figure, "we have reached a

verdict.''

''And what is it?''

''The defendant, Carlton Miller, is guilty of trespass, illegal entry, and subversion of the morals of this place. Furthermore, he is guilty of destruction of our energy resources. He must be ejected, up to that *other* place. But that is not all.'' The Ayatollah fixed burning black eyes on Quentin Thomas. ''This lawyer must remain here, as hostage for defendant's guarantee of perpetual banishment.''

Quentin Thomas was too astounded to be horrified. ''Me? A hostage?'' His red robes swirled out.

''Yes, a hostage,'' said Judge Jones. ''A *brilliant* solution. I completely concur in the jury's recommendation.''

By now Thomas had had a moment to think, and he relaxed a little. ''Meaning no disrespect, your honor, but I wonder if you and the Ayatollah have thoroughly considered all angles of this hostage business.''

''What are you talking about, Mr. Thomas?''

''Just this: Mr. Miller's H-TEC patent application has been allowed by the United States Patent Office. I have paid the final fee, and it will now automatically be sent to the Issue Branch in the Patent Office.''

''Is that significant?''

''Yes. Once his application gets into the issue mill, it will certainly be published in the *Official Gazette;* printed copies will be available to the public; thousands of energy machines will be built and operating within a matter of months, maybe even weeks, with their heat-frames plugged into this place and draining away your BTUs.''

''Make your point, Mr. Thomas.''

''If I get back right away, I could stop the official machinery. I could kill the patent. If I don't get back the patent will issue, and to paraphrase the bishop, hell will eventually freeze over.''

''You plead eloquently, Mr. Thomas. For both yourself and your client.''

''Thank you, your honor.''

''Under the circumstances, I will set aside the jury's recommendation,'' said the judge. ''And now, with consent of counsel, I will dismiss the jury. Do I have your consent, Mr. Thomas?''

''You do indeed, your honor.''

''I'm glad we agree on something. Gentlemen of the jury, thank you for your thoughtful participation. We now dismiss you.''

The four vanished in a puff of smoke.

''Where are we now, Mr. Thomas?'' asked the judge.

The attorney had been thinking. In chess, the best defense is a counter-attack. Was this a chess game? We shall see. He said, ''With the court's permission, I move to dismiss the pending order to show cause, and petition the court to order a transfer of the exclusive right, title, and interest in and to the seashore to Carlton Miller.''

''You are a very interesting person, Mr. Thomas,'' mused Judge Jones. ''Don't you ever give up? Don't answer that. I don't want to encourage you. If you had your way, you'd turn this around, wouldn't you? You'd bring a writ to eject poor Mr. Higgins.''

''I would, your honor.''

''But that would require a showing of title in Mr. Miller, wouldn't it? You don't even admit that *I* have title in the shore, Mr. Thomas. How could Mr.

Miller have any title if I don't?" The flamelets leaped up triumphantly in the reptilian eyes.

"Adverse possession, your honor. Mr. Miller held the shore exclusively and adversely to all comers for the required term."

"That's twenty-one years, isn't it?" said Judge Jones. "How do you measure time here?"

The lawyer's mouth twisted crookedly. "Your honor has precluded precise measure in this place by failing to provide a sun. The burden of proof as to passage of time or the lack thereof therefore shifts to the court. Unless the court has clear proof that twenty-one years did not pass, the court is asked to take judicial notice of the requisite term."

"Interesting," said the judge softly. "On the other hand, Mr. Higgins died a few seconds *before* Mr. Miller walked through the heat-frame, not twenty-one years *afterwards*."

"Granted, your honor. But the point in time at which you chose to materialize Mr. Higgins on the seashore has nothing to do with a twenty-one-year interval. For the nature of time here is this, that each moment is an eternity. And certainly Mr. Higgins didn't arrive there on the seashore till after what seemed an eternity to Mr. Miller."

"I understand your position, Mr. Thomas. Go on."

"Yes, your honor. May I remind the court again that my client committed a cold-blooded double murder, a crime of infinite horror. For this, he should be condemned to suffer in this place for eternity."

"But he *isn't* suffering, Mr. Thomas. On the contrary, he seems to *like* our humble facilities. Such conduct is giving the neighborhood a bad name. In fact, his presence here is wrecking the whole cosmic scheme."

"Is suffering the problem, your honor? Perhaps we can work out a compromise, a consent decree, whereby my client agrees to suffer, say once daily."

"Don't be ridiculous, Mr. Thomas. Do you have anything further to say?"

"No, your honor. That's our case. We await your verdict."

"An interesting situation, Mr. Thomas. We are going to have to eject Mr. Miller. No doubt about *that*. The only question is *where to*, and also, perhaps, *when to*. Back to Terra? Or is he dead, and must go to—ah, the other place?" He jerked his head upward. "But let's put Mr. Miller on the shelf for the moment and talk about *your* future, Mr. Thomas. As you have so ably argued, if you stay here, Mr. Miller's patent will become public knowledge, *out there*. And our cosy little situation down here will be soon drained of its heat. As an institution, we fade and vanish. We'll simply lose the calories we need to function properly. That would be sad. Very sad. So we can't keep you here. On the other hand, if we send you back, Mr. Thomas, there's really nothing to stop that patent from issuing. In fact, back there, you might even be inclined to exploit it yourself, publicize it even more, license it to all comers, all governments. So, in that sense, if we send you back, we but speed our doom here."

"No, your honor. If I did all that, the sulfur sea would die. That would be a

gross disservice to my client. I could be disbarred.''

Judge Jones burst into horrid peals of laughter. ''Are you indeed so honorable, Mr. Thomas? For several billion dollars in licensing income most of our lawyer tenants would have welcomed disbarment. And worse.'' The judge leaned forward over the bench and the scaled fingers folded together. ''I can't keep you. I can't let you stay. But there *is* a solution, which incidentally simultaneously and neatly disposes of Mr. Miller.''

''I don't understand.''

''Of course you don't. And you never will. Good day to you both, gentlemen.''

''But your honor? The decision? The verdict?'' His red robes fluttered uncertainly.

He found that he was talking to the air. Judge Jones had vanished.

Quentin Thomas looked down at the anxious face of his client. And that face, too, began to fade.

He was alone in the courtroom.

And then the room began to go.

And he with it.

9. A Rude Awakening

He woke up, disoriented by dreams and nightmares.

It was the phone.

He was stretched out on the chaise longue, in his study. The night light was on. How did he get here? He didn't remember falling asleep here. And especially not in his red robes for the defense.

He remembered the heat. Sure enough, his armpits were drenched. And his face was beaded with sweat. But how, why? The room air was cool enough.

The phone continued to work on him.

He looked at his wrist watch. Three A.M., June 10. *June?* Worse and worse. Wasn't it actually early October? What had happened to July, and August, and September? His watch must be wrong. Easy enough to check. He looked over at the wall clock. It too read three A.M., June 10. Very well, then. In that lost dream world it had been October. But here, in this room, in the real world, it was June. He had to accept it.

So, how about the phone?

The phone was a voice response unit. If, from where he sprawled, he said, ''Quentin Thomas, law offices,'' the device would open the circuit, more lights would come on in the room, and the automated notetaker would indicate its readiness by a tiny green light.

On the other hand, if he said (perhaps a bit grumpily), ''Recorder,'' the phone would stop ringing, and the caller would listen to: ''This is a recording. Quentin Thomas is not presently available. At the sound of the beep, please leave your name and number.''

His deepest instincts told him not to answer. That the consequences would be catastrophic. He saw all this with an eerie sense of *déja vu*. He saw images reflected back and forth, as between mirrors within his mind. If he could only *remember*. *Flames*. Was he trying to remember something about flames?

He saw flames dancing. They turned into musical notes. The notes turned into a symphony.

His nightmare was continuing.

The perspiration was evaporating from his clothes, and he felt chilled.

With mechanical patience, the phone persisted.

He had to get hold of himself.

Was he beginning to remember something? *What?*

He had staggered up to a sitting position on this very chaise longue once before, red-robed and sweat-drenched.

The phone had rung.

Had he answered? Yes, he had.

Then had come the horrors.

Fading . . . coming back . . . fading.

The phone continued to ring.

Wait! *It was all coming back!* Carl Miller . . . the acoustical flame . . . H-TEC . . . the double murder . . . the hearing . . . the heat. He had it all. Mr. Jones had thought to defeat him and Carl and to cancel out H-TEC—by the simple expedient of returning them to an endless cycle, starting at this hour, at this moment, with this phone call, repeating, repeating, forever and ever. Mr. Jones had thought to win by locking him and everything else into a closed loop.

But it wasn't going to work. The Jones solution had finally failed, because he, Quentin Thomas, now remembered everything, starting with this first phone call of June 10. And he knew how to break out.

Don't answer that phone! That was how to escape. Simply don't answer.

Carl, put your Mossberg 409 away. Leave Denise. Forgive them both. You have your music. Forget H-TEC. Perhaps sometime, somewhere, you'll still find the Tenth.

And may you and I never meet again, Mr. Jones. Never, never, never.

"Recorder," he said. ■

THE ANALYTICAL LABORATORY

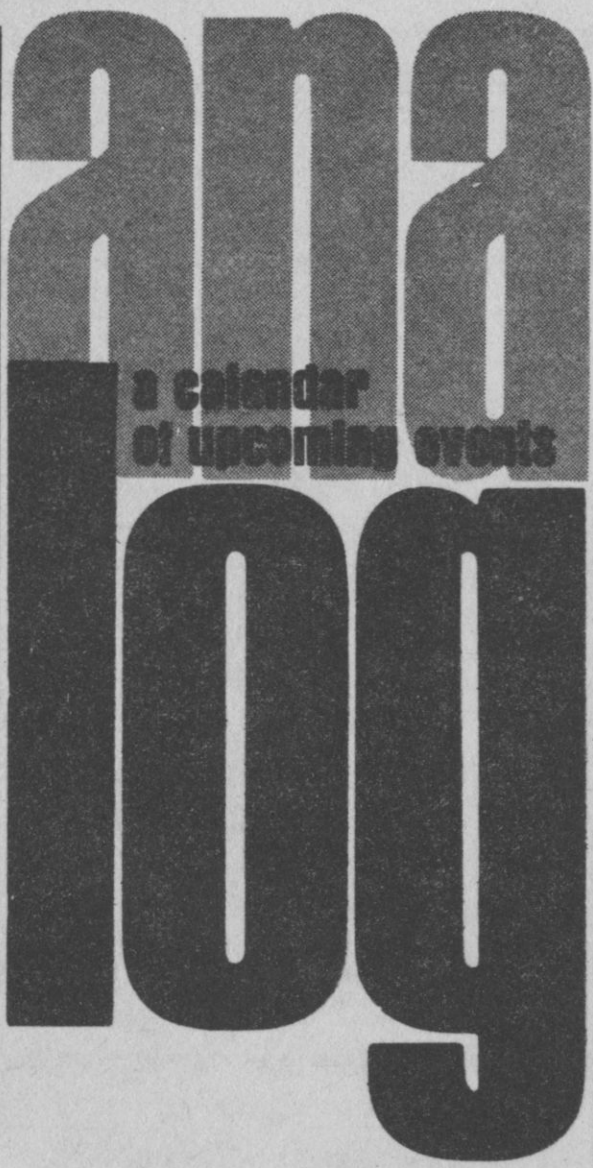
Continued from page 59

2. "A Taste of Dragon's Egg," Robert L. Forward (2.62)
3. "Death Risk," Milton A. Rothman (2.25)
4. "Man's Biological Future," L. Sprague de Camp (2.03)
5. "Steamer Time (Again?)," Wallace West (1.70)

Covers (1.67)

1. January: Paul Lehr, for *One-Wing* (3.76)
2. February: Kelly Freas, for "Savage Planet" (2.96)
3. March: Vincent di Fate, for *World in the Clouds* (2.74)
4. April: Paul Lehr, for "Nightflyers" (2.73)

Voting at the top of the novelettes was pretty tight: Michael McCollum's "A Greater Infinity," Charles Sheffield's "Moment of Inertia," and James White's "Federation World" were all hot on the heels of the winners. And it's interesting to notice that while we sometimes get complaints about a growing emphasis on science fact which some people (mistakenly) think they perceive, you voted a resounding first place to the longest article of the year (and, I think, one of the most challenging we've published since I've been here). Looks like quality can sometimes overcome reservations about quantity. ■



4-7 May
NCC '81 at Chicago, Ill. The National Computer Conference. Info: AFIPS, 1815 N. Lynn St., Suite 800, Arlington VA 22209.

8-10 May
Kubla's Ninth Khanphony (Tennessee-area SF conference) at Holiday Inn, Nashville, Tenn. Guest of Honor—Charles L. Grant, Master of Ceremonies—Andrew J. Offutt, 1981 Frank R. Paul Award Winner—Jack Gaughan, Special Guests—Forrest J. Ackerman and Stephen King. Registration—$8 in advance, $11 at the door. Info (registration/art show): Ken Moore, 647 Devon Dr., Nashville TN 37204. 615-832-8402. Info (hucksters): Larry Wolfe, 410 N. 16th St., Nashville TN 37206. 615-228-8850.

10-13 May
NUCON (Australian regional SF conference) at New Crest Hotel, Sydney, N.S.W. Guest of Honour—Larry Niven. Info: Geoff Langridge, 1 Raper St., Newtown NSW Australia.

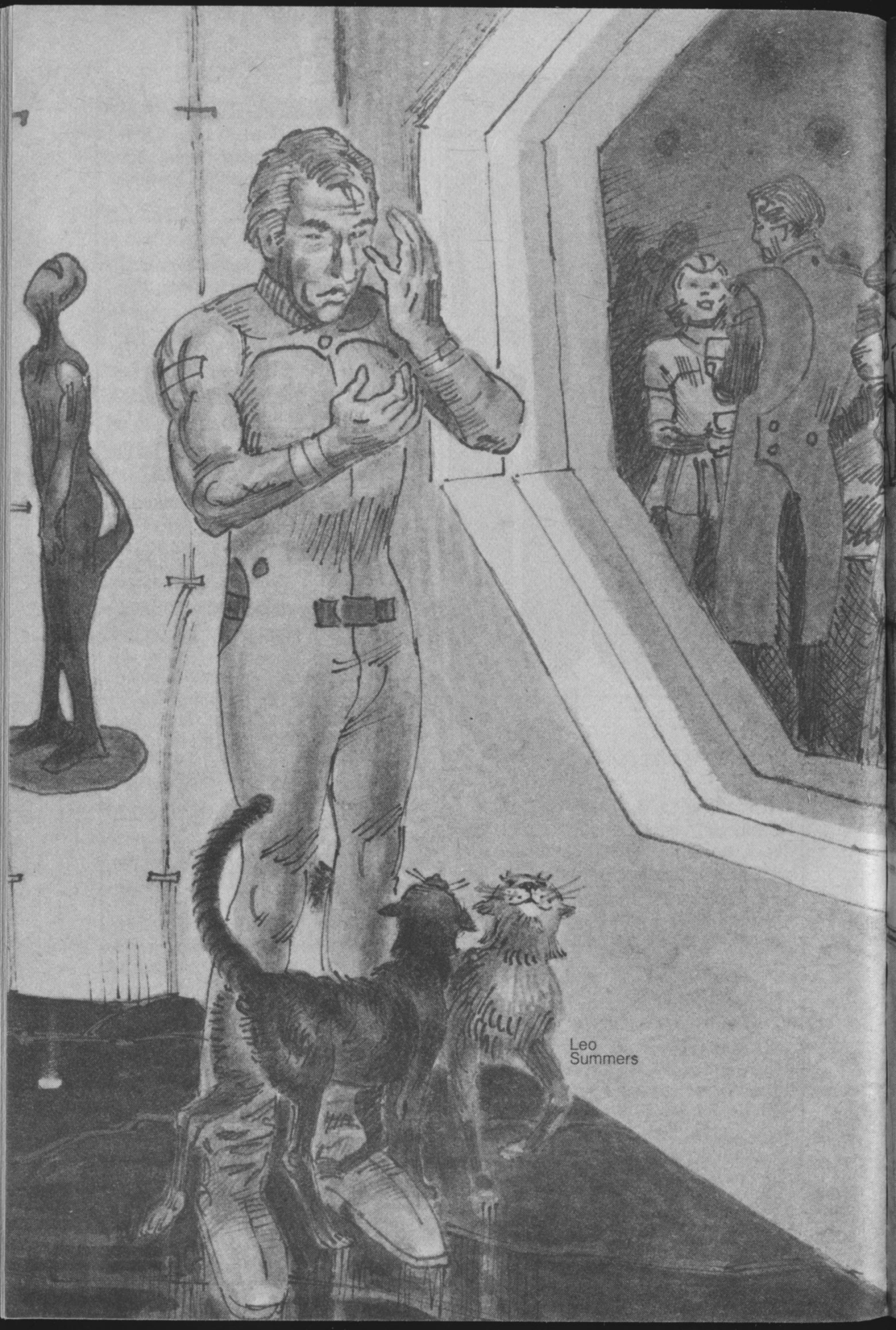
22-24 May
V-CON 9 (British Columbia SF conference) at Holiday Inn, Harbourside, Vancouver, B.C. Guest of Honour—Vonda N. McIntyre, Fan Guest of Honour—John Gustafson, Toaster—Jon Singer. Registration—$12 until 15 April 1981, $15 thereafter. Info: V-Con 9, P.O. Box 48701, Bentall Stn., Vancouver, B.C. V7X 1A6 Canada.

22-24 May
DISCLAVE (Virginia SF convention) at Sheraton National Hotel, Arlington, Va. Guest of Honor—Isaac Asimov. Registration: $7 before May 1; $10 afterward. Info: Alexis A. Gilliland, 4030 8th St. S., Arlington VA 22204.

29-31 May
AMBERCON 3 (Kansas-area SF conference) at the Holiday Inn Plaza, Wichita, Kan. Guests—Ken Keller (fan), Bill Warren (artist), Walt Liebscher (special), Edward Bryant (toastmaster). Info: AmberCon 3. Box 947, Wichita KS 67201.

2-7 September
DENVENTION II (39th World Science Fiction Convention) at Denver Hilton, Denver, Colorado. Guests of Honor—C. L. Moore and Clifford Simak, Fan Guest of Honor—Rusty Hevelin, Toastmaster—Edward Bryant. 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: Denvention II, P.O. Box 11545, Denver CO 80211. 303-433-9774.

—Anthony Lewis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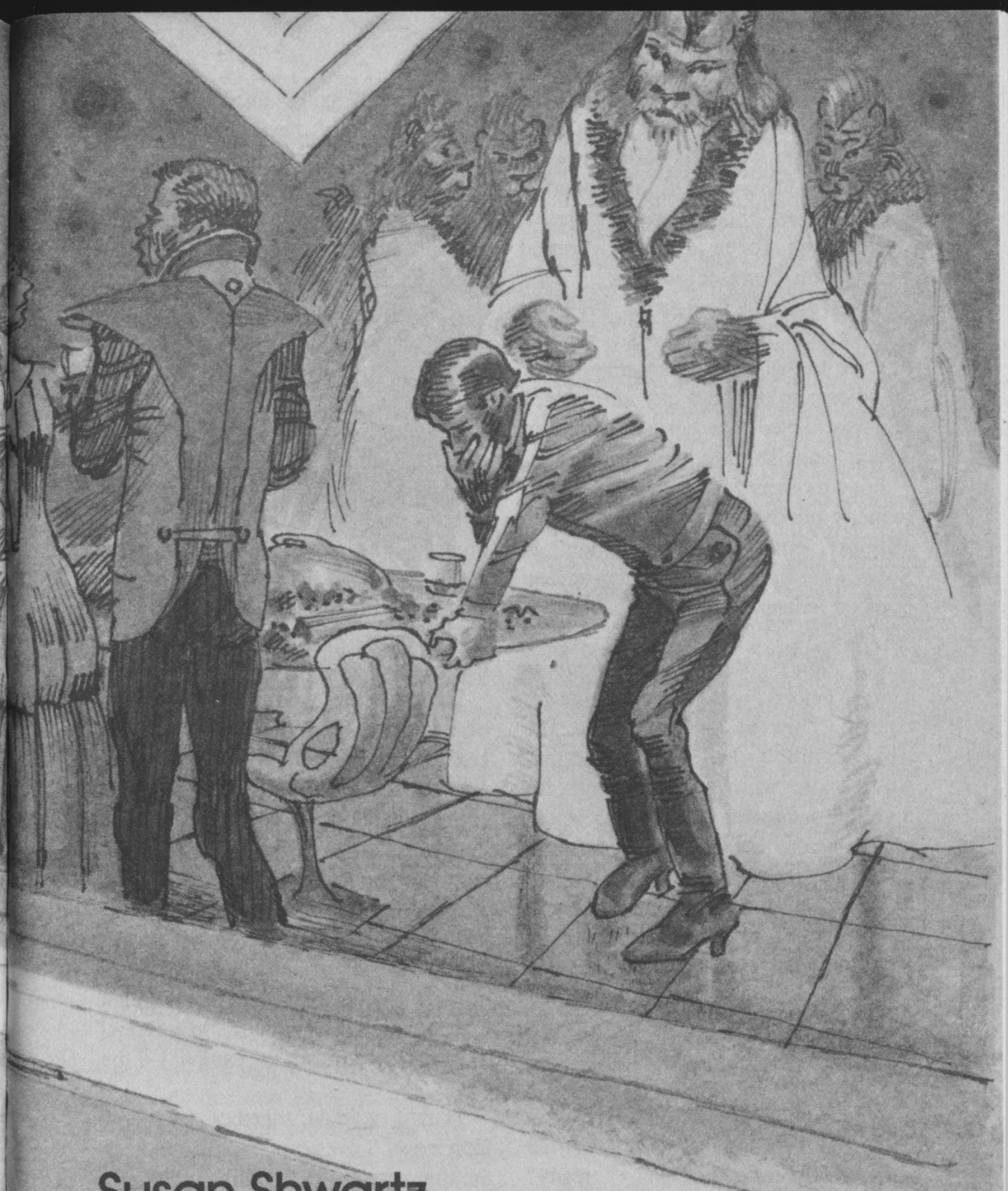


Susan Shwartz

Cultural differences are only *one* of the possible barriers to human-alien interaction.

BY A NOSE

Locked outside the *Edmund Rostand*'s decontamination chamber, Jon MacLeod listened while his partner raved.

"Damned fedayeen . . . they bombed the generators," Sonia Yerushalmi cried. "Now the force dome's shorted out . . . the Dome of the Rock . . . it's collapsing. GET BACK THERE! . . . Oh my God, the sirens. . . ."

Even though Sonia had never come any closer to the holy city after which she was named than her homeworld of Ararat, anguish rang in every word.

For a moment MacLeod was tempted to break into the sealed decontamination chamber, but only for a moment. If Sonia were hallucinating that fedayeen bombed Jerusalem, she'd probably snap his neck.

If I didn't collapse with whooping asthma before I got to her, he thought bitterly. Then he sneezed again. The large, sensitive—hell, too damned sensitive—nose which had won him the revolting nickname Cyrano was blocking up again. He reached for an antihistamine spray. Maybe the human race *had* invented a faster-than-light drive; it still couldn't get rid of allergies. Barak and Deborah, Sonia's cats (tolerated on board ship because they killed stowaways that he was *really* allergic to), rubbed against his legs as if they sensed that their human was in trouble.

"Form up," Sonia was ordering an imaginary Peaceforce squad. "Get the perimeter defenses in place . . . ready? As soon as those ships enter range, fire!"

Jon glanced at the control panel. The red light still flashed: **Unsafe To Enter.**

"What happened?" he asked the steaders who'd brought Sonia in.

"We've all gotten used to these episodes," Mtebwe, head of the steaders' council, told him. "Just as we were getting down to arguing island rights with the Melissoi, Contracts Administrator Yerushalmi took off, screaming about an alert."

"Great," murmured MacLeod. He looked for contempt in the big, healthy man's eyes. *Good old Cyrano MacLeod—won't even leave his ship to help his partner. The pilot who's allergic to planets*. Dammit, he hadn't asked to be born in an L-5 colony with massive allergic reactions to most planet-bound objects—dust, trees, animals, unsterilized water. And his first year of Earthside schooling had been a disaster. *Let's take Cyrano out into the fields and watch him wheeze*.

Lucky for him, AgriTerra desperately needed pilots to service their expanding Homesteaders Incorporated subsidiary; pilots who were only glorified taxi drivers for the contracts administrators like Sonia, who helped the investment steaders make planetary investments pay.

Now Sonia cowered against a bulkhead. Cowered? Sonia Yerushalmi had never cowered in her life. She clawed up into a defensive posture and defied her imaginary enemies. "Murderers! You won't put me in the camps, I'll die first. . . ."

They'd worked together for—how long now? Two years. Sonia had been the first person—beside his shrink—not to call him Cyrano. "Jon," she'd said once, "nobody is allergic to planets. And you've got immunities. You can beat this. What else do you have that research lab on board for?" Research into allergies was his hobby. Maybe it

had begun on a know-thine-enemy basis, but it had expanded into a genuine fascination. Jon "Cyrano" MacLeod might be allergic to most microbes, but he was a pretty damned fine microbiologist.

A beep from communications drew him away from the observation panel, and he activated the message readout.

AGRI-TERRA, HOMESTEADERS, INC. (subsidiary) TO C.A. SONIA YERUSHALMI. SETTLERS, BETA HYDRI IV, DENIED FIVE-YEAR CONTRACT EXTENSION. ACKNOWLEDGE RECEIPT. END TRANSMISSION.

Investment steaders had ten years to show a profit and then—well, people did say that Homesteaders, Inc.'s motto was "Use it or lose it."

Jon's first glance through the viewscreens at Melissa had convinced MacLeod of one thing: he didn't want this world. In fact, he didn't care if he *never* went outside. Melissa, Beta Hydri IV, with its fronds, its blossoming trees and sweet winds, might be an agriculturist's paradise, but the pollen count would lay him up for weeks.

So he'd seen the Melissoi only in holos. Like humans, they weren't native inhabitants of Beta Hydri IV, but they'd serenely accepted humans and the name that some classical scholar among the steaders had tagged them with. The century-old decision *Earth vs. Doona* had established legal precedent for two sapient, non-native species sharing the same world, but law and AgriTerra often fought it out. The steaders could only stay if they managed to show a profit. But every time they sat down to discuss apportionment of Melissa's land, minerals, and water rights, they found themselves almost negotiated off the map by the Melissoi.

Not to mention the hallucinations which had Sonia out there in deep space without a ship. MacLeod wished they had never come to Melissa. Unhappiness—and his allergy to her cats—made his eyes water as he watched her square off against imaginary storm troopers. "Nazis! Melissoi! I'll rip your fur out!"

Sonia had actually told him that she found the gentle, intelligent Melissoi most attractive. They were covered by long, honey-colored fur, so peaceful they didn't even eat meat, and possessed of a complex system of reciprocal obligations that the settlers were struggling to learn. Do one of the Melissoi a favor and he had to reciprocate—except during business hours. Anything else was *i-karu*, and Melissoi were never that.

Hurling herself against imaginary Nazis, Sonia came up against a chair and knocked the wind out of herself. The red light signalling decontamination in process blinked out. Good! MacLeod cracked the seal and ran to her.

Chlorpromazine, he thought. It suppressed hallucination. As it took effect, MacLeod hoisted her onto his shoulder and set off for sick bay . . . and his research lab. He was astonished at how light she felt in his arms. Howling plaintively, Barak and Deborah scampered between his legs all the way to sick bay.

The comm in the tiny room beeped and Jon punched for reception. Hearing Mtebwe's agitated voice, he activated visual reception, too. The big man looked as bad as he sounded.

"Cyrano, that you? We just heard from Homesteaders, Inc. Did they si-

mulcast to you?''

''I've been watching the contracts administrator, but I heard. Tough luck, Mtebwe.''

''I'm not surprised. Remember? I used to work for AgriTerra. Use it or lose it. Listen: can I talk to Ms. Yerushalmi? How is she?''

MacLeod glanced over at Sonia: olive skin, dark hair, small sturdy body mounded under heat-trapping foil blankets with her cats huddled protectively against her. ''Sleeping it off. Your medics haven't got any idea of what causes these episodes?''

''Nothing we can prove. You've got the reports.'' Mtebwe looked uncomfortable. ''I really have to talk with her.''

''I'll try to wake her. If I can't bring her around, I'll put my suit on and come out myself,'' he promised Mtebwe. *Great going, Cyrano. What do you think you can do that* she *can't?* A little too abruptly for politeness, he signed off before the other man could say just that.

''I got concessions out of . . . Melissoi before I . . . what happened?'' Sonia muttered. She started to sit up and dislodged Barak from her shoulder.

''Mtebwe brought you back screaming about terrorists.''

Sonia dashed a blunt-fingered hand across her chin-length dark hair. ''God. I feel like I fought the war all by myself. But I know I got the Melissoi to agree to some very favorable allocations on that big island.''

She leaned forward as Jon brought up the contract record from the computer. As the green letters formed in the liquid crystal readout, they both groaned.

''That land's vertical!'' MacLeod said. ''You got the steaders the face of every goddamned cliff on the goddamned island!''

''Stop shouting,'' Sonia told him, rubbing her temples. ''It makes my headache worse. I know there were some mineral rights—yeah. Those cliffs are shale rock. Shale oil—that's it—''

''Fine, if you were dealing with the anachronists who still use petrochemicals.''

Yerushalmi swore in Hebrew and Arabic. ''Oil. That figures. Must have reverted to racial memory or something.''

''You told me Jews aren't a race, remember?'' MacLeod grinned.

After a moment, Sonia grinned back. Then she sighed. ''I'll just have to go back and talk to the Melissoi again.''

''Rest first.''

''The steaders haven't got that kind of time. Homesteaders denied the extension, didn't they? And Mtebwe's probably frantic.''

''Even so, they can wait for a few hours,'' MacLeod ordered. ''Now, are you hungry?''

Sonia lay back. ''Not really,'' she murmured. ''But if I'm not being a complete *noodge*. . . .''

''Coming up.'' Of all the scoutships in AgriTerra's fleet, only the *Edmund Rostand* had a galley programmed for chicken soup.

Sonia Yerushalmi sat with the steader council of five and Mtebwe, waiting for the Melissoi. She glanced curiously around the dome that served the steaders as a town hall. The Melissan steaders were something new in her experience. Most investment farming communities

were members of one minority group, like the Zionists who had fled Pan-Mesopotamia to homestead Ararat. But *these* steaders! Mtebwe wasn't the only black, and Sonia had seen Scandinavians, Orientals, a sizeable portion of the nationalities of Old Earth represented on the community's files.

How well will they stand up together? she wondered. Without some sort of religious or cultural bond, soon people might simply write off their investment and pack up, Sonia feared.

She glanced over at Jon. He sat far from the dome's iris, his entire body covered in protective gear. A transparent facemask and oxygen tank made it possible for him to watch this meeting as he'd insisted on doing without coming down in asthmatic attacks.

Suddenly, Lisa Rorvik, the steaders' treasurer, began to sway and croon in her seat. Two of the audience helped Rorvik out of the dome. Her deputy took her place at the conference table. The hallucinations had forced these people to learn to work together, it seemed. If you were working on the fusion reactor, or felling trees, or with valuable (and expensively leased) equipment, and your partner started tripping out, you needed to depend on the people around you.

Nice people, thought Sonia. *They deserve to win. And I've only made things worse with that shale rock. . . .*

Six Melissoi entered, one for each of the steaders on the council, followed by a seventh. He was tall like the others, with that long, honey-colored body fur that served the aliens as warmth and adornment. *Barak and Deborah think they have pretty coats, do they?* Sonia longed to run her hands over the Melissoi's fur. Part of her immediate attraction to them was her fondness for her own cats, she knew. So did Jon. One of the reasons he'd come along this time was his own allergy to cats and his insistence that, cat-hater and planet-hater that he was, he might pick up something she had missed.

The council and its chairman rose and bowed politely to the Melissoi. Several Melissoi observers carried bundles and trestles. Amiably they helped the humans set up an informal buffet.

Jon had raised hell at that. "You mean you see people bouncing off walls in hallucinations and you still eat with these aliens?" he'd exploded.

The Melissoi were great ones for sharing food. Though they refused to touch animal protein (politely concealing any revulsion they might feel toward carnivorous humans), they expressed pleasure at the taste of Terran carrots and artichokes adapted for Melissan soil. Well, that was something: if the settlers lost their contract, the Melissoi might take their crops off their hands.

"So you can eat their food," Jon had roared. "Do you have to?"

Melissan custom decreed that you shared food with the people you talked business with—or you didn't do business. Sonia, like the settlers, helped herself sparingly and hoped for the best.

"Klee-yes, Ms. Verushalllmi," one of the Melissoi chided her. From the silvering in his fur and some incalculable dignity of carriage, she knew he was an elder. "You must shhare with uss."

He ladled out a more generous portion of the high-protein fungi that Melissoi regarded as a delicacy.

"Thank you," she said. She served the alien in her turn from a dish of cassoulet. Melissoi liked lentils. As she and her—*her dinner partner,* she grinned to herself—returned to the table, she noticed Jon collecting samples of food and the spices in which it had been cooked. Maybe the medics had pronounced it harmless, but Jon would make his own tests.

Were the Melissoi deliberately feeding humans a hallucinogenic food to which they were immune? Nothing in their psychology would justify such behavior: they would call it *i-karu.* Poisoning—genocide—was a human trick: atrocities like gauchos slaughtering Indians, Englishmen selling smallpox-ridden blankets . . . Melissoi didn't do that.

Just as well that humans and Melissoi had concealed their homeworlds' locations from one another. Sonia had a horrible mental picture of the Melissoi arriving at AgriTerra's headquarters and, with perfect courtesy and devastating competence, winding up owning AgriTerra, Homesteaders, Inc., and a good chunk of the rest of human society. It would be too bad if their superior trading skills made humans distrust and attack them . . . for that, too, was a human trick.

Meshugah, she told herself. She shoved away her plate, leaned forward, and projected a holographic map of the island with its damn shale-oil bearing cliffs. She began to explain earnestly to the Melissoi that the owners of such cliffs really deserved access to them by land as well as by sea.

The nods of the council and the respect in the lambent, wise eyes of the Melissoi confirmed that she was winning her point. The elder waved a hand—a paw?—and answered.

Concession! At least she'd won the steaders a partial victory. Sonia allowed herself to relax slightly. How beautiful the light was, glinting on the alien's fur, and how venerable it made him look. Sonia was sure that the one she sat across from had to be male; the fur made him look like a sage with a beard and shabby eyebrows, like her grandfather, who had been one of the first settlers on Ararat. *Zayde* had always reminded her of Moses Maimonides. So did this tall, furred alien. *Maimonides on Melissa,* she mused, and started to giggle.

Here I go! Before she panicked or spaced out completely, she thumbed off the contract recorder, stood up to leave . . . and keeled over.

Jon worked in his lab within calling distance of Sonia. She slept off another set of hallucinations and another dose of chlorpromazine. At least this time she hadn't fought imaginary terrorists. She'd giggled in his arms all the way back to the ship, babbling about Moses Maimonides, the Melissoi, and some Old Earth Caliph instead.

The smell of the spices in which the Melissan food had been cooked wafted through his nose filters, and he turned on a blower. *Wouldn't be much good, would he, if that nose of his betrayed him? Even if he was called Cyrano.* His research equipment was better than anything the stead doctor had: perhaps he'd catch something the local medic missed. For example, that spice that looked like nutmeg: in large enough quantities, nutmeg was hallucinogenic. But he fought

off a feeling of helplessness.

Several hours later, the lab results gave zero readings—just as he'd feared—on dopamine, mescaline, or lysergic acid diethylamide, his likeliest suspects. Even the unlikely ones had tested out negative. Something was playing stars and comets with the steaders' nervous systems, all right, but it wasn't the Melissoi's food. And, until he could isolate a cause, he couldn't start working on a cure. All right: so he could drug the entire population on chlorpromazine, but that way they'd never get anything done.

Use your brains, Cyrano. Use 'em or lose 'em.

Something that affected all the humans on the planet except him. And he, of course, was muffled in protective gear, even his eyes covered.

It wasn't Melissan food. Maybe it was the Melissoi themselves.

The ventilation system in the *Rostand* sent continual currents of sterilized air through the conference room where Sonia and MacLeod sat with the steaders' council—Mtebwe, Lisa Rorvik, Hosato Eriko, Jan Arvidsson, the chief physician, and an engineer. Although all of them had passed through extensive decontamination, MacLeod was taking no chances—not with the antiseptic cleanliness that his own health depended upon.

"We know it's something in Melissa's environment," he said. "But this room is clean. It shouldn't affect you here. Maybe it's the Melissoi?"

"Why haven't you had it?" asked Lisa Rorvik.

"Cyrano is hyperallergic, remember?" the physician asked. "When he came to the last contract meeting, he was—"

"Totally shielded. I didn't even breathe the same air. For all the contact I've had with your world, I might be in deep space." *And I wish I was.*

Jon fingered his outsize nose and saw Sonia watching him. She knew how much he hated his nickname. Sympathetically, she passed him his inhalator. Maybe Barak and Deborah had been banished from this meeting, but his sinuses picked up traces of their earlier occupancy. Damned cats!

"I have to thank you," Mtebwe told Sonia. "At least we've got a fighting chance now. . . ."

"I feel as if I've failed you," she said. "I can't understand it. He seems so reasonable, that Maimon—"

The black man looked puzzled. Sonia flushed. "When I . . . as I began to trip out, I thought that one of the Melissans had turned into Moses Maimonides. He was a philosopher who served a twelfth-century Caliph in what was North Africa back on Earth.

"You know," she continued, "there's a story about Maimonides. He was physician to the Caliph. A lot of wealthy Muslims envied him that post. Why should an infidel, a Jew, have such power? So, to antagonize the Caliph, one man told him that Maimonides was saying he hated being around the Caliph because his breath was so bad. And then he went and told Maimonides that the Caliph had said the same thing about him. Now, Maimonides felt terrible, because the Caliph was his friend as well as his patron. What made it worse: he had to be at court the next day. Well,

he went, and he wore a white handkerchief tied over his mouth to protect the Caliph from his breath, and what do you think? The Caliph was wearing one too!''

''Are you saying that the Melissoi's breath . . . that when we sit in the same room with them. . . .'' Arvidsson began to cry and hiccup.

''Here.'' Quickly MacLeod handed the physician a spray hypo. He glanced at the label and administered it. *I'm going to run short on chlorpromazine,* Jon thought. ''But there aren't any Melissoi here, and Arvidsson's just flashed back into hallucination. Sonia, so much for your breath test.''

''No, MacLeod,'' said the engineer. ''Once a hallucinogen enters the bloodstream and starts affecting the nervous system, it takes quite a time for the enzymes to clear it away. And, since the hallucinogens derange the neuron receptors, you get flashbacks—more hallucinations. So, if Contracts Administrator Yerushalmi suggests that the Melissoi's breath produces hallucinogenic vapors—''

''They'd be so different from us internally that we couldn't share food,'' the physician stated. ''Our food would give them violent allergic reactions, and it doesn't. So that's not it.''

''Maybe we could explain our problem to them—'' suggested Hosato Eriko. ''They might find the idea of their affecting us while remaining sober themselves *i-karu.*''

''Or damned good business,'' said Mtebwe.

''But this is *i-karu,*'' the Melissan Sonia still referred to as Maimonides said. Despite the long, soft fur which covered his face, his distress was evident. It haunted the large, expressive eyes, hunched the broad shoulders. Even his fur seemed to crisp and riffle in agitation. ''Wha-aat sshall we do?''

One of the other Melissoi answered, and Maimonides rebuked him sharply. The younger alien continued in trade speech. ''I have told—'' a rush of water over rounded stones that apparently was the chief elder's name— ''that you humanss have sstimulantss that we might drrink and uphold *karu* thereby. . . .''

''Jon, this isn't going to work,'' Sonia observed sardonically. Then she yawned and cursed the tranquilizers that prevented her from hallucinating . . . or concentrating.

She was right. By the time the Melissoi each had had two drinks, all the steaders knew it too. The Melissoi couldn't take alcohol. Looking sick and profoundly embarrassed, one of the younger Melissoi left the dome rapidly. Two others, including Maimonides, fell asleep.

A disgruntled, discontented MacLeod and Yerushalmi walked back to the *Rostand.*

''I hate being responsible for these people's defaulting,'' Sonia reproached herself for the hundredth time. ''Use it or lose it. They're going to lose their investment and I don't know what else to do.''

She stumbled, and MacLeod put out a suited arm to steady her. Melissa's one moon was in eclipse, and a reddish glow turned the fronds and waving trees into a magical private kingdom. Another man, walking in the moonlight—*or lack thereof,* Jon thought

wryly—might keep his arm about her shoulders, try to kiss her. But if Jon kissed Sonia, all she'd feel was a faceful of plastic tubing. Another man might say something, the right thing.

Some Cyrano, he observed cynically to himself. Cyrano de Bergerac, the poet, always had had the right words . . . even if he'd put them in the wrong man's mouth. But at least he'd had the satisfaction of knowing that his Roxane, even if she'd married Christian, had loved him.

But all MacLeod could mumble was, "It isn't your fault."

"If I'd worn a protective suit like yours, I wouldn't have this—this whatever-it-is—in my system. I could negotiate without being afraid I'd space out in the next instant. Maybe you should conduct the rest of the negotiations."

"I wouldn't know what to say."

"Cyrano, at a loss for words," teased Sonia sleepily.

Dammit, she'd never used his nickname before! "Don't call me that! You know I hate it!"

"Jon, I'm sorry. It's this damned trank . . . no control over what I say."

But he was too frustrated, too angry at their bafflement, at his feelings and his inability to express them to hear her.

"Do you think I like it? Cyrano of the *Rostand,* big-nose MacLeod. One whiff of an alien world and he gasps for breath. The nose may be big, but it's damned ugly and damned useless. Hell, I even need medication to cope with those stinking cats of yours."

The argument about the cats was as old as their partnership. The black humor of their situation hit him a second before it hit Sonia, and they both started laughing.

"It isn't my cats' smell you're allergic to—"

"I wouldn't bet a quarter's pay on that," Jon chuckled.

"You know it's the dander from their fur that people are allergic to. You especially, because—"

"Because I'm more allergic than —wait a moment!" He stopped so rapidly that Sonia bumped into him. For a moment she almost was holding him in her arms. Even that didn't register. Jon felt as if he were standing in blinding light from the force of his sudden revelation.

"Dander! That's it!"

"That's what?" Sonia asked. Law she knew, and history, and the martial arts, and hundreds of other useful things. But she didn't know allergies; couldn't know them the way Jon did. Because of his own allergies, he was probably the greatest expert on them in ten worlds.

"The Melissoi are fur-bearing creatures." He plucked off Sonia's hands. "I have to get back to the Dome right now."

"Why?" Sonia's voice rose plaintively.

A normal man would have enjoyed the night wind against his body as he ran, MacLeod thought. For the first time in his life, that observation gave him no pain. Because of his allergies, that hated lifelong handicap, he could solve the problem of what about the Melissoi affected humans. Normal people with normal allergic reactions wouldn't think of it. *Dander. . . .*

Maimonides still slept off his drink

at the conference table as MacLeod barged in. Running up to the elder, he drew his bush-knife and cut free a hank of fur which he tucked into a belt pouch and carefully sealed away.

"I thought for a moment you meant to stab him," Sonia commented from behind him. "But you're just going to test his fur."

"That's it, Sonia!" Exultant, he picked her up in a bear hug and swung her around. "And if the hallucinogen can be derived from my tests—and it can—then I ought to be able to develop some kind of counteractant."

"You've done it!" she shouted, disturbing the few humans who slept in chairs in the dome. One of the Melissoi stirred, his malt-brown gaze resting suspiciously on MacLeod's pouch and the bald spot in his elder's pelt.

"*I-karu*," Sonia reminded herself. She gathered the longish hair at the back of her neck and marched over to him. Pulling out her own knife, she handed it to him hilt-first. "Here," she said, "you cut it. Let *karu* be maintained."

They had sequestered themselves on board *Rostand* while Jon, with Sonia's inexpert help, experimented with Maimonides's fur. To all inquiries from the steaders' comms, a recording answered that they had isolated the cause of the hallucinations.

The remedy that Jon and his computer synthesized much later was tested on an insistent Sonia. "I'm not much use if I keep on hallucinating, am I?" she asked reasonably. "And if I keep taking tranks, I might as well put in for a disability pension right now."

When she showed no ill effects and—a ship's day later—hadn't hallucinated again, MacLeod administered the drug to himself, just to be on the safe side. The sterile solution was something he didn't think he could be allergic to. He disposed of what was left of the fur and climbed gratefully out of his protective suit.

"All we have to do now is mass-produce this—or—" he yawned prodigiously.

"The steaders have medics. Let them do it. You're going to get some sleep," Sonia said. She steered him to his cabin and, despite his embarrassed protests, all but tucked him into bed. Deborah jumped up beside him, he sneezed, and she shooed the cat away. "You sleep. I'll contact Mtebwe."

Once again the steader council met on board the *Edmund Rostand*. When the steaders called him Cyrano, this time Jon MacLeod only smiled. He'd nosed out the answer, hadn't he? A long sleep, a bath, and a huge meal—on top of his achievement—made him feel as if he were basking on the beach under warm sun. So what if that was a condition he could only simulate with UV in the ship's solarium? If he could counteract the Melissoi's hallucinogenic dander, he could conquer his own allergies . . . one of these years. For the first time in his life, he believed that.

"What's in this stuff?" asked Mtebwe.

Sonia tapped out an access code from the computer which the physician studied as MacLeod explained.

"The hallucinogen produced by the Melissoi's fur is an indole amine roughly analogous to the LSD synthesized first during the mid-twentieth century. It's

similar to the neurotransmitters serotonin and norepinephrine. So similar, in fact, that it substitutes for them in sensory and cognitive neural pathways. Hence the hallucinations. And you get repeat performances—flashbacks, as the hallucinogen wrecks the synapses more or less permanently. Even the normal excitants that should be there—serotonin and norepinephrine—don't fit.''

''What about genetic damage?'' Rorvik asked.

''I can do genetic counselling,'' the physician said.

''You won't have to worry about Melissoi any more,'' MacLeod told the council. ''Not once you get these pills into your system. First, they contain a chlorpromazine derivative to stop those little jaunts into otherwhere you've been likely to have. Sonia's been taking that stuff just to be able to function. Then there's a block called dibenamine. This isn't just an antagonist to the hallucinogen, but, as a block, actually stimulates the production of norepinephrine. Next, the cure sensitizes the nervous system to such an extent that the receptors can't mistake anything else for the excitants they're supposed to have. Nothing will sneak in.

''And finally,'' here MacLeod grinned, ''since I thought that their fur gave them a certain natural advantage, I decided I'd better maintain *karu* by providing you people with an advantage too. You're not just going to be staying sober, friends. From now on, you're going to be operating on the level of an adrenaline high whenever you take this stuff. And, if you need to rest, you simply stop taking it—and stay away from Melissoi. It's safe. In any case, you'll be able now to catch up to the Melissoi and keep even—''

''This part's my job,'' Sonia interrupted. ''What Jon's saying is that you're going to be able to honor your contract with Homesteaders, Inc. The Melissoi won't be able to outbargain you any more.

''Congratulations.''

As Melissa waned first into a tiny green disk, then a green pinpoint, and as even its star became indistinguishable from any other star, MacLeod felt a great sense of relief. He welcomed the boredom and tranquillity of deep space.

''Where do we go next?'' he asked rhetorically.

''Orders coming in,'' Sonia informed him. ''AgriTerra wants us to report for briefing at Central, then proceed to Amazonis.''

MacLeod swore explosively, then sneezed. ''A jungle world! Do you have any idea of what the plant life—let alone the humidity—does to my. . . .''

''You've got your lab, haven't you?'' she asked, unsympathetic.

''Yes, I've got my lab.'' Maybe he could stop being red-nosed, wheezing Cyrano . . . *one of these days*.

''It'll be good to dock at Central Station,'' Sonia thought out loud. ''You like it there, don't you? I certainly think we're entitled to celebrate. I know I mean to.''

What—or who—was Sonia looking forward to seeing there? Before Melissa, Jon might simply have brooded in jealousy. Now, however, he gathered up his courage. If Cyrano de Bergerac, his namesake the poet, could find words, so could he.

At least he could try.

"Who's on Central, Sonia?" he asked. "Someone I don't know about?" Now he had it. He'd turn the whole matter into the same old Cyrano-joke. "Is the *Rostand* going to lose you to Christian, Roxane?"

"Jon MacLeod," Sonia snapped, revolted, "my name isn't Roxane. And what makes you think a woman from Ararat could possibly fall in love with someone named Christian?"

Jon put both hands over his face. He should have known.

"But is there anybody else?" he persisted. If there were, well, he wouldn't like it and he'd hate losing her as his partner, but he couldn't continue in this silence any longer. At least now, Sonia knew how he felt—and in a moment, he'd know where they stood.

Sonia was looking him over as if she actually liked what she saw. "Another man." She left her console to come and take Jon's hands. "Really, Jon, why don't you speak for yourself?" ■

The Alternate View

A PLEA FOR AN ANTI-SEMANTIC POLICY

G. Harry Stine

Read that title again. Don't fall into the trap described in "Communications Barrier"(Analog, February 2, 1981 issue). The above title was deliberately designed to catch your eye, to yank the customer in off the street, or to cause a knee-jerk emotional reaction.

Many people believe that the field of semantics was developed by Alfred Korzybski earlier in this century and think of it in that sense: the many ways in which meanings of words and other symbols influence the responses of human beings to their environment and to each other. However, Aristotle used the adjective *semantikos* ("significant") in *On Interpretation*.

Semantics is the study of the connection between a linguistic feature and a mental process or symbol. As an author, I use semantics knowingly all the time; so does the alter-author of this column, Dr. Jerry Pournelle.

And so do the anti-technologists when they come face to face with hard data that refutes their emotional position on an issue. They've learned to twist the *meaning* of the data through careful use of semantics and end up with something that appears to support and reinforce their stand . . . provided you don't read it very carefully. Since a dismaying number of people today are functional illiterates, this policy of data-twisting using negative semantics turns out to be highly effective.

They don't argue the data itself; they attack either the *validity* of the data or the *meaning* of the data.

This is not an exclusive technique used only by anti-technologists, by the way. Respected professional scientists and engineers use it to attack a colleague they don't like or a new hypothesis that threatens them.

The "synthesis of random matrices": that's the basis of creativity according to Arthur Koestler, and what triggered this piece was a wire service release out of Washington by a well-known and highly-respected science journalist reporting the issuance of the final report on the Satellite Power System Concept Development and Evaluation Program that's been jointly conducted for the past four years by the Department of Energy and NASA.

The report was issued without fanfare

by DOE and would have remained buried under the tons of other study reports of the federal government had it not been for the vigilance of pro-space organizations. The positive results reported in this study report *can't* get buried now. The cat's out of the bag.

But the way it was reported twists the results with a slightly negative slant through the use of negative semantics.

Example: It describes the SPS as "a concept that would use an 18-square-mile array of solar cells 22,300 miles high to convert sunlight into electricity equal to that generated by five standard nuclear power plants." Read it again. Is the SPS a tower of solar cells 22,300 miles high? Note that it's compared and referenced to "standard nuclear power plants." Why the use of the highly negative semantic symbol of "nuclear power plants" and what's a "standard" one? Was Three Mile Island a "standard nuclear power plant?" Is the SPS going to be as "dangerous" as five TMIs?

Example: The wire service release states: "The converted solar energy would be beamed in the form of microwave radiation to a receiving antenna 6 miles wide and 8 miles long . . ." If anything will trigger that emminent international expert in all fields of science and technology, Ralph Nader, it's the word "radiation." The word now has such negative semantic content because of Mr. Nader and the squads of anti-nuke anti-technologists that its use casts serious but ill-considered doubts on the whole SPS concept by people who don't know anything about it and depend upon others to do their thinking for them. (Incidentally, this last characteristic is *not* shared by most readers of this magazine as the mail has amply confirmed!)

What are the negative semantic triggers contained in these examples?

1. Comparison of the SPS to a nuclear power plant which has been linked directly with the explosion of a nuclear weapon. This equates apples to oranges to mushrooms. Even the initial premise is incorrect: a nuclear reactor *cannot* behave like a nuclear bomb. There's a great difference.

2. Comparison of the SPS power beam to both a microwave oven (which everyone knows cooks things fast) and radiation (which everybody knows is "bad"). We've been living with microwave radiation for nearly forty years, which is two human generations; any harmful genetic effects of microwave radiation would have shown up in the second generation. The energy density of the SPS power beam is *orders of magnitude* below that required to cook a bird flying through the beam, much less melt an airliner. As for bad old radiation, you're reading these words by the reflected radiation of the sun or a lighting device.

There are other negative semantic gaffs in this news story, but these two serve to indicate what's meant by the use of semantically-loaded words and phrases. A person reading that story who's seriously concerned over the potential impacts of nuclear power plants and the electromagnetic environment but who's not educated or trained in physics or bio-physics would get very little real information but would have a lot of opinion shaped by it.

The DOE/NASA SPS study looked at a lot of aspects of a potential pro-

gram. I can speak with assurance about the study because I was one who helped study certain aspects. I have the individual reports of individual study areas; I have yet to see the overall final report because it hadn't reached me by the time I had to write this. However, I know what the final overall report *must* say because of the individual reports.

Good science reporting is an exceedingly difficult task. Very few people are capable of it, although there are thousands who think they're doing it. I stand by my statement on page 5 of "The Space Enterprise" (Ace, 1980) when I maintain that all the good science reporters in the United States would fit comfortably inside a Volkswagen Rabbit. I do not include myself, especially not as the alternate author of this column because *this* is *not* science reporting and isn't claimed to be. The very title of the department implies a viewpoint.

Good science reporting involves presentation of the facts with a minimum of journalistic slant, no insertion of the opinions of the reporter, and a careful avoidance of semantically-loaded words, phrases, or symbology. Except for some of the professional journals where opinionizing is discouraged or must be clearly labelled as such, there are few real science magazines. Most of them are journalistic attempts at presenting science and technology with the same biased and insufficient research, inadequate study, and opinion disguised as fact that grace the magazine racks in airports, drug stores, supermarkets, and book stores. Among those real science magazines that stand out so starkly against this melange is *Science News*. Reporting as much science and technology as it does every week, it hasn't got *room* for editorializing.

Our civilization, culture, and society is based on science and technology. It's difficult if not impossible to make a rational decision in business or government—or in the voting booth—without either the education or training in science and technology that will permit such a decision or the input of straight science reporting for those who don't have such education or training.

The DOE-NASA SPS study is a microcosm of current technological activity. It's being studied to death before the first spade of dirt is moved. It's under-funded at the expense of "social programs." (If providing adequate energy to people isn't a social program, what is?) There are a lot of unanswered questions that can only be answered by the old adage from the early days at White Sands: "Get them scientists away from that rocket and *shoot it!*" It's an honest concern among many honest people who wish to make sure technology is used wisely and safely. And it's the target of anti-technologists who utilize the rational tools of semantics to achieve irrational ends because of fear.

Proper decisions in such matters cannot be made other than rationally. Since most of our information on a subject comes from the news media, this amounts to a plea for an anti-semantic science reporting policy—i.e.: reporting scientific and technical matters without use of semantically-loaded terminology that may be used to disguise opinion or bias as fact.

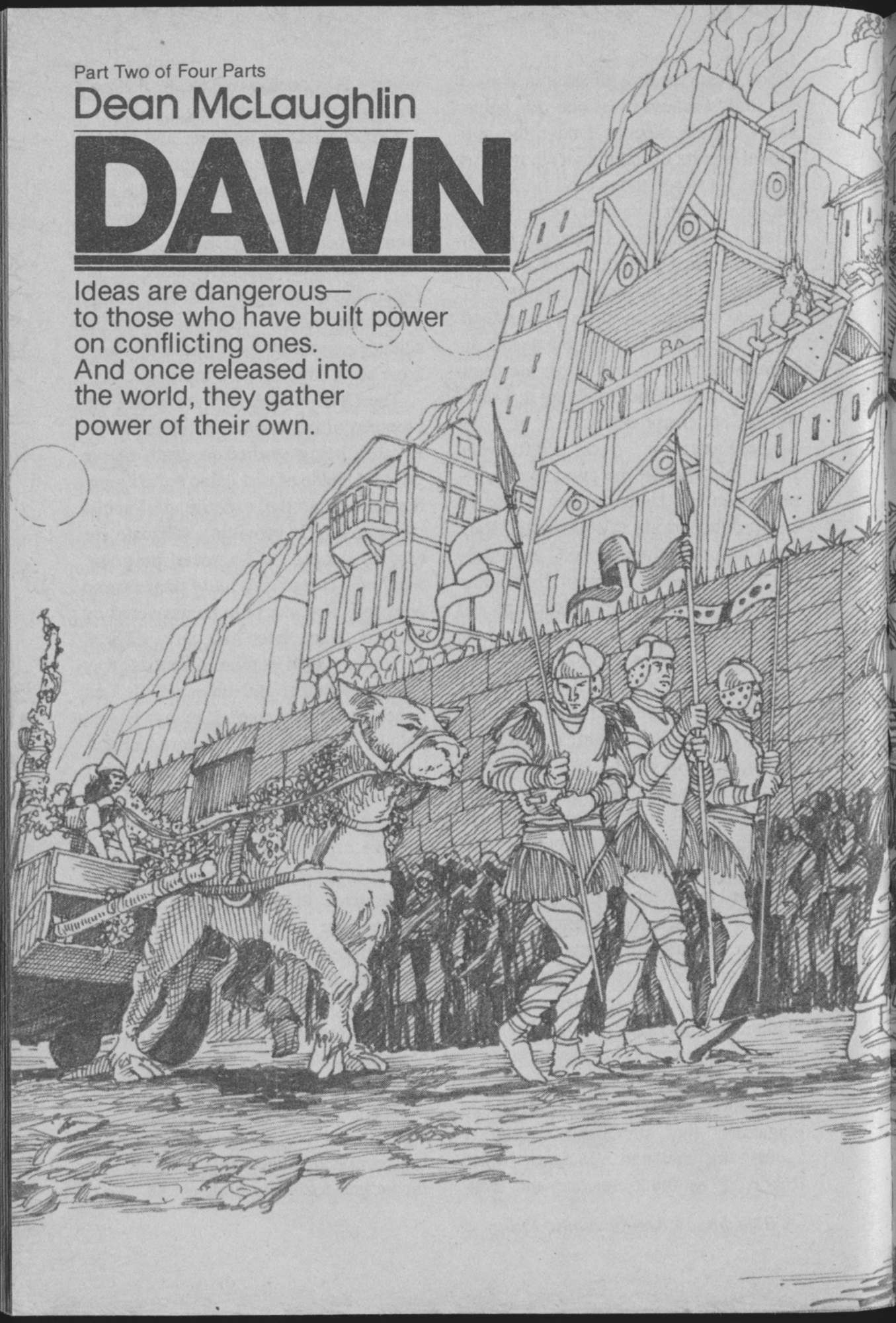
What's wrong with using scientific and technical objectivity to report scientific and technical matters? ■

Part Two of Four Parts

Dean McLaughlin

DAWN

Ideas are dangerous—
to those who have built power
on conflicting ones.
And once released into
the world, they gather
power of their own.




Jack
Gaughan

Synopsis—Part I

On a world nameless because, so far as its people know, no others exist, young ISAK, an informally trained scribe, thought he needed only to tell the Temple's Council of Brothers of his foretelling that the gods would cause a time of darkness to happen and he would be believed, honored, possibly rewarded. In any case, it was the proper thing to do. Dubious and cynical, the heirophant ARTANEEL, at whose shrine Isak had taken service, agreed to arrange his audience before the Brothers.

Neither SEDMON nor the lesser Brothers, nor their Legate Priest, BALCHIN, are impressed. Since never in memory have the gods permitted to happen even a moment during which at least one of them did not stand in the sky, watching and giving light, the possibility that such could happen is beyond belief. And Isak has admitted the foretelling came to him by rational thought, not revelation.

The power of the Temple is based on knowledge. No man doubts that the gods control the world's seasons and its climates, the tides and the run of eels in the river, and that they reveal their intentions for the world by how they stand in men's sky; the ever-changing sequence of their rising, the constantly shifting angles of divergence of their shadows from the foot of a shadow post, and by how far those shadows extend. Equipped with its Archive of records reaching back many generations, the Temple and only the Temple can produce a foretelling of the likely prospect for an enterprise, be it agriculture, commerce, fishery, or the hunt. Not even the Temple, though, has been able to foretell how the gods would share the sky at some future moment; the gods are gods, and therefore unknowable.

Isak, not sufficiently schooled to know it was impossible, solved the puzzle. He found that the gods were completely predictable. By that course, he chanced on the discovery that the Pale One, who alone of the gods (if, indeed, she truly was a god) did not shed light but stood only as a perfect white disc in the sky, would pass in front of Actinic Gamow at a time when he stood otherwise alone in the sky; all the other gods would have gone below the horizon. For the first time in memory, there would be darkness.

Scorned by the Brothers, disappointed and bewildered, Isak begins with Artaneel the long walk down into the city. Artaneel scolds him for his naivëte. Before they reach the foot of their descent from the Temple's height, their way is blocked by a squad of Temple Guards accompanied by an ambitious underling from Artaneel's shrine who points out Isak as the false prophet and Artaneel as his advocate. Artaneel, who until that moment had thought himself in no hazard, having done no more or less than a heirophant should, tries to flee and is killed.

Taking advantage of the confusion, Isak escapes, killing a Guard in the process, and finds uncertain refuge as a prisoner/guest in the household of PALOVAR and his pregnant daughter KALYNN. They hide him in an underground vault under the watch of their aging servant, HOBUR. He tells them of his foretelling and how he came to find himself in their garden. Kalynn is

sympathetic, perhaps because she broke a pot over his head while capturing him. Palovar is more skeptical.

Quickly, Isak discovers they are involved in a conspiracy against the Temple, something he had never imagined possible. To be against the Temple was to be against the gods; and how could a man be against the gods? For their part, Palovar is not sure Isak is a genuine fugitive; he might be a provocateur in the Temple's service. Even if genuine, they warn, men higher in the conspiracy may decide that to keep Isak carries too great a risk; still scouring the city, the Guards might search the house again and find him, while releasing him for possible capture by the Guards would entail a similar risk. The Guards might persuade him to talk before they split his tongue, the fate of false prophets.

"You would kill me," Isak says.

A third possibility exists, Kalynn's suggestion: he might be useful to the conspiracy. To explore that question, he is visited in his hiding place and sharply interrogated by two persons whose importance to the cabal is suggested by the fact that they come masked. One, identified by Kalynn's tongue-slip as EB, shows himself to be a formally trained scribe; the other, just as obviously, is a man of power among the conspirators, perhaps the leader himself. Though he is nameless, Isak comes to think of him as HIS LORDSHIP. As they depart, still undecided—for Isak has told them much that Eb must investigate—Kalynn lingers behind; she has noticed how Isak has passed his idle captivity scratching notes in the grease on serving boards on which his meals were brought, trying by careful thought to extend his understanding of the gods. She offers to bring waxboards, possibly even some parchment and writing tools.

"I would like that very much," Isak says.

PART TWO

Also none among us has seen
God.
(. . . We have thought often
The flaws of sun in the late
and driving weather
pointed to one tree but it was
not so.)
—Archibald MacLeish

In the time that followed, Kalynn came often and stayed long. She brought his meals, and she sat on the floor near his feet and asked him questions. As she had promised, she brought waxboards and, later, parchment and writing tools. Sometimes, when the conversation flagged, she sat quiet and watched him work, or left him for a while to think, to calculate, to ponder.

But for much of the time she was there, and he came to accept her quiet presence. He taught her to read a shadow post's castings and after that, each time she came, she told him how the shadows lay. At first there was some confusion because the artisan who, long ago, had placed the post had laid the marker tiles according to a decorative scheme of his own instead of where they should have gone. But once the trouble's cause was known it became no more work than a few quick scratches to know exactly how the gods shared

the sky. From that he could measure the passage of time.

He showed her how the sounds of her name, spoken, were marked on a wax-board. She tried to imitate the scratches, clumsily at first, but then with growing skill. He had always been told that women lacked the intellect to learn a scribe's craft. Now he saw that, like so many other things commonly believed, it was not true. He taught her how to record a shadow post's castings. After that she brought him the readings freshly scratched on a board. He was surprised and pleased at how quickly she learned.

During that time, Palovar did not come, nor did His Lordship, nor Eb; only Kalynn. Sometimes he glimpsed Hobur glowering in the outer chamber, but that was the only other face he saw. After the first few visits she began to bring her own meals. Though Palovar sometimes came home at Alpher-rise and setting, she explained, just as often he ate with his men. She thought it foolish for her to eat alone while Isak also ate by himself; for his part, Isak was glad for her company. When she was with him, he could almost forget his circumstances.

Almost.

"They're still trying to find you," she told him one time as she settled herself. She'd brought a set of tasko pieces and a playing board. She placed a lance piece to begin the game. "We found out they've told the street wardens all over Center to watch for you, and what you look like, and to ask if you've been seen. They stopped a caravan halfway across the desert to search it for you. They've searched boats on the river and all the towns from here to the mountains. And there've been acolytes going all around wanting to look at everyone's scribes and asking questions and saying if an out-of-work scribe comes, to lock him up and call the Guards. They'll pay a half thousand gold marks to anyone that catches you. Are you really worth that much?"

She'd started the game; it made him the defender. He set a lance piece of his own on his side of the midline, toe to toe with hers. "I could not have earned so much in all my life."

Another lance piece in hand, she looked up from the board. "Is a scribe's pay that scant?"

"For one who did not learn his craft at a scholarium," Isak said.

She'd been tempted to play her second piece in the same square as her first, but now she placed it in the adjoining square. "But your death would be worth that much?"

Reaching for another lance piece of his own, he paused. "Did they say they want me dead?"

"They haven't said it, but they do, don't they?"

It seemed likely. He set his piece, toe to the midline, two squares to the right of his first. "If they have offered that price, that is what they think it worth." His eyes scanned the board but hardly saw. His thoughts were not on the game. "It is true, they have such wealth, to them it would be a pittance, but even so I cannot think why they would offer so much."

"You can't?" She added a sword piece to the square held by her second lance. "I think I can."

It looked as if she might attack through the gap in his line. He added

a sword piece between his two lances, but this time one square back from the midline. "I do not understand how they think in the Temple," he said.

"But it's obvious," she said. Carefully she chose another sword piece from her dwindling rank of uncommitted pieces. "You've said that a darkness is coming. That the gods will close their eyes to us. I don't care what you call it, it's a prophecy, and you're its prophet. And that's how the Temple must think of you. And—have you thought?—if that darkness comes . . ."

She placed her sword piece on the other side of her first lance. She could begin her attack now, as soon as she had positioned her crown. "If it comes—don't you see what it will mean?"

"*When* it comes," Isak corrected. He put a sword piece on the board opposite her latest addition, one square back from the midline.

"All right; when it comes." To her it was an unimportant quibble. "Do you see?"

"Must it mean something?" Isak asked. "Can't it be just something that happens?"

"Doesn't everything the gods do have meaning?"

He studied the board, trying with half his mind to think what her strategy would be, and with the rest how to answer her question. "I know only that for many things we do not know the meaning. Even the most wise in the Temple can only guess and pretend."

Her fingers found her crown piece, though he was sure she had not sought it with her eyes. She added it to the board directly behind her attack line in the row of squares against the edge of the board. "Don't you mean almost always?" she asked.

To put his own crown piece on the board was obligatory. He placed it to his right in the edge square, second row from the back. "Perhaps," he admitted.

"And if it was sent by the gods, what would the darkness mean?" She advanced her first sword piece diagonally across the midline into the square held by his number two lance.

He wasn't surprised. She'd declared her intention to attack when she put her crown piece on the board. Now he studied the pattern of pieces and tried to guess her plan. "It would seem a sign of their displeasure," he said. That much was obvious—so obvious it hardly needed to be mentioned.

"Exactly," Kalynn said. "So when you say the gods will send darkness, you are saying they are displeased. It's still your move."

He'd finally decided, rather than commit any of the pieces he had already in position, to add a sword piece against the midline, in the square between his two lance pieces. But part of his mind still gnawed at the other question. "When the gods show displeasure, people usually blame the priests," he said, putting the sword in place. "The priests would have us believe they speak for the gods, and also to the gods in our behalf. If the gods are displeased, it would appear the priests have in some way failed."

It was her turn to study the board. "So? You still don't see it?"

He frowned and shook his head. "They believe I do not speak truth. So does it matter what I say?"

She added a lance piece on her side

of the midline, immediately across from the square where her sword piece had his lance engaged. "I know they don't believe you," she said. "But you are speaking as a prophet speaks, and what you were saying—maybe not directly, but it's what you implied—was that the gods are displeased with those who stand high in the Temple, who claim to serve them, but who everyone knows do not. So of course they would want to stop you from telling anyone else. And what better way than to say you're a false prophet and cut your tongue?"

He had the feeling of having glimpsed truth without truly comprehending what he saw. There was the sound of sense to what she said. But if she was even partly right, she had to have an understanding of the Temple and the Temple's minions far better than his own. How could a sheltered girl know so much, he wondered, when he had himself worked among priests and the servants of priests all his life and had thought he knew them, but knew now that he did not?

"I said nothing about the Temple," he said. "I spoke only of what the gods would do. I did not claim to know why."

She gestured at the board. He had forgotten the game again. He advanced his number-one sword into the square where his lance piece stood, engaged by her sword. "Kill," he announced formally, and took her sword piece from the board. Then, the kill having won him another move, he advanced the sword piece across the midline to engage the lance piece waiting there. It brought a momentary twist of pain to the corner of her mouth. He told himself it was only a game, but he wished he could have made her smile instead.

"What matters is what they thought you were saying," she said. "That's why they want you dead." As she spoke, she placed a sword piece behind the lance he'd engaged. "Oh, you're too quick for me, Isak."

He'd advanced his lance piece across the midline to join his sword, killing her lance. Now he considered his next move. "And you?" he asked. "What do you think I was saying?"

She too was studying the board. "Why, I think if you had meant what they thought, you would have said it plainly. I don't think anyone knows what the gods want, or why they do things. Maybe they do things for reasons that have nothing to do with us."

He'd considered attacking her backup sword piece, but her lance in the square beside the one he'd taken was in position to come to its defense. Instead, he advanced his sword diagonally into the square beside her sword and behind her lance. Nothing now stood between his piece and her crown. "The priests would say you were wrong," he said. "But if you asked, they could not tell you how they knew. Myself—I must say I know very little about the gods."

Touching a thumb to her lower lip, she took another lance piece from her reserve and, after a hesitation, placed it in the square ahead of her crown. "They'd say they know because they know the gods," she said, looking directly at him. "But that's silly. The only way they could know what the gods want, or think, or feel would be if the gods told them. But if the gods tell them things, they'd know you never left this

house so you must be still inside. Because the gods watch. They watch all of us, all the time. But the priests don't know where you are. Father had some men he knows up the river at Where They Fought and another at Deep Crossing—local merchants he trades with—he had them tell the Guards a scribe who looks like you asked them for work. It's too soon to be sure, but we think it's fooled them. But, if the gods could tell them things, they'd know it wasn't true. They wouldn't be looking all over for you. They'd be taking this house apart, a stone at a time.''

Abstractedly, Isak nodded. Without direct knowledge, she had deduced a truth. For all the Temple's pretensions, the gods did not communicate. All that was known of the gods was inferred, argued out, guessed at, or merely believed. And yet . . . and yet . . .

He advanced his lance piece to join his sword, consolidating his hold on the square. ''The Temple does not know much about the gods,'' he said. ''Every local Temple has its records. The priests do not lie when they say they know the significance of how the gods share our sky. But why the gods do those things, or what they think, or what they want of us—those are things we do not know. Any man who claims to know does not speak truth.''

''Would you say, then, all prophets are false?'' she asked, and added another lance piece to the protection of her crown, this one toe-to-toe with his sword. She challenged him with her eyes.

''I have not claimed to be a prophet,'' he said. For the moment his attack was stalled, as he'd known it would be. He would have to bring more pieces into action. He studied the board.

''But you are, Isak,'' she said. ''Whether you want to be one or not. The Temple's said you are.''

''A false one,'' Isak said, still pondering the game.

''That's what the Temple says. But people don't always believe the Temple. Not any more.'' For a moment she looked about, to laugh with delight. ''That's another thing Father and . . . and his friends are doing. They're going to have men talking about your prophecy, telling other people, as if they'd heard it somewhere. And travelers. And boatmen—especially boatmen, because they go up and down the river, and they could have heard it anywhere. And . . .''

Talking about it animated her. He let her talk on and on, and thought about the game until, his strategy decided, he positioned a new sword piece against the midline, toe-to-toe with her number-one sword. ''Why?'' he asked.

''Don't you want people to know? Wasn't that why . . . ?''

''It is what I had sought to have done,'' Isak said, ''though I would have had the Temple proclaim it. But I am wondering why your father—and the men he is involved with—would take the risk of telling such a thing when the Temple has said it is false? Are they so anxious that people should be told? Do they . . . ?'' A new thought came. ''Does it mean your father—his friends—now believe I have given them truth?''

She sighed. ''It's not that simple.'' For a while she pondered the board. At last she added a lance to back up her

number-one sword. "They don't tell me everything. But I think they're doing it because it's a way of saying the gods are not well served by those who now hold power in the Temple—a way that will make a strong impression on a lot of people. It doesn't make any difference if they believe you or not."

Isak nodded. It made a narrow kind of sense but it left him troubled. These were men who cared for nothing but their own goals. They did not care about truth. They were indifferent toward serving the gods. He advanced his second-line sword to the midline, into the square held by his number-one lance. He did not like to think of his foretelling being used by men to further goals of their own, even though it might be what the gods wanted.

But that he could not know—not he or any other man. He tried to think what he would want were he a god, but no answer came. He did not know, even, if—given the power—he would take one man from those who ruled the Temple, or all, or none. Could any man claim to know how the gods should be served?

"It's your turn," she said. It brought him back to the game. He hadn't noticed she had moved.

The game. He added another sword piece to the board. The game. That was a universe he could understand. It functioned by a simple set of rules. There were no mysteries.

The sword of the Japanese samurai was a triumph of the metalsmith's art. It should be stressed, though, that it was art, not science; those who worked the metal had only the most superficial understanding of what their rituals accomplished. They knew those procedures would create an amazingly useful piece of steel. Little more.

Modern, civilized commentators (momentarily forgetful of napalm, hydrogen warheads, and zyklon B) may think it barbaric that such artistry and, yes, reverence, should be devoted to the manufacture of a tool good only to kill with, but in those times, in that place, a man who expressed such sentiments would himself have been considered odd. It was a civilized instrument. It gave clean death.

—Benjamin Dana

Another time, over a serving board of pickled eel and greens, he asked about the tokku sword. Escape was still a thing to think about; His Lordship might decide to keep him alive, but it seemed unwise to let his life turn on that man's whim. It needed careful thought, though. Should he try and fail, his life would not be worth as much as a desert stone. His experience with swords was meager, but to have a sword such as that might, even so, be all the difference. Tales of feats done with those blades were still told in taverns and around desert cookfires, as if their metal held a power greater than—and apart from—the men who wielded them.

But first he had to know if it was still a living blade. He had seen only two before in his life, both of them Temple prizes. One was snapped close to the hilt. Both wore crusts of corrosion.

At first, when he spoke of it, she frowned. She tilted her head and peered at him. It took him a moment to realize she didn't know what he was talking about.

"In the room where you . . ." He touched his head. The wound was almost healed.

"Oh," she said. "First Palovar's tokku."

It was his turn to frown while he groped to understand her nuance.

"Tokku," she repeated. "That's Old Tongue for sword. I only know a little Old Tongue, but that's one word I know. So I don't think of it as a sword. It's not a sword. It's a tokku."

He nodded. He understood her now. "It's your father's?"

"Now it is," she said. Her hands made small motions, as if she was trying to say more than her words said. "It was First Palovar's when the Temple came. He held station in the household of the Duke Lagash—he who was then the Duke. It was given him by the Duke himself. When the Temple came he helped defend the castle, and when it was taken he escaped and found a place to hide. And he kept his tokku. You probably don't understand, but it was important for a man to keep his tokku. They had a saying: *Tokku ha, il gotch.* —'In my hand or my belly!' First Palovar kept his tokku. Not many did. And you've heard what the Temple did to the smiths who made them. Nobody knows how to make them any more."

Isak had heard what was done to the smiths. He nodded. "And, ever since, your house has intrigued against the Temple?" It was hard to believe. So many generations!

The shake of her head was quick. "That's something recent. Oh, there were a lot of other houses that felt the same way. But, as for hoping to do anything, it's only been the last few rounds of 'taking that we've . . . and mostly it's been only talk. We haven't the strength to do it by ourselves. We'll have to win a lot of common folk to our side. That's why . . ." She broke off. She made a fluttery gesture. "We think your prophecy might help us."

He could have argued. His foretelling said nothing of what the gods expected of men. But he had told her that—told her, it seemed, a thousand times. Meanwhile, he wanted to know more about the sword. "The . . . the tokku. It has been kept because you hope to . . . to use it?"

"A tokku is power in the hand of he who holds it," Kalynn said. "If the chance comes—yes, of course it will be used."

"After so long? The others I have seen had no edge, and one was broken."

"Temple relics?" she asked, and smiled when he nodded. "Yes. Those are the ones they show, because they seem to confirm the Temple's power. But those of us who kept our tokku . . . almost every 'taking, as far back as I can remember, Father has taken it down and seen that its edge is true, and held it in the light of the gods whose overtaking it was. He showed me its grain because that is the mark of a true tokku, and because he is proud of it, and because he has no son; it is like the grain of fine timber. And he would polish it with oil and put it in its scabbard and hang it back on the wall. Even before we began to work with others,

he said the time will come when it shall make priests' blood spill. I hope it does."

He had not seen her so fervent before. He stopped eating to look at her. She was not a different person. She was the same person he had thought he had begun to know, and even now he thought he knew her—better, now, than before this moment.

"You hate the priests," he said.

"If they had done to you . . ." she began, but broke off and looked away. When she looked at him again, her mouth wore a wry half-smile. Forced, but still a smile. "When they wanted to search the house we had to take it down and hide it. So much for battling the Temple! If they'd seen it . . ."

Yes, had the Guards seen it they would have pressed their search until they found him. And the Temple would have taken it and broken it, another prize.

"You killed one of them," she said. "Not a priest, but at least one of those who serve the priests. That's almost as good."

"I felt no pleasure in it," Isak said uncomfortably. "It's still hidden?"

"They might want to search again," she said.

He couldn't ask where it was; to do so would betray his interest. So much for using it to help him escape. He pushed the serving board toward her. "You're not eating."

"I guess I'm not hungry," she said. She looked down at her swollen lap. "I'm sorry, Isak. I think too much about . . ." She shrugged. "Things." She looked up. "I'm not very good company."

"I have no other," he said. He set the board aside and reached for the waxboard she'd brought. Best to draw her mind from such thoughts. He motioned her to come around beside him. "Now, here is how we correct the lie of shadows at your post. We have determined, first, that the vector of true north turns six radients westward from the vector given by the marker tiles. Therefore, to know the true standing of the gods, we must subtract that number from . . ."

She listened raptly. She watched the marks he scratched on the board. Her golden head leaned close to his arm, almost touching. He was conscious of the warmth of her, and her closeness. Conscious, too, of the child in her body. Some gesture of hers had made him think of it. With a deep ache part of him wished it could be his. But of course that was not possible. He tried to put it out of his mind but it stayed with him like the sound of a lute behind a singer's voice as he went on with her lesson.

Above all things, two forces shape our lives: what we believe about the nature of our world, and the intractable nature of our world as it truly is.

—Benjamin Dana

That time, after her lesson, when she went away, she was gone longer than ever before.

At first he didn't notice. He had his notes to study, to amend and think about, and new thoughts he'd only now thought of to put on waxboards and ponder; and other things he'd already pondered to put on parchment. By now he

had the beginnings of a treatise, an exploration into what was truly known about the gods and how they related to the known world. It was very hard to keep his thoughts clear and he lost track of the passage of time. But after a while he became aware that a long time had passed and Kalynn had not come.

He broke off his work. He crawled into the entranceway and put his ear to the chinks between the stones. No sound came. He sought a crack of light, but found none. Placing his hands on the stones, one by one, he tried to move them. They held as firm as if rooted to the earth.

He hesitated then, not sure what he should do. Perhaps a more forceful effort would dislodge them; but, though he had glimpsed the chamber outside, he had no knowledge of anything beyond. And, knowing the penalty for failure, he was not yet prepared to take the risk of breaking out. He retreated to his quarters and tried to resume his work. She'd left him a small jar of wine and a brick of cheese. He nibbled the cheese and sipped the wine and thought how his universe had narrowed to this tiny cell. All that he knew of things beyond its walls had to be brought to him. He could not confirm its truth by his own observation. The whole world could have ceased to exist and he would not know it. Perhaps even the gods were gone.

It was an absurd thought, but though he tried he could not contrive a way to prove it wrong. He sat with a clean waxboard on his knees and searched his mind. Several times he touched his fingernail to the shiny, slick surface, as if about to begin, but each time he paused and, after a moment, withdrew. Finally, he put the blank board aside and took up again the one he had been working on. He found, now, that his thoughts on that question came easily, smoothly, and with a clarity he had not felt before.

He was no closer to knowing what the gods were. Most likely he would never know. But he did know how they shared the sky and the sequential process by which they changed that sharing. Knowing that, and separating that from all else men thought they knew of the gods, he found it was no more difficult to describe their motions than it would have been to describe the workings of an elaborate machine. He was still at work, scratching marks on the board as fast as his finger could move, when at last Kalynn returned.

When the first stone was taken from the entranceway, he put the board aside and scrambled into the tunnel. While one part of him was careful to notice how the stones locked together, another felt the gladness of relief that she was all right. He'd been afraid, though he could not have explained what of.

"I'm back," she said.

He helped her climb up. "I had begun to wonder . . ." he said. He hadn't meant to say it. It came from his tongue without thought.

"I had to go talk to some people," she said. "And the midwife. I wanted to talk to a midwife, because . . . well, I'm sort of afraid and I don't . . ."

She saw the look on his face, his involuntary glance to her swollen belly. "Oh, not for a long time yet." Belittling. "I think not until after the darkness. I hope not. She said I shouldn't get excited, or try to do too much,

or . . . oh, a lot of things. If you hadn't told me about the gods—about the darkness—I think I'd be terrified when it happens, and that wouldn't be good. So even if you haven't helped anyone else, you've helped me. I want you to know that. And all I've done is hit you on the head and put you in this hole.''

''Could I have found a better place to hide?'' he asked.

Hobur handed up the basket she'd brought. ''Have care, young mistress,'' he said, and touched his temples before bending to lift the stones into place.

Isak took the basket and, made clumsy by its bulk, worked his way back into the chamber. Once there, Kalynn unpacked their meal; fresh yellowbuds still in the husk, water nuts, a melon so perfectly ripe her knife sliced through it at a stroke, a jar of wine. She plucked a yellowbud from its husk and offered it to him. He matched her gesture. ''You must be starved,'' she said.

As they ate, he noticed she had put the knife down where, if he wanted, he could snatch it up. Held against her throat, it could win his freedom.

It tempted him but he let it lie. Looking deep into himself, he knew he could not put a blade to her no matter how desperate he might be. He sensed she knew that.

She poured the last of the wine into his mug and, looking straight into his eyes, picked up the knife and dropped it in the basket behind her. ''They wanted me to test you,'' she said, turning back to him. ''I told them we could trust you. They weren't sure. Now . . .''

She broke off. He saw her lips move, though he heard no words. Thank you, he thought she was saying. Or something private, to herself. He couldn't be sure. But then she was looking straight at him again.

''Isak, how do you feel about the Temple?''

The question came unexpected. He had to pause, to think how he should answer. ''I have been trying to decide,'' he said at last.

''They want to kill you,'' she said. ''You know that.''

He nodded. ''That does not mean they are evil men. Perhaps it is what the gods would have happen.''

''Do you believe that? Would you let them kill you?''

''I would prefer to live,'' he admitted. ''I do not know what the gods want. Perhaps they enjoy to watch, to see how we play the game. Can anything happen that the gods do not want?''

She bent to clear away the melon rinds, the other leavings of their meal. When she turned again to him her shoulders were set. ''The priests say they serve the gods, that all they do is for that purpose. I say they lie.''

He frowned. In spite of all that had happened, all he had seen and learned, he could not bring himself to accept that. The Temple served the gods, who were the life of all men. To speak as she had spoken was to speak against the gods. Could anyone serve the gods and still say such things?

She guessed his mind. ''We have no argument with the gods,'' she said. ''They are . . . well, the gods. But the priests . . . they claim to read portents, tell us what the gods intend, and claim we benefit from their foretellings. For that we give them tithe and privilege. But they're not satisfied with that. They

mislead us, lie to us, and say it was the gods, for reasons only the gods can know and which no man can understand, not even priests. While they—the priests!—see their own holdings prosper at our cost. Did you ever know a thin priest?''

Isak thought of Lurgien, gaunt with age, seamed jowls and sunken eyes. ''Once,'' he said.

''Once!'' She seized it like a prize. ''Once!''

He hadn't meant it as an argument. ''I do not say that no priests are corrupt,'' he said. ''I know that some are. But I have known others who were decent, honorable men. And it is true that portents can be seen and understood, though I must also say that often they are difficult to read, and the foretellings are not always certain.''

Her tongue had been poised to resume the attack, but instead she only looked at him. She might have studied an intricate carving with that sort of look. ''It's something you know,'' she said at last.

''It is part of a Temple scribe's craft,'' he said. ''We keep record of how the gods share our sky. We search old records for previous times they took a similar configuration and search out the happenings that followed. From what we have found, the priests prepare a foretelling. But often we will find that similar sharings of our sky were followed by events that were very different. I do not know if the gods deliberately deceive, or whether it is only that we fail to understand them.''

''Isak,'' she said, intently frowning, ''are you saying that anyone could do what the priests do?''

He spread his hands. ''Only the Temples have the records.''

''And it gives them power.'' She slapped a hand on the floor. ''Power to do as they want, take what they want, gather wealth to themselves, and leave none for others.''

''Some of them,'' Isak admitted. ''They are men, no different from other men.''

''And the higher they stand in the temple, the more self-serving.''

Of that realm he had no certain knowledge. He said as much, with a wordless motion of his hand.

''Do you doubt?'' she asked.

''I do not know,'' he said. ''I know that you hate them.''

''Do you think I shouldn't?''

Struck by her vehemence, he could only draw back. ''My lady, I do not know. Have you a reason?''

For a moment she was very still. ''You didn't know? You didn't even suspect?''

Dumbly, he shook his head. ''My lady . . .'' he began, and found that his confusion let him say no more.

A moment longer she looked into his face. ''You have never spoken anything but truth to me,'' she said. She spoke as if from a great distance. ''I . . .''

Abruptly she held out her arm, pulled back her shawl to show the bare wrist. ''You see that I wear no man's cuff. You did not wonder?''

''My lady, I . . .'' In his circumstance he had not had the right to raise such questions. ''What use would it have been to wonder? I could see you have a child, and I could see that you do not admit to being owned. Should

I have thought you were so careless as to have had an accident at the baths?''

''They do happen,'' Kalynn said. ''It isn't always a matter of letting it happen.''

He nodded. ''But that is not why you will have a child.'' She had implied as much by her words; he had never thought it likely. ''My lady, the happenings of a person's life are even less knowable than the gods. I could invent a thousand conjectures which would do you honor, and there might be yet another thousand I could not. Any might be true.''

''And another thousand that would do me no honor at all?'' she suggested. She said it lightly, but she rested her chin on her fist, challenging.

Isak pretended he had not heard. ''I have made no judgement,'' he said. ''I do not know enough.''

She looked away.

''Have I said words that hurt?'' he wondered aloud. ''I did not mean . . .''

''Isak. Please. I know you're trying to be kind. That is what hurts, because there were others who were not. I would . . . after the next harvest, I would have gone to the auction. I was eager for it. There were—'' She closed her eyes. ''—Oh, several young men who would have entered bids for me, any of whom I would have welcomed whether they offered much or little. But, since . . .'' Her hand touched the bulge of her pregnancy. ''. . . they have turned their interests elsewhere. The best I could hope, now, would be to be a secondary woman to a rich man whose principal woman is barren, perhaps to be discarded once I have produced an heir. I think I will ask Father not to offer me.''

''If their interest waned, I think they must never have valued you,'' Isak said.

She was slow to reply. ''I'd like to believe that.'' She looked straight at him. ''Would you have turned away?''

For a moment his thoughts were stuttering confusion. The idea was completely new, nor did he know enough to guide him to an honest reply. ''How can I say?'' he managed at last. ''I, who have never owned a spare farthing, who did not know you before I became your captive? None of it could have happened.''

She smiled a sad, quiet smile. ''And if you had a farthing now?''

He found that more than anything else he did not want to hurt her. ''I think you would be worth far more.'' He could say that in honest truth. ''But I have no farthing, and small hope I ever shall.''

Again she looked away with that sad smile. ''You're being kind,'' she said. ''It wasn't fair to ask. I . . .'' She reached out. Fingertips brushed his arm. ''Others have not been kind.'' Her posture changed then, and her eyes became direct. ''But I was going to give you truth. I have no way to prove what I say; I can only ask you to believe. It was a priest who put the child in me.'' Her eyes faltered. ''I don't really know. It may have been several priests.''

And may her bridegroom bring her to a house
Where all's accustomed, ceremonious.

—W. B. Yeats

She told it all then. It had been warm in spite of the season and she had gone to the baths. She had passed through the waterfall curtain from the thermal pool and, still tingling from the cold water's shock, had turned to follow the concourse toward the courtyard when the priest stopped her. She had hardly noticed his approach; her attention had been taken by the wealth of honor scars on the muscular back of a Guard—with such scars, even naked he could be mistaken for nothing else—who strode ahead of her. The sight woke troublesome feelings, feelings she did not understand. For a moment she did not breathe.

The priest had been coming the other way. His body still reeked of the masseuse's unguents and his belly wobbled gelidly. He was ugly flesh, white as a skinned gavial and fat as a filled oil bladder, so she was hardly aware of him until, as they were about to pass, he put out an arm to block her. His soft hand cupped her shoulder. She gave a startled cry but the Guard did not turn. Why should he?

"I saw the torque at his throat, so I knew he was a priest," she said. "Just as he must have seen the maiden's chain at my waist." She did not understand what was happening. She was a little afraid, though she knew someone was sure to come in a moment. In a stern voice the priest demanded her name and her father's name. That made her even more afraid, for when one was naked in the baths she left identity with her clothes on the shelf in the entrance hall. But he was a priest, and if she understood his torque's designs and decorations, a priest of high station. She did not dare defy him. She blurted her name, but then her voice failed out of fear. He repeated his demand, her father's name. His hand tightened on her shoulder. Trying to avoid his eyes and the sight of those dewlapped jowls, she looked down and saw unequivocal evidence of the nature of his interest. She twisted out of his grasp, ducked under his arm, and fled.

He did not follow, and she thought the matter ended. In the courtyard she emerged into the sight of the gods. Their warmth bathed away a chill she had not known she felt. She looked up, gave them honor and gratitude. They were all in the sky, all but Actinic Gamow. In the west, about to go down, the Twinned ones hovered above the horizon's dark haze, while ascending the eastward sky, forming a canted triangle, Blazing Alpher and Red Bethe stood very close now to their overtaking, with Bright Dalton to southward, soon to overtake both, trailing less than a hand's span behind. Standing north, following all, the Pale One floated white, ghost-cold, like a perfectly round, hard-edged cloud. Such a clustering of the gods was not common, and was almost certainly portentous, though she could not have guessed what of. In her present mood she found it disquieting.

She took one of the leather pallets and spread it on the lawn and let the gods warm her body. Previous basking, both there and in the garden at home, had already stained her a smooth honey brown, which she took as a sign of special favor of the gods. Memory of the priest began to fade.

For a while she lay there, turning now

and again so that the gods could examine all of her, taking pleasure from the warm intensity of their regard. As always, Alpher blazed too bright to look at. She reached up a hand to mask his sight and sought Red Bethe in the sky beside him. Even unschooled in the finer points of god-watching it took her only a moment to find him. He stood north and slightly east of Alpher's disc, not more than a finger joint's length away. He was at his smallest, a tiny, round fleck, shining like a ruby heated to brilliance. After only an instant she had to look away. That their overtaking was very near she had known. The city was full of preparations for the festival, though she had given it scant thought herself. It was a thing the Temple did. Perhaps it had already begun, although she hadn't heard the Temple's gong.

After a while she joined a game of tag—a team of girls against a team of boys. When a boy held the sponge, she ran to escape him, dodging around the other boys who tried to block her; when a girl had the sponge, she moved to block escaping boys so the girl with the sponge could mark them. Kalynn took her own turns with the sponge and shouted with delight when she made a score. There was much laughter, good-natured taunts, more than a few tangled sprawls. Her body acquired a dozen different-colored blotches. Half a hundred. So did all the others'. When it ended she never knew how long it had gone on. Returning to the baths, she washed off the stains, the sweat, and the grime in a tepid cascade.

The way the game had ended had made her uneasy. A boy and two girls had fallen in a complicated tangle which their efforts to sort out only made more complicated. At first it was comic, a cause for laughter from both onlookers and the persons involved. Then the girl on the bottom gave a cry of alarm and it was instantly apparent that the boy had lost control of himself. Hastily, two other boys moved in to break them apart. No real harm was done; the girl quickly regained her composure and the boy was horribly embarrassed. After that, no one had wanted to continue the game.

In the cascade, thinking about it while the water splashed against her body, Kalynn remembered the priest. What had happened in the game hadn't been all that uncommon. At one time or another in the course of it almost all the boys had shown signs of similar arousal; it was a commonplace of bath garden games, more a cause for amusement than scandal. It was just that this time, accidentally, it had gone beyond fun, become serious. What bothered her was that she couldn't forgive the boy and yet think ill of the priest. The impulse he had shown had been only natural.

But he had touched her, and he had demanded her name and the name of her household. It wasn't right to ask someone's identity at the baths. Even a priest should not have asked. It disturbed her that he had.

She swam briefly in a scented pool, then dried herself before the thundering flames of the furnace room and stepped out into the entrance hall clean and new, though still uneasy in her mind. She was taking her clothes from the shelf when the Guards came upon her and clamped hands on her arms.

Startled, she tried to pull away, but

they did not let her. They turned her around and she looked up into the face of a Guards Captain.

"You should be proud," he said. "The gods have chosen you." Beyond his shoulder, across the hall through a swirl of moving people, she saw the priest—the same one, though now he was clothed in his robes. Fine robes they were. She felt his eyes on her body.

Frightened now, she tried again to break away, but still they held her. Her clothes were on the floor, tangling her feet. She hardly noticed.

"You will come," the Captain said.

Naked as she was, they took her out into the street. They lifted her into a wagon and bound her to a post that was wrapped with garlands and stood in the center of the wagon bed like a ship's mast. A flowered crown was placed on her head. The scent of the flowers dizzied her. The Guards made her drink from a bowl. It was a cool fluid, thin as whey, but it burned her throat and became a core of heat deep inside her. The drome were goaded and the procession began.

Acolytes flanked the wagon on either side, endlessly chanting. Another acolyte came behind, striking the gong that hung from the wagon's tailsprit, waiting each time for the last dull vibration to die before he struck again.

Ahead walked the priest, in his hand a staff that carried a carved, gilded sunburst on its head. With staff and open palm he gestured flamboyantly to the people in the street who paused to watch them pass. A squad of Guards followed, bright fluttering banners tied to their pikes. Then the wagon, its driver a hunchbacked dwarf who stood on the seat, capering and waving his goad to the crowds that seemed to have gathered from nowhere. Desperately Kalynn tried to tear herself free. She was naked outside the baths. Her mind was a chaos of terror and shame. But the thongs were tough and tightly knotted, and she could not find voice.

Slowly the procession ascended the streets of the city. Flowers and green leaves were thrown into the wagon, and handfuls of barley and rye. Something strange began to happen inside her; the hot glow within seemed gradually to expand, to fill her, as if Blazing Alpher's brilliance shone from her innermost core while she herself was far away and all that was happening happened only to her body. The procession twisted from street to street. Flowers covered her feet, collected into a mound almost up to her knees. Behind the wagon now a crowd followed. Some held aloft boughs of new growth. Others bore the tools of a trade. Children rode shoulders, chattering excitedly, waving their hands in the air. The wagon bumped over the cobbles. Its wheel rims scraped and rasped. Joints creaked. The gong sang. The acolytes' chant droned on and on.

The procession came onto the Avenue of Priests, but altered neither pace nor ceremony. Step by step, stage by stage, it ascended the high bluff's wall toward the height where the Temple waited. The drome hissed frustration as their paws fought for purchase on the smooth stones. Acolytes leaned against the wagon's thwarts, urging it upward. The cadence of their chant never faltered.

She looked skyward, where the gods watched. They could hardly dazzle her

more. In a remote, dissociated way, she knew what was happening. She had known—perhaps she had always known—that a woman was brought to the Temple as part of the observance of the Time of Overtaking. She'd never concerned herself with such events, never wondered where the woman came from, who she was, how chosen. Neither did she know what was done with her. It had never seemed important; nor had she, now, the will to do more than let it happen.

"It is done differently in different places," Isak told her. "In Remoss it was the same woman for many rounds, and then it was her first-born daughter. I saw a town where all the young women met in secret and chose one from among themselves. They thought it was a privilege. In Filorna it is the winner of a game."

"And in those other places," Kalynn asked, "what is done to them?"

"That is also different," Isak said. But he was almost sure, now, what must have happened to Kalynn. He felt a need to give her understanding of the reason for it. "The overtaking comes always between the time of harvest and the time of planting, just as the season of most growth comes when they do not stand in the same sky. The ceremony is to honor the gods for the bounty of the round of seasons ended, and to seek their favor in the round to come. It is no small thing."

He saw the frown begin between her brows and hurried on. "You know—I am sure you must know—how different a round may be from the one before and the one that follows; that in one an enterprise may prosper, but in the next, in spite of equal skill and effort, it may utterly fail. I have myself seen pastures turn to barren earth, crops dead for lack of rain, and mud where a river had filled its banks only the round before. I have seen boats come back to shore with their catch baskets empty, voyage after voyage, and storms that came suddenly from beyond our world's edge, from which no boat ever returned. My father sailed on one of those. I myself was with a caravan trapped in the mountains under rains that seemed would never end. No man has control of such forces. Only the gods can do such things."

She did not speak at once, and when she did she spoke as if from far away. "And for that I was given a child I did not seek, by a man I would never have let touch my hand."

He'd never thought of it from that point of view, but as she spoke he understood it clearly. Still . . .

"I have been told of a town where the woman's belly is cut open, and all that is in it they scatter on the fields. Of course, she does not live."

He thought, telling her that, she would see that worse could have happened, but he spoke without watching her face. When he looked he wished he had not spoken.

"And that is done as honor to the gods?"

"That is what they believe—those who do it. At least, that is what they would say."

"And what was done to me, that also was done to honor the gods?"

"That is what they would have said." Isak was feeling very uncomfortable now. She'd made him think about it, and his thoughts were disquieting. "I

must admit I do not know of any time that doing such things has changed the prospect foretold by how the gods were standing in our sky, so I would hesitate to say that they speak truth.''

He picked up a waxboard, scratched a hasty note, and laid it aside. ''I will have to think about that,'' he said, still drawn into himself, trying to find the shape of his thought. ''If it is true the gods share our sky according to a systematic pattern, however complex, and if it is true that how they share our sky foretells how an enterprise will prosper against the variations of the seasons, then it must follow that there is a pattern, also, to the variability of the seasons. I would have to search in the Archives to be sure, but . . .''

She touched his hand. ''Isak, if that is true, what they did to me was . . . was useless.''

The same thought had come to Isak. He nodded. ''Yes, that would be true,'' he admitted.

''I've tried to talk to Father about it,'' she said. ''He wouldn't listen. 'I . . .'' She looked down at her hands. Her fingers struggled with each other.

''If you want to tell it,'' he said. He made his voice as gentle as he could. ''If you feel you must. It's not a thing I have a right to ask.''

''But you do,'' she said.

He looked at her, not understanding.

''You said I was worth at least a farthing,'' she said, as if that explained everything. In a strange way it did; and, at the same time, it explained nothing.

The procession topped the final slope and turned, and trod the Great Way. Ahead the Temple yawned. She should have felt afraid, but it was not like that. It was as if she only watched, was not involved. Musics—perhaps they'd always been there—appeared, the thud of drum joining the beat of the gong, brasses erupting to a fanfare, the reedy keen of bagpipes. The Temple loomed nearer, and nearer still. The acolytes' chant and the beat of drums advanced their tempo, blended with the fanfare into a throbbing crescendo that went on and on, rising and rising, until it was the only sensation she could still perceive. Then it ended.

Surrounded by the sudden quiet, the wagon had stopped close beside the Obelisk in the broad expanse of the great square. With a swirl of vestments, the acolytes spread from the wagon and, augmented by more who appeared as if sprouted from between the cobbles, formed a circle around the wagon, the Obelisk, and the shadows it cast across the stones. Linking their arms, they held the gathering crowd from invading that zone. Kalynn felt the thong at her throat come loose, and then her waist, and then the one that bound her knees. Her wrists were set free. Hands took her arms and guided her down off the wagon. Her feet scattered flowers as she moved. The hard, god-heated stones seared her unprotected soles.

She was brought to the place where the shadows thrown by Blazing Alpher and Red Bethe lay, one within the other—so the overtaking had begun! —to the place where Bethe's deeper darkness ended and only the red-tinted shadow of Alpher reached beyond. They turned her to face the Obelisk, a tall black column against the blue sky. In that shadow she felt suddenly cold.

A lesser priest advanced and draped

a garland over her shoulders. She felt a tug at her maiden's chain, heard it snap. It rattled on the stones. But for her dazzled distantness she would have screamed. Somewhere a voice was speaking Old Tongue. Hands took her right arm; something closed around her wrist like an animal's jaw. Other things, softer, were pressed against her palms and her fingers were made to close and hold them: a clutch of winter blossoms and a sheaf of yarrow, and on her wrist a jewelled gold cuff, as if she were a bride. Emeralds, opals, and jade gleamed in Bethe's saffron blaze. Rubies flashed with inner fire.

The bowl was put to her lips again and she was made to drink. The fire of it traced a scar down her throat and pooled, a knot of flame, in the center of her body. Perhaps she swayed.

The priest approached. The same priest; she knew that face. He bent, scooped up her maiden's chain, and faced her, cascading it from hand to hand. His jowls wore a pleased look. Abruptly, without a glance to see if one was there to take it, he passed the chain to an acolyte. He lifted his hands under her breasts as if to test their weight. His thumbs stroked the smooth, soft skin. His pleased look deepened.

Turning then, he raised his arms—outward at first, and the crowd's babble stilled. Then upward, open-palmed, toward the gods. He spoke an invocation. It was in Old Tongue; Kalynn did not know the words. The acolytes, all of them, wherever they stood, voiced a reply. Another bold-toned call. Again the acolytes responded, then broke into a chorus of parts; one cluster, then another, uttering their litanies and, in their turn, falling silent. The voice leapt across the open space from group to group like a bounding ball, at first with a ponderous rhythm, but relentlessly quickening, becoming faster than her dazed attention could follow, then faster yet, and faster, becoming a resonant cacophony that yammered through her being endlessly. A drum took the rhythm, beginning softly, then more loudly. Another joined, and another. Brasses glazed the air. Chimes clanged.

Acolytes turned her around, urged her forward. Her body obeyed; she had no will to do otherwise. Perhaps the priest followed; she did not know. She walked the path of Alpher's shadow; a lesser priest touched her shoulder each time she began to stray from it—followed it all the way to its end. Touches at her shoulder turned her now, turned her toward the Temple. A way opened for her through the throng. In moments it was carpeted with flowers and fern fronds. They were cool and soft after the hard, warm stones.

Into the Temple through the high central arch. Down the nave of the great hall through dim light to the transept. All the great hall's shutters were closed; she could see almost nothing. They stopped her before the High Altar. Deep shadows gloomed around her, dark as deep water, and still the din of drums and flutes and bells and, loud, the chanting voices. A blaze of light shone down on her, warm on her forehead, her shoulders, her breasts. An oval pool of brightness surrounded her feet on the smooth stone floor. It dazzled her downcast eyes. The smoky sweetness of incense filled the air she breathed.

"There are mirrors on the Temple's

roof," Isak said. "They can be turned to reflect a god's light down into the hall, no matter where he may stand in the sky."

"I didn't know that," Kalynn said. "I didn't know where it came from. I thought it was the gods."

At the time she hadn't even wondered. It was all experience. Things felt and seen. To have questioned any part would have been beyond the strength of her will. A lesser priest brought the bowl to her again. He raised it to her lips. Again she drank. The heat glowed through her body. She felt as if the light around her shone from that inner flame, like fire shining through glass.

The chant slowed, became again a perceptible rhythm reinforced by the march of the drums. The horns and chimes fell silent. Four senior priests took station around her, facing inward from the edges of the pool of light. She was induced to turn, to face them one by one, and as she paused before each one, that one advanced a step and touched her shoulder with a talisman: the coiled, stuffed skin of an eel, a wine sack, an ungulate's plump egg pouch, a wand of gold. Beyond the pool of light, as she turned, she could see only shapes and shadows, the massive roof timbers, stone arches, and a bright patch where the entrance arch gave a glimpse of the sky. Again she went around the circle, to be touched again with talismans: a water tuber, a skein of gossamer yarn, a leviathan's tusk gnarled and brown with age, and a cluster of agate berries the sight of which, even in her dreamlike state, made her breath catch. But even then she did not have the will to resist when, after touching the cluster to her shoulder, the priest plucked one of the berries and placed it in her mouth. Its skin broke. Her mouth was filled with sweetness.

This time, as she turned again to face the altar, she was stopped. Again she was given the bowl. Again she drank. Behind her the chant exploded to a crescendo of pure sound.

Something made her look up. Standing beside the altar, benignly smiling on her, stood the priest, the one who had chosen her. For a moment their eyes met. Peripherally, she saw his hand move.

The light around her narrowed, blinked out. Darkness wrapped around her like a cloth. Before she could move or think or even draw breath, hard hands took hold of her. Thrust forward, her feet gone from under her, she would have fallen. There was a scuff of sandals, a rustle of robes. Half carried, half dragged, they took her away. A latch snapped. Ahead a curtain was flung aside and she was in a passageway with walls of dressed stone. Small lamps in niches gave dim light. Flanking her on either side, two senior priests hustled her along. She stumbled, could not find her balance. The quiet gloom was cold on her nakedness.

"I have seen it done several times," Isak said. "In several places. There is a frame between the mirror and the skylight, and when it is turned it closes like a scissors except that blades come together from six sides instead of only two. The shaft of light you were standing in becomes thinner and thinner and then it is gone. And then they take you away, and then the frame is opened again, and it would seem to all who

watched that the gods whose light it was had plucked you from the Temple.''

''But that's not true,'' Kalynn said. ''I was still in the Temple. If they serve the gods, why would they contrive a deception like that?''

Isak shrugged. He could give no explanation beyond things he'd already said.

She had very little more to tell, or possibly she remembered less than had happened, for by that time her awareness had become like a tiny spark that floated in the air far behind her. After a long journey through passageways and stairways and thick, squeaky-hinged doors, she was in a chamber where again the light of the gods shone—muted now, as if through gauzy curtains. And there she was left on a soft leather couch, bathed in that light, and there the priest came to her while her self watched as if from a distance, unable to do more than watch and feel. He laid his weight on her body. His torque bruised her cheek and his body smelled of sweat and scented oils; and his body invaded her body in the way that a man did his woman, and though the part of her that watched knew that she was not his, her body yielded and received him, and received him, and received him.

When it was done, the priest went away. A lesser priest came with a bowl, and two acolytes who bathed her, a task they performed with the detachment of butchers handling meat. When the light in the chamber changed its tone, as if a god had gone below the horizon or another had risen, the priest came again. Or perhaps it was another priest. She was too far away, then, to know faces. Her body accepted him. The light changed again, and again he came, and again she watched while her body was used.

Again and again, that was the way of it, the light changing and the priest coming to her and the hard edge of his torque cutting welts in her cheek, her throat, the side of her jaw, forcing tears to her eyes. Again and again he used her body and went away until the next time the light changed. She never knew if it was one man or many. Only one face stayed in her mind, but there could have been others. Many others.

When they were done with her they wrapped her in an acolyte's robe and put her in a curtained carriage. Then—she never remembered how—she found herself outside the gate of her father's house. The overtaking was done; Red Bethe's shadows edged Blazing Alpher's on the right-hand side as the two began to separate. It seemed a long time she leaned against the gate's hard panes before she thought to lift the knocker bar. Old Bellreo peered through the spy box, quickly unbarred the gate, and shouted to the house. Hobur came and carried her inside. The jewelled cuff was still on her wrist; her broken maiden's chain was clutched in a hand.

''So now I wear neither,'' she said. ''If I believed it was a god who put a child in me. I'd proudly wear a cuff. But it wasn't the gods. It was the priests, and they are only common men.''

''A priest would say he acted for the gods,'' Isak said. ''That the gods acted through him.''

She looked directly into his eyes. ''Do *you* think that?''

Isak pondered long before he gave reply. ''No, I do not,'' he admitted.

"I think once I would have, but now I do not know a reason why I should. Like yourself, I must question whether—as they claim—they serve the gods. Would the gods send a darkness, if all was right with how they serve?"

"You know they wouldn't," she said.

He hesitated. "No," he said. "I do not know that. I do not know why the gods do what they do. I do not know what they want. That they affect the world we live in no one doubts, but why . . . ? I believe no man can know, that those who say they know do not speak truth."

She brushed a strand of hair back from her face and tossed her head. "Then you would say the priests—the ones who used me—that they used me because it suited them. They acted for themselves, and only for themselves. They did not serve the gods."

Isak could not face the direct look of her eyes. He looked down at his hands. "Admitting that I could be wrong, I would have to say that is a logical derivative of what I believe. But I must also say I do not know the gods."

She studied him a moment longer. Subtly her gaze softened and the faint touch of a smile warmed her mouth. He could not guess what she was thinking. Then the moment was gone and her posture had nothing but the hardness of bones.

"Isak, I want to see their power broken," she said. Her teeth flashed. Her chin lifted. "So does Father, for that reason and for other reasons. So do his friends, though I'm not so silly as to think their reasons have anything to do with me."

As she spoke, her eyes seemed to watch something behind his right shoulder. The illusion was so strong Isak had to reject the impulse to turn, to see what was there. He knew there was nothing.

"Do you still think I'm worth a farthing?" she asked.

It took him by surprise. "More than that," he blurted, even before he thought.

"And . . . and if you *had* a farthing . . . ?" She spoke with aching hope.

He didn't know how to answer. "How can I say?" he asked. Though his thoughts stuttered, the words came easy to his tongue. "Does it matter? That an ill-schooled scribe, a wanderer without wealth or station, known to have spoken heresies, whom the Guards would kill on sight, whom the Temple's enemies might kill for lack of knowing what else to do with him—that he might think you worth a farthing at brides' auction? Do you think so little of yourself?"

"And you?" she countered, whip-quick. "Is that all you think of yourself?" She did not wait for a reply. Reaching out, she touched his knee. Her hand paused there. "Isak, if you had a farthing, it would be your whole wealth. So it would mean more to me than any fraction of a rich man's horde. That is what I was asking." She took her hand back and looked away. "Perhaps I was silly to ask."

It was his turn to reach out. He touched her forehead, made her look at him. "No. Not silly, or foolish, or thoughtless," he said. She was such a baffling mixture of softness and iron. "If there was a thing I could do that would heal the harm that has been done

you, I would do it. If I had a farthing, and if it were enough to win your nod at the auctions, I would be in truth the equal of a man of great wealth."

"I think you just did," she murmured, so softly he wasn't sure, at first, what he'd heard.

He frowned. "Did what?"

Her shoulders flexed uneasily, but her voice was calm. "Healed me," she said simply. "Won me."

He was slow to understand. Then, understanding, he discovered that his mind was divided equally between excitement and doubts. "But I do not have a farthing," he said. He had to speak truth. "And small hope I ever shall. I may not even live."

She shrugged. "We'll just have to do something about that," she said, as if it was the easiest thing in the world.

Today, when astronomical discoveries pour in at a stunning rate from our telescopes and space probes, it is easy to forget that one of the greatest astronomical advances was something seen only in mind's eye, quite independent of observations.

—Owen Gingerich

Later, when she had gone and he could think more calmly, he saw it was a hopeless dream, the sort of fantasy a marketplace storyteller might invent to coax a few coins from his listeners. Real life did not happen like that. Too many improbable things would have to happen; to begin with, he would have to stay alive.

She returned after a while, bringing hot food. Again there was the business at the entranceway, helping her to climb up, then taking the serving board from Hobur, and then the bowls and jars. Through it all she hardly spoke, but her hand seemed to linger on his arm; she bumped against him almost playfully; and the way she looked at him was, at the same time, both disquieting and pleasant.

Back in their chamber again she busied herself arranging the board and the bowls and filling their mugs from one of the jars. Now, though she spoke while she worked, it was only to tell him she hadn't been able to read the shadow post. Thick clouds filled the sky from one horizon to the other, she said, and a cold, thin rain was drizzling down. He nodded at the news; it affected nothing. Time would pass at the same pace as if the sky was clear and the gods looked down.

She lifted the cloth from the board, revealing a stuffed roast sandlapper. Working deftly, she scored the glazed skin with a knife and poured a steaming sauce over it from one of the bowls. Another bowl contained brookweed hearts in thin broth. There were prawn nuggets baked to a flawless white, and kyrt bean pods showing pale yellow where the flame had burst them. She broke a scrap of bread from a loaf still redolent from the oven and offered it, host to guest. Almost without thought, he took it and, tearing off a shred of his own, gave it to her in return. She accepted it, hesitated, smiled a shy smile, and put it in her mouth. Only then did he remember it was by that gesture that the bargain at brides' auction was sealed. He felt her grave eyes on him.

It seemed the wrong moment to talk about realities.

"Isak," she said, "I want to know how you do it—how you foretell the gods. Is it something you can teach?"

With his wine mug halfway to his lips, he paused. He had taught her the rudiments of writing and reading, and some of the simpler manipulations that could be done with numbers. She'd been an able student, at least the equal of a scholarium novice. To bring her into understanding of the gods as he had come to understand them would be severalfold more difficult, but there was nothing intrinsically beyond her ability.

"You are the first ever to ask," he said, and set his mug down.

"Would you?" she asked. "Please?"

"I would like to," he heard himself saying. "I think the gods would want me to. No one else has thought it possible to know."

She sliced a joint from the sandlapper and passed it to him. "And the gods? They would not be unwilling to give a woman their signs?"

A wisp of steam trailed from the piece of meat in his hand. "The only sign they give is how their shadows fall," he said. "That sign they give to everyone. From that it is only a matter of calculation. I have not yet shown you how fractions are treated, and there will be the special considerations that result from dealing with cycles, but except for those you know all the parts of the process. The only other thing you must learn is the relationships you will be dealing with. I see no reason you cannot learn any of those things."

She had cut a joint for herself and had bitten a mouthful off the bone. Slowly, thoughtfully, she chewed and swallowed. "And when I have learned these things, I will know how the gods will share our sky from one passing to the next? And in a hundred passings? A thousand?"

"You will know how to evoke that knowledge," Isak said. "Yes."

"And there is nothing magical about it? No ritual? They do not speak to you in a secret voice?"

He shook his head. "It is only a matter of knowing their paths and their pace. The rest is nothing but arithmetic."

Her eyes watched him. "That's strange," she said in a faraway voice. "So very strange."

He finished the last of his meat. She cut him a piece of the flank. "Sometimes I wonder if the gods are anything like we believe them to be," he said. "So many things we have always believed, I have discovered are not true."

"Is anything really true?" she asked, all innocence.

For a moment it seemed a nonsense question. But then Isak saw the deeper implications of it, and the words he had been about to speak vanished from his tongue. He wondered if she realized the profundity of what she had asked. He found his voice, but now he had no words. "My lady, I do not know," he said at last.

Moreover, the recent measurements suggest that the neighborhood of our galaxy may not be a representative sample of the universe. If true, this observation implies that cosmology has its own

"Catch-22"—whereas the vicinity of our galaxy may not be typical of the universe, only that region can be studied accurately.

—Beverly Karplus Hartline

When they had done eating, he began her lesson. All the while they ate, casually talking between mouthfuls, he had thought about how he should start. He could have merely given her a tabulation of the measures and shown her the arithmetic by which he could produce a foretelling, but that was not the way he wanted her to learn. True understanding was more profound than numbers. Given understanding, the numbers made sharp the precision of that knowledge. Understanding gave the numbers meaning.

So he began with a caution. "I should tell you," he said, "I do not know if this description is true. All I know is that it is consistent with the facts I have learned, and I have found no contradictions within it. That is not the same as being sure it is true."

She nodded, watching him, a waxboard on her knee. He hoped she grasped the distinction.

"I will begin with our world," he went on. "It is commonly believed our world—the solid world under our feet—is like a slab, like—" He pointed to the serving board, scraped clean and leaning against the wall beside the entranceway. "—and surrounded by water. Perhaps floating in it."

"Are you saying it's not?"

"Floating?" he asked. "Even if I were wrong about the rest of it, I could not accept that it floats. It is composed of earth and stone and sand, none of which will float in water, so I cannot believe that our world would float. But I would say also I do not think our world is a slab of matter. More likely, I think it is a rounded shape, possibly a sphere, and while it would appear the gods follow paths across our sky, the actual fact would be that our world spins like a potter's wheel while the gods themselves move only very slowly. Their motion across our sky, I would say, is only an illusion produced by the rotation of our world, which carries us around under them."

By the time he finished, she had let the waxboard slip from her fingers. It leaned against her knee while, head bent, she held her chin between her thumbs. Her frown could have been from concentration or deep physical pain or both.

"A sphere? Like a ball? But . . ."

"Do you remember the town I told you of, far to the north, where Actinic Gamow never left our sky?" he asked. "And in the village where I was born, a story is told of a man who came ashore in strange clothes and with a strange twang in his speech; he said he had sailed from a place on the shore of the East Ocean—the far edge of our world—and was caught in a storm that drove him eastward until he came to our land. From these and—well, there is other evidence—I am led to think there is a circular quality to our world. A sphere would be the simplest form, but there is no reason it could not be something else."

Still she fought the idea. "Our world is down under our feet, and our sky is above. On a ball there would be only one small place where you could stand up straight. Anyplace else you would

have to lean to one side, the way you do on a steep hill, and dig your feet into the ground to keep from slipping off.''

He nodded. They were objections he had thought about. Once they had troubled him deeply. ''Very few places are perfectly level,'' he said. ''And I am not sure it is true our world is a sphere. It could be a series of concentric terraces, like a festival cake, though if that is the truth of it I cannot account for rivers that flow northward. The terraces would have to be terribly irregular. But I think . . .''

He took a deep breath. It would be a sophisticated argument. ''In my search of the Archives, I came upon a curious fact. When I matched the shadow-post records from one place with those of others, during any known passing, the shadow a god casts as he touches his highest point of that passing—which we call the zenith point—in the north is longer than his shadow farther south. In places far south it may even fall on the southward side of the post. Now it is possible that some of the posts are not perfectly erect, and some of the marker stones might not be correctly placed, just as we discovered about the post in your garden. And the location of many towns is not perfectly known. But these are Temple posts. I cannot believe that all would be faulty, or that the faults would show such a consistent trend. So I believe the direction we think of as downward is not, as it would seem, everywhere vertical to the same flat surface, but rather it is inward toward the center of something round. I think of a drop of water on a pot's glaze, how it holds its shape like a bubble. A sphere, as I say, would be the simplest form.''

Kalynn made a few scratches on her board, but carelessly; she was thinking about something else. ''A sphere,'' she said again, so softly it was hardly more than breath. She looked up suddenly. ''And spinning? Wouldn't we feel it? When I turn around too many times, I'm dizzied. And it's so obvious the gods sail across our sky. I see them do it with my own eyes. Why, isn't that what makes them gods?''

Reasonable arguments, all of them. Isak nodded. But he said, ''The speed of our world's turning is not so great that we must feel it. To go around once takes all the time from the beginning of a god's passing across our sky to the beginning of his next. And I have stood on the deck of a boat when a swirl of the water caught it, and I saw how all the other boats—even the land on both sides of the river—seemed to go in a circle around me, even though I knew they did no such thing.''

''But like a potter's wheel?'' Now it was clearly like pain, but still she hadn't yielded. ''What could it stand on?''

It was one he couldn't answer. He gestured his failure. ''I do not know.'' It was a poor answer. He felt compelled to go on. ''Perhaps it is like a ball tossed in the air. How can it fall, if all things fall toward its own center? Perhaps it floats in water; I do not know what lies beyond the South Ocean. Although, as I have said, I do not know how it could float. I . . . I would like to be able to tell you, but the knowledge is not in me. I hope, some time, if the gods are generous, I will find out.''

She listened, made another mark on

her board, laid it aside. "I see," she said. "And that is all?"

Quickly he shook his head. "That is all about our world. Now, if I may, I will speak of the gods."

"Do you dare?"

"I have learned," he said, "that I do not need to fear them. They have seen me conduct my research and heard me speak. They must know I have spoken only truth, at least so far as I know it. They have done nothing to harm me. At the same time, men have . . . but you know all that. Who, then, should I fear?"

She picked up her board again. "Tell me of the gods."

Everything in her posture, the inflection of her words, the way her eyes stayed on him, declared her confidence that he could tell her all there was to know. It was a humbling moment. He knew so terribly little.

"As much as I have learned," he promised. He took a breath. "I have told you already that their course across our sky is an illusion—that it is our world that moves under them, while they move hardly at all. Perhaps you have noticed how their paths during a passing are essentially parallel, and how there is very little difference to the way they share our sky between one passing and the next. Those are both results of that cause."

She looked from him to her board, then back to him again. "Must it be that way? Couldn't it be the gods who move?"

"It could be," he admitted. "But which is more reasonable? That all the gods would follow such similar paths, and at such a similar pace, even though nothing apparent links them together, or that it is we who move under them while they hold almost still?"

She was slow to answer. "I hadn't thought of it that way," she said. She shook her head. Her gold hair rippled. "It's all so strange."

"If the gods were as we might imagine them, would they be gods?" Isak asked.

She blinked, then smiled. "You're teasing."

He admitted as much with a nod, though the question continued to whisper resonantly in his thoughts. What *did* make them gods?

"To continue," he said. "I have found some of them move so little that only by searching the Archives—I discovered records almost black with age—did I find proof they have changed their positions. Actinic Gamow and Bright Dalton move so slowly that, within the span of a man's life, it would almost be true to say they do not move at all. And the Twinned Ones, Gold Ephron and Embrous Zwicky, though they circle about each other, sometimes close, sometimes far apart, but always returning, they would seem to stay always in the same part of the firmament. I have found no evidence of a significant change."

"You found that in the Archives?" Kalynn wondered. "But why hasn't someone . . . ?"

There was still some wine left. Isak poured a dollop into his mug; talking was dry work. Still holding the jar, he looked a question to her. She declined with a shake of her head, and he saw that her mug was still almost full. Set-

ting the jar aside, he sipped and waited for the words to come.

"It is in the Archives," he said, "but not in an obvious form. The records are from many places. They go back many lifetimes. Each record shows only how the gods appeared to share our sky, as marked by shadow posts at one place at a certain moment. To find what I have told you, I had to cast them into new tabulations—tabulations which combined the records from many places and moments, and which assumed our world moves under them. Once I had done that, their true motions became apparent."

She contemplated her waxboard. "How did you know to do that?"

"I had noticed two things," he said. "I remembered that village in the north. I wondered how Actinic Gamow could follow a circle around our sky when watched from that place, while in other places through all that season he appeared to follow a normal path from one horizon to the other. And the other thing—my measurements of time with a pendulum made me notice that all of Gamow's passings, his apparent course around our world, were equal in duration to each other within twenty nocks, which was less than the factor of error I obtained when I tested the pendulum against a sand glass."

Her frown had deepened as he spoke. "I don't understand."

"It meant Actinic Gamow did not change his pace," Isak explained. "And then I found that Bright Dalton matched his pace to within forty-five nocks, though standing always in a different part of our sky."

"I see," she said. She spoke slowly, thoughtfully, still absorbing the significance of that information. "And a nock? How long is that?"

He wondered how he could tell her in a way that would have meaning. Then, without knowing how he thought it, he knew. Searching with a hand behind the chest he was sitting on, he found a chunk of stone he'd cracked from the wall, then hidden, so she wouldn't suspect he had explored for ways to escape. Holding it up as high as he could reach, he let it go. It struck beside his foot. "That long," he said. "Perhaps a little less."

She looked at the stone so long and so silently he was sure she'd guessed its origin. But then she nodded. "So," she said, and he knew she understood and was convinced. "They do not move. But we do. But . . ." Another thought came. "You do say the Twinned Ones move, and Blazing Alpher and Red Bethe and . . . and the Pale One . . . they *must* move, or how could overtakings happen? They . . ." She leaned back, closed her eyes, opened them. "They *must* move."

"They move," he said. "Though I am not sure the Pale One is a god. She is different from the others. She seems more like a solid body. A sphere."

He saw the idea come to her—saw the excitement on her face, the quick movement of her hands. "And you say our world is a sphere? Do you mean the Pale One is a world? Like our world? Would our world look like that, if we could see it from our sky?"

It had taken him a hand's count of passings to think of that. What kind of marvelous creature had he here? For a moment his breath did not come. Had

there been a farthing in his purse—but he hadn't even a purse!—he'd have put it in her hand without pause for thought. He wondered what surprising thing she would have done if he did that.

But he said, speaking with care, for he was touching close to the question of truth, "Those things are possible. I would not dare claim they are true. Were they true, I would have to explain why we do not see oceans or mountains on her face, nor any of the other things we have on our world. I would have to explain why we see only those stripes across her face, and those but faintly; and why they slowly change so that one time she will appear slightly different from another time. Do you see how terrible it is to think about such things? You discover that you know nothing. Less than nothing!"

"Like everything else you've told me?" she asked.

He looked at her carefully. Did she mock him? Did she think him foolish to seek understanding of a universe in which nothing could be firmly known? "It is only a way to think about things," he said, knowing it sounded lame, but knowing it was the only true thing he could say. "I know too little of the gods—only the truth of how they share our sky."

She laughed a satisfied chuckle that crinkled her nose, and retrieved her waxboard. "All right. Tell me about the rest of them."

She could have anything she wanted of him. "As I have said, yes, the others move: the Pale One, Blazing Alpher, and Red Bethe—even Gold Ephron and Embrous Zwicky, though their motions would seem to be only between each other. Otherwise, they seem to stay in their own part of the firmament. Only the other three show significant motion."

"Only three of the seven," she murmured. She scratched marks on her board. "And they . . . ?"

"They circle our world," Isak said. "But they do it opposite to the way our world's turning makes them appear to go." He saw her face go blank. He paused and waited for her hesitant nod, which came, and then the glow of understanding.

"Is that all?" she asked. She shook her head. "It can't be all."

"The Pale One moves most quickly," he told her. "She circles the firmament once every forty-two and four-fifths of Gamow's passings. Actually it would be a little less than that, but to be more exact I would need to use a more complicated fraction, and that is close enough for now. I think it is because she is nearer that she is more rapid than the others. She does not have as far to travel."

Kalynn marked her board. "And Blazing Alpher?"

Words he was about to speak caught in his throat. "I am not sure," he said at last. "Either our world circles Blazing Alpher, or Blazing Alpher follows a path around our world. To us it would appear the same, whichever is true. The cycle is three hundred seventy-nine and one-eighth passings—Gamow passings, that is—which is also the time between the moment when Actinic Gamow has overtaken him until Gamow has—in appearance, at least; I would say it happens differently—made a circuit of the firmament and overtaken him again."

Kalynn looked away for just a moment. "Wouldn't it be possible that both are moving?"

She pleased him more and more. "Yes, it is possible," he admitted. "I would have no way to know. Before a motion can be measured, one must have a fixed point to measure from. To say that both are moving would make the description more complicated without making it even slightly more accurate. So it would be a needless complication."

"But both could be moving?"

"Or possibly neither," he said. "I cannot imagine how, but I do not claim to know all things about the gods. The appearance is that they move."

"But our world does not appear to be shaped like a ball," Kalynn said. "Nor does it seem to spin. I certainly don't feel it."

"That is true only if you do not consider all I have discovered about how the gods move," Isak said. "When that is considered, what seemed strange before becomes more reasonable. Some things are as they appear; others are not. The problem is to distinguish between them. That is what I have tried to do."

She held her face between her hands. "It's such a strange way to think of things," she complained. "Doubt all, believe nothing, yet by measuring time and how the gods make shadows fall, and trusting that, coming to a . . . a truth? . . . different from things no one ever doubted. Yet . . . yet I can find no fault with anything you say."

Isak shrugged. "It is also an error to let facility of argument persuade. It has been known to lead men far from truth. It is possible I am wrong; or, possibly, all who have thought on the matter before me are wrong. But they did not have a way of carefully measuring time. Because of that, I have come to a different truth."

She worked her lower lip against a tooth, bent again to her board. "And Red Bethe? He is the other one who moves?"

"He is the other one whose movement I have been able to measure," Isak said. "All of them move, but I believe the others are more distant. Their motions are much less obvious."

"How does he move?"

He sipped the last of his wine and set the mug down. He spoke carefully. "His course lies farther from our world," he said, "and both our world and Alpher would seem to be enclosed within it. Like the others, it is circular, but I would have to say that our world does not seem to be at its center. Hardly anyone has failed to notice that when he is overtaking Alpher his disc is smaller and that he shines less brightly, and from that moment his brightness grows and grows until, when he stands in the firmament on the far side of our world from Alpher, he shines most brightly and we feel his warmth. Also, I have found that the speed of his motion changes according to where he stands in relation to Alpher. In fact, when he stands opposite to Alpher in the firmament and our world is between them, he pauses and for a time retreats the other way along his path. Then he reverses again. I do not understand how that is done, for otherwise the gods move in regular patterns, but that is the appearance I have drawn from the records."

"And that is why no one has been able to foretell how the gods will stand?" Kalynn guessed. "Because Red Bethe does not move like the others?"

"That is one reason," Isak said. "That, and because they have failed to imagine that our world might turn like a spinning ball. I think it is because no one else who put thought to the matter has stood on the deck of a boat and seen all the world turn around him."

"Would someone else have thought our world is like a boat?" Kalynn asked.

He shrugged. "If I could think of it . . . Am I so different from other men?"

For a moment, she smiled—a pleasured, glowing, completely unreadable smile. "You are different from anyone I've ever known."

"And you," he blurted, "you also." Flustered then, not sure what he had said or what he'd meant to say, he took refuge again in things he was sure of. "I was speaking of Red Bethe. He appears to overtake Blazing Alpher every four hundred twenty-two of Alpher's passings—within one or two of that number—but I would say that is not the period of Bethe's course around the firmament. Rather it is the duration of Alpher's circuit with the addition of a factor taking into account Bethe's advancement around the firmament during that time."

Kalynn brightened. "And perhaps also his advancement while he's doing that?"

"Exactly. Yes." It was delight he felt that she had thought of that. "But the thing to remember is that, though it appears Bethe pursues and overtakes Alpher, that is an illusion created by the turning of our world. The actual way of it, I would say, is that Alpher, who follows a more rapid course in the direction opposite to the way he appears to move, overtakes Bethe. Bethe, I would say, does not complete a circuit of the firmament but once for every nine and two-thirds of Alpher's."

Now her frown, the way her hand paused on the wax board, told him he had confused her. He could understand that. It was a clutch of concepts too complex to be instantly grasped. He had difficulty with it himself; so much of the understanding he'd come to was so sharply at odds with all he'd thought was true before he gave thought to the question. Old habits of thought died hard.

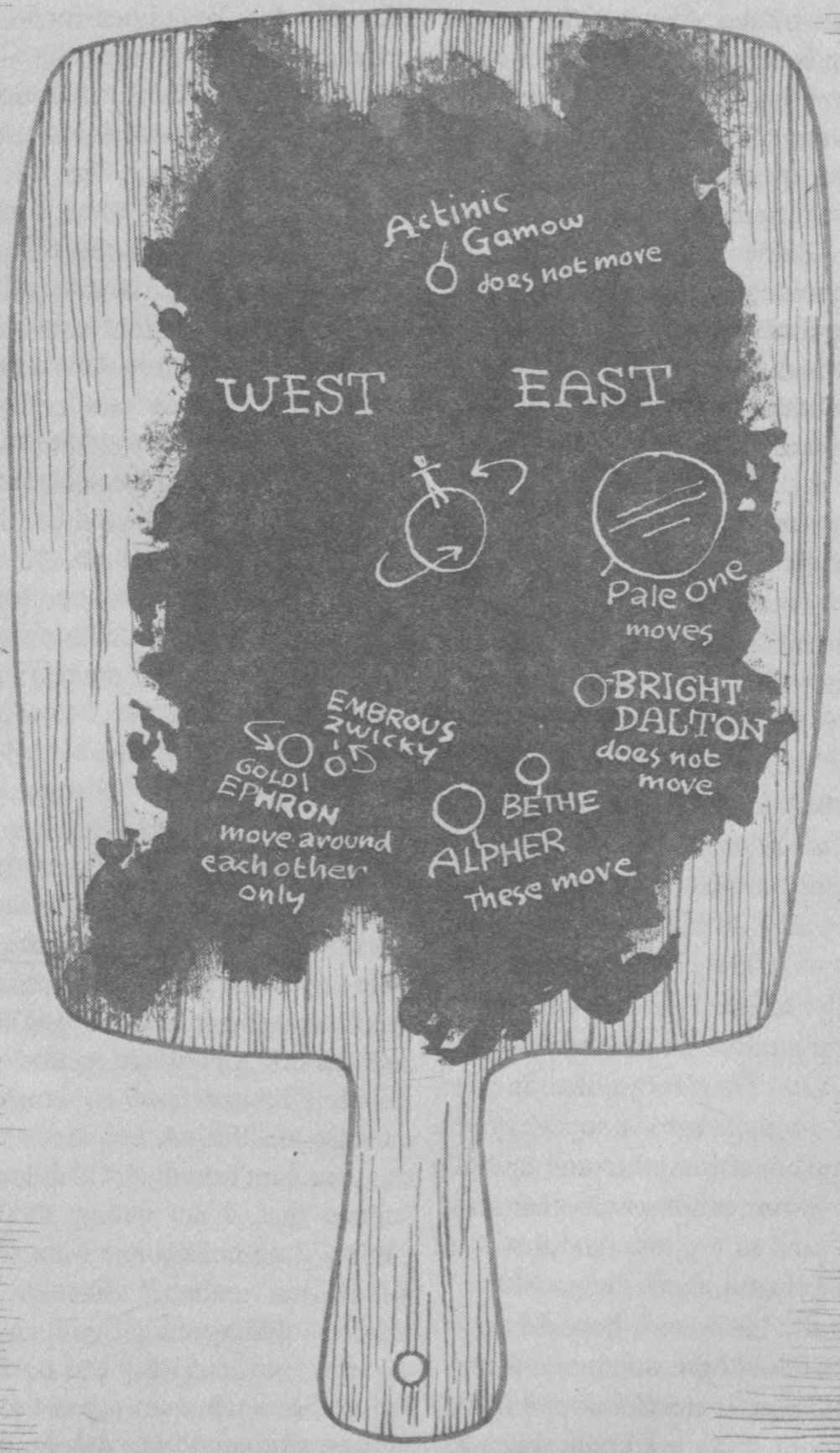
"Think of two circles," he said. "Think of one inside the other—smaller, of course—and imagine yourself standing within the smaller one. And think of two drome wagons, each following the path of one of those circles. Let them move at the same pace."

He watched her as he spoke, and she watched back. Her eyes told him that her mind saw.

"The one that follows the smaller circle will complete a circuit in less time," he went on. "It does not have as far to go. So it will appear, if you are standing inside the smaller circle, that the one walking the inner circle moves faster. I am not sure why that is so. It is not logical, and it is not true, but it is the way of things."

He saw the beginnings of another frown, but then she nodded.

"I do not know if Alpher and Bethe move at the same pace, but I know Bethe must stand farther from our world even when he stands at his nearest.


Actinic
Gamow
does not move
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moves
BRIGHT
DALTON
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move
EMBROUS
ZWICKY
GOLD
EPHRON
move around
each other
only
BETHE
ALPHER
these move

Therefore, to appear to move as rapidly as Alpher, Bethe would have to move much faster. Therefore I believe it is Alpher who pursues Bethe and overtakes him, not the other way around, regardless of the way it looks to our eyes. But except for the occasions when his motion in reverse has taken him back past Actinic Gamow so that he must repeat the overtaking—and there have been several such occasions noticed—Bethe overtakes Gamow once for every nine and two-thirds times that Alpher overtakes him. Since I believe Gamow does not move more than a little, I believe those overtakings are a better measure of how long Bethe takes to make a circuit of the firmament.''

She pushed a strand of yellow hair from her eyes. ''It's all so strange.'' She bent to her waxboard again. ''Our world turns around and around. We should be made dizzy, but we are not.''

''Only confused,'' Isak said.

''And the firmament surrounds our world, and within it Actinic Gamow and Bright Dalton each hold places that do not change, and Gold Ephron and Embrous Zwicky do not move away from one part of it. Only Blazing Alpher and Red Bethe and the Pale One truly move, and those motions you have measured. And while for Bethe the motion changes—but changes in a pattern you have marked—for Alpher and the Pale One the movement is as constant as the flow of sand in a glass. And that is all there is to know about the gods?''

''Not all,'' Isak said. It would not do to let her think there were not still mysteries. ''There is much I do not know. Much, even, I do not know the questions to ask. But there is one thing, one more thing . . .''

''More?'' she wondered. She hugged the wax-board to her.

''A curious thing,'' he said. ''I have found . . .'' He groped for words that would make the concept clear. ''I have told you the length of the shadow a god will cast when he stands at zenith is not the same everywhere. To the north it will reach long; farther south it is shorter. The greater the distance between those places, the more difference. But between places that lie east and west of each other there is almost no difference, perhaps none at all. That would be consistent with my thought that the shape of our world has a certain roundness to it. But also—and this has been known for a long time—in a single place, the shadows change length between one passing and another.''

''The ones that move?'' Kalynn guessed. ''Alpher and Bethe?''

''All of them,'' Isak said. ''Though for the others the change is much smaller.''

She rubbed her brow as if dazed. ''But you said they move so slowly that it makes no diff—'' Then she realized her mistake. ''It's an apparent motion?''

It pleased him that she caught the idea so quickly. ''I think it must be,'' he said. ''I have tried to imagine what makes the illusion. I have not been able to, but I am sure that is it. If I am wrong about that, I am wrong about everything. I do not believe I am wrong.''

''I don't either,'' she said. ''Even if I don't understand.''

He wondered what had made her say that. So much went against everything men had always believed. So much was

pure conjecture. Was it because it was he who spoke? That he had knowledge other men lacked? He closed his eyes and tried to think; he had drifted into another digression. There was so much that had to be explained.

"It is the Pale One who is important," he said. "She is the one who will cause the darkness."

"Yes." She had been waiting for that.

"I . . ." He started to speak, but the words stopped. It was hard to hold the vision of it in his mind. "She changes the height of her zenith point. As I have said, all the gods do that, and—have I said?—for each the change follows a regular pattern, from short shadow to long and back again. For most—all except Red Bethe and the Pale One—the cycle's duration is almost exactly the same as the duration of Alpher's round. So close that they must be related. For Red Bethe . . ." He hesitated. "For Red Bethe, I have not been able to analyze it completely, for it is not quite so simple a pattern in his case; I think it is because he moves around our world, and his complete cycle, I think, is related to the length of his circuit of the firmament, while the smaller cycles within it are equal to the time between his overtakings of Blazing Alpher. But that is not what I want to tell you."

She smiled. Did she mock, or did she merely tease? "Say what you want to tell me."

"I want to tell you about the Pale One," he said, speaking against the uneasy feeling that it was not what she had wanted him to say. "Like the other gods, as she moves around the firmament, she moves also southward, then northward, so that if I should measure her height above the horizon as she moves through her zenith point, with each passing her height would become less and less until she came to her minimum. Then, with each passing, she would stand higher and higher until she touched her highest point and began again to descend. And the duration of her cycle would be only a little more than the duration of her circuit of the firmament."

He said the last part carefully, and she sensed that care. "It's important?"

"Very," he said. "It has the result that, as she makes her circle around the firmament, the place in the firmament where she will be when she stands at her highest will be different each time. It shall have moved a little farther around the firmament in the same direction as her true motion. A little less than the thickness of your little finger if you hold it out as far as you can reach."

He demonstrated; she tried it herself and he saw the delight on her face: she herself could measure things!

"After many times, the point will have moved all the way around the firmament," he said. "And it happens that . . ." He stopped again. Again there was something he had to explain.

"I have said that Gamow moves so little it is not significant. Now I must say that is not exactly true."

"You mean it is?"

With a nod he confirmed it. "I have found records—very old records—that would show the longest shadow of his cycle has not always been as long as the shadows he casts now, and that his

shortest shadow, then, was also not as long.''

''Then . . .'' Kalynn touched her lip. ''That would mean he actually *does* move. It's not an illusion. Am I right?''

''He moves,'' Isak said. ''But so slowly that it would be a lifetime before the change would be enough to measure.''

''And Bright Dalton? What about him?''

She was so very quick.

''I have found records that would have him standing low in the west at a time when he should have already gone down.''

She absorbed that information. ''But it would take a lifetime for the movements to make a difference?''

''At least a lifetime,'' Isak said.

''And has that something to do with the Pale One? And the darkness?''

He nodded. ''It has been at least a lifetime since the last time the highest point of the Pale One's path has come near the point where Gamow stands. This time, when the Pale One overtakes him . . .''

''But . . . aren't you saying that it's happened before?''

''A lifetime ago, yes—it happened,'' he said. ''But Gamow stood a little higher then. And his apparent motion—I spoke of it, did I not?—would have him seem to move through a small oval against the firmament, perhaps as wide as two fingers, possibly as high as a thumb. That last time, Gamow appeared to rise higher as the overtaking approached. The Pale One passed very close below him but they did not touch. It was noticed then, and it was thought that he had taken care not to let her come between us and his eye. The records I found speak of it. This time he will not rise so high. She will pass in front of him and block his sight.''

''And that will be the darkness?''

''Yes,'' he said. ''When it happens no other gods will stand in our sky.''

For a moment she was still. She rested her chin on both fists, and though she seemed to study the almost blank wax board that lay on the floor in front of her, he sensed that what she truly saw was with an inward eye.

''But if our world is rounded, as you say,'' she began, ''at the moment they come together, won't the other gods be standing in the sky of other places?''

Oh, how the sharpness of her mind delighted him. ''The Pale One's disc will stand in front of the point where Gamow stands for at least half a passing. Remember that the speed with which the gods seem to move is an illusion caused by the turning of our world. It will need that much time for her to complete the overtaking. The darkness will happen everywhere on our world.''

Kalynn picked up her board. She examined it for a while; her frown deepened, relaxed, then deepened again. Her hand chopped at the board's edge. ''It shouldn't sound so reasonable,'' she complained. ''It shouldn't happen so—so normally. Something like that . . .''

''I know,'' Isak said. He had felt the same pain. ''That something so strange should happen from no more cause than the way they have always moved. Sometimes I think it must be by such accidents that they do all the things they do—that perhaps they do not watch at all, and care nothing for us. It frightens

me to think such things. What might our world be like if the gods did not watch? Would men be as they are? But I cannot stop my mind from asking questions. Why do the gods let me doubt them?''

''Could they stop you?'' Kalynn asked.

''If they can, they have chosen not to,'' Isak said. ''But why would they choose that? I would like to contrive a test that would tell me if it has been by their choice—but I can think of no way.''

''Could they *want* you to wonder about things?'' Kalynn asked. ''Is that possible?''

''My lady, much is possible,'' Isak said. ''But to know that is to know nothing. What is needed is to know what is true, and that . . . I would have said it was hopeless to understand the gods, yet they have shown so much to me that I cannot help but think, if I could see only a little more clearly, or reach and touch a little more—if I could think only a little more sharply, I would know them in all their diversity.''

''If you could, would they still be gods?'' Kalynn asked.

''That is one of the things that troubles me,'' he said. His wine mug was empty and he could not remember draining it. She noticed his downward glance and offered her own. ''You have taken none at all,'' he protested.

''The midwives say it's best if I do not,'' she said. ''They say the child will be more pleasing. And it . . .'' Her voice broke a little. ''. . . it may be all I shall ever have. They should know, if anyone does, shouldn't they?''

He was less sure. ''I think it is a thing their teachers told them,'' he said. ''And they had it from theirs. Such things are sometimes true. But I have found it is not a dependable way to know things.''

''Is there another way?'' she wondered.

''I think there could be,'' Isak said. ''All I have learned is that I should doubt, and the tricks that can be done with numbers. But I think . . .''

''Ah, daughter! There you are!''

The voice from the entranceway made them both look. Palovar's face was framed in the opening.

''I should have guessed,'' he said.

''Is something wrong?'' Kalynn asked. Isak saw tension in the way she held herself. Had she something to fear?

''We must talk,'' Palovar said, his voice imperative. ''Come.''

She looked from her father to Isak and back again. A reluctant pause, but then on hands and knees she entered the passageway. Once she paused again and looked back over her shoulder. ''I want to learn the rest of it. You'll teach me? Promise?''

How much he wanted to! He wanted to go after her and bring her back and tell her all of it. He wanted to drill her in the process of foretelling until she knew it as well as he knew it himself, until she could look at the sky and know almost without conscious thought how next the gods would stand. But he could not even speak, could not tell her he had never had a student of his own, or that he feared that if he died all he'd discovered would be forgotten and he would have failed both truth and the gods. What he wanted counted for nothing. He was as much a prisoner as if he were bound hand and foot.

He watched her climb down from the entranceway. Unseen hands assisted her. Once more she looked back, her face framed as her father's had been a moment before. "Promise?"

He could only gesture his helplessness.

Crafty men contemn studies; simple men admire them; and wise men use them.

—Francis Bacon

He waited long. She did not come.

Solitude was a thing he had known, in one sense or another, most of his life. Idleness, though, he could not endure. He held a waxboard close to the lamp's prow until the wax softened. He rubbed it smooth, his hands doing automatically what they had done so many times that it was as if they had always known how.

The problem of how the world moved still bothered him. Taken into its parts, it was simple enough. The world spun around and around like a top, and possibly—keeping to the analogy—possibly it wobbled like a top about to fall. That would account for most of the length-of-shadow changes. If it were suggested that the gods who moved around the firmament moved also northward and southward in the course of their rounds, most of the remaining change could be explained. The similarity between the duration of the shadow cycles and the duration between Alpher's Gamow-overtakings could be dismissed as an interesting coincidence. But that analysis could not explain why the change of shadow-lengths for Gamow and Dalton, who seemed fixed to the firmament, was different one from the other. There seemed no geometry by which the world's spin or wobble, or any combination of the two, could account for that difference. Again he reviewed the possible configurations. One by one he had to reject them. They did not fit the patterns he had found. They were not, therefore, satisfactory descriptions of how the world and its surrounding universe were arranged.

He was still at work, still pondering, when Hobur again removed the stones. Isak put the wax board aside and started to rise, to help Kalynn up. But it was Hobur's face that appeared in the opening.

"You be told to come out," the old man said.

For a blank moment, Isak didn't understand. On hands and knees, he paused. Only slowly did the significance come to him. "What will they do?"

"Old Hobur hears only what the master do want him to be hearing," Hobur said. "If more be wanted ye must seek it of another tongue. Be you coming?"

It was hardly a matter of choice. In the outer chamber Hobur had set one of the stones against the wall, but even so it was a long step down. Hobur steadied him until he found his footing. When one of the stones slipped in Hobur's hands as he was lifting it, Isak caught it before it fell and helped the old man raise it the rest of the way. It fit solidly into the wall.

Hobur turned. "Be thanked, lad. These hands . . ."

He held them out. Isak saw the awkward twist of the fingers. He could almost feel the old man's pain. He looked away—looked at the wall. Where the

stones had fitted looked like every other part of the wall. If he hadn't known, he could not have said where the way into his hiding place was concealed.

Hobur nodded to him to proceed and retrieved the lamp that was their only light. They threaded their way across the chamber on a narrow zigzag path between high-piled bales, chests, jumbled bundles, and lidded wicker baskets whose open weave gave glimpse of scroll-ends and parchment-sheet edges. He paused and fingertipped the dust on a hamper top, and tried to guess if the records it held went back only a few rounds or if they covered lifetimes. He wondered if, allowed to study them, he would find relationships between their accounting and the way the gods had shared the sky, and whether those relationships would match the Temple's list of auguries.

Hobur thumped his shoulder. "They be waiting, lad."

At the far wall their path ended, with no apparent way to go further. Hobur nudged Isak aside, set down the lamp, and knelt before an unblocked section of the wall. He groped down close to the floor. A section of the wall hinged upward. A stick dangled by a thong from a corner. Hobur used it to prop the panel open. With a nod, but no words, he told Isak to go through.

They came out into yet another storage room. Isak had a vision of an endless series of such chambers, one after another, through which he would pick his way until he died of age. But then Hobur came through with the lamp and he could see more than shapes in the darkness. Old furniture was crowded against the wall through which they had come; a scarred bench had been their step down to the floor. Hobur closed the panel and heaved a bundled rug onto the bench. Scooping up a handful of dust, he covered all trace of their passage, then scrubbed his grimy hand on the front of his smock. With his other hand he turned Isak's attention to the flight of steps that mounted the wall at one end of the chamber, almost hidden in the gloom. "Upward, lad."

Hobur stayed close behind, his lamp casting wild, erratic shadows. A glow of stronger light, muted, beckoned like a promise from above. The steps were stone, scalloped by use and gritty underfoot. Where the two walls met, the stairway entered a tunnel. The light strengthened. Isak looked up and saw the skylight high overhead and the shadow-cloaked roof beams.

A few more steps and his head came level with the floor. On his left a wall ascended, blank and plain, all the way to the skylight. Ahead, another wall blocked the way; that one would have been featureless too, but for the ragged scar where the stucco had cracked off. The bricks within were lumpy, earth-colored, of many sizes. To his right the floor sprawled out. A carriage wheel with a broken spoke leaned against the wall. The clean-swept, hard-packed earth bore the imprint of sandals and drome paws and wheels. One of the people waiting was Kalynn, which raised his hopes, though she was primly clad now, as if for the street, her shawl tucked into the waistband of her ankle skirt. The other was Palovar. Between them a barrel stood on end, its upper end open, the staves splayed like the shards of a flower beginning to blossom. Beyond

them, like a frame to their tableau, a pair of coach-sized solid doors admitted a sliver of the gods' light through the crack where they joined. Angling to the right across the open floor, Alpher's ray was like a streak of gold. Another ray, red-tinged along one edge, lay leftward; that would be Ephron and Zwicky, standing now so that their rays, like their shadows, merged.

He did not realize he had paused until Hobur's hand at the small of his back urged him on. He looked at Kalynn. "What . . ?"

Palovar gestured him to be silent. Kalynn moved as if to take a step toward him, then hesitated. Isak stopped again at the top of the stairs. Hobur was still behind him, but that wasn't a way out, anyhow. Nor did he know if he needed to escape. "I don't . . ."

Palovar advanced, but stopped beyond arm's reach. "Not the ordinary way a guest leaves." He nodded to the barrel. "Nevertheless . . ."

Isak followed his nod with more than mild unease. Inside that he would be helpless. His eyes went to Kalynn. There was much he wanted to say to her, much he wanted to ask, but he could not speak. He could only touch his brow. "I did not come in the ordinary way. Now I will be permitted to go?"

"Not exactly," Palovar said.

"Isak, it's all right," Kalynn said. And, to her father, "Please let me speak." Then she was standing so close that, had he dared, he could have put his arms around her.

"It's just we can't risk them seeing you come out of our gate," she said. "The street wardens . . . they've been told to watch, and there are so many of them."

Isak nodded. It made sense.

"You'll be some bad wine going back to a merchant of equally bad character, along with footmen enough to enforce our complaint," she said.

"But then I'll be let go?" The thought came, then, that once free he would have no place to go. Such freedom lacked attractiveness.

"Not exactly," Palovar said—the same words as before. He came to stand beside Kalynn, his arm possessive around her shoulders. "She has convinced my friends you might be useful to them."

The word made Isak turn his head. "Useful?"

"I speak carelessly," Palovar said. "They will explain. Considering that the Temple would have your tongue, I think you'll not object."

"Would I have a choice?" Isak asked.

"Discuss it with them." Palovar nodded again to the barrel. "They're waiting."

"I still want you to teach me, Isak," Kalynn said.

"You are with them in this?" Isak asked.

She looked down. It made him notice again the bulge the child made in her body. A priest's child. "I know what they hope, what they plan. I have talked with them." Then her chin came up. "They might have killed you."

Hobur helped him climb into the barrel and began to close it around him. Hugging his knees, he looked up into Kalynn's face. "As you see, I am not in control—not even of myself."

She leaned closer, though not so near

as to interfere with Hobur's work. "Isak, have you thought? Isn't it possible, when you say how the gods will move, that actually it could be *you* who decides how they will move?"

In another context, from someone else, he would have laughed; she meant it seriously. "No," he protested. "It is not that way at all. . . ."

"Mind thy noggin, lad," said Hobur. Hardly waiting for the warning to be heard, he brought the barrelhead down—snapped it into the notches on the inner faces of the staves. The last two hoops scraped wood and, with a few hard strokes, were hammered tight. Quickly it was done. A crack between two staves let in a scrap of light, but Isak couldn't turn his head enough to see.

"Can you hear me, Isak?" Kalynn's voice; a tapping on the wood above his head.

"I hear," he said. His voice made a hard echo in the cramped space.

"Try not to make noise. They'll let you out as soon as they can. And, Isak—"

A long quiet.

"Yes?" he asked.

"When you can—if you can—please come back. Teach me."

"Daughter, enough," said her father in tones that forbade her to speak more. "Hobur, see if the wagon has come. Our friends will be waiting."■

END OF PART TWO

For permission to use the quotations included in this installment, I want to thank—

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THE REFERENCE LIBRARY

By Tom Easton

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Dream's Edge, Terry Carr, ed., Sierra Club Books, $5.95, 313 pp.
Dream Makers, Charles Platt, Berkley, $2.75, 284 pp.

Science fiction is the more or less legitimate offspring of the first industrial revolution. We therefore cannot say that it had any real roots in ancient Greece, however often historians with a yen for precedent may claim it does. It was born with the scientific method and the assembly line. It first saw the light of day in nineteenth-century France and England. It entered puberty in the America of the 1920s, and in America it grew and matured until, to many, SF now seems a peculiarly American institution.

SF may in fact belong more to America than to any other nation—at least, the vast bulk of the stuff is published here—but there are fans abroad as well—in Europe, the USSR, Australia, and elsewhere—and they can in all honesty point to their own indigenous brands of SF. Unfortunately, we don't see much of it here. The translation business is heavily oriented in the English-foreign direction, and the typical monolingual American is blocked from access to much foreign SF. Why are they blocked? There's no conspiracy. Simply, publishers and editors aren't generally any more able to read foreign tongues than their customers, so they are unlikely to find decent foreign SF. Too, they may feel that so much English-language SF is available that they needn't go to the additional expense of paying translators.

Nevertheless, some foreign SF does reach these shores. Most of it needs no translation: it's English, Canadian, Australian, almost American in everything but slang and ethnic jargon. We

get some French, Polish, German, Scandinavian, and Russian, a little Japanese. And nothing else, although we know it must exist. Are there no strange dreamers whose native tongues are Swahili, Italian, Chinese, Tagalog, Arabic, Hebrew, *et* multifarious *cetera*?

The problem is not one I can solve from my desk here in Maine. I would need a vast library, a vaster network of foreign correspondents, contacts with a corps of varied translators, and—last but hardly least—a pet publisher or printing press.

Given all that, would it make any sense at all to bring the world's SF into English? National tastes are so idiosyncratic that American readers might find no more than academic interest in the SF from most countries. They would find more appeal in SF from those countries with more technological orientations, the "developed countries": Japan, France, Russia, Germany, Scandinavia. Their SF already trickles in. Yes, it trickles in, idiosyncracies and all, and though the themes may be familiar, the treatments can seem alien enough to make many American readers reject them.

As a case in point, I offer Russian SF. Macmillan has been translating it and selling it in neat packages introduced by Theodore Sturgeon. I have two of the packages before me now, both first published in hardback in 1979 and now out in paper under the Collier imprint. One is **Far Rainbow/The Second Invasion from Mars,** two short novels by Arkady and Boris Strugatsky. *Rainbow* concerns a colony world on which scientific experiments set in motion a process that will shortly wipe the planet clean of all living things. The characters struggle to reverse the disaster or, alternatively, to save what they can aboard a too-small starship. The theme is one that could easily fit into the American opus; the treatment is alien. The Strugatsky brothers present a society with a marked collective flavor, but more Soviet yet is the way the characters view themselves. Physicists, supposedly brilliant, behave as incompetent, adolescent dunderheads, and though there may well be a touch of satire in this, I suspect it strikes close to home. Anyone who has lived too long at home, or known one who has, must be familiar with how prolonged existence under a parental thumb perpetuates adolescent states of mind. In the USSR the collective attitude, while crucial, must be subordinate to the *in loco parentis* monolithic state, and we might expect the citizenry to be locked into an adolescent psychology.

Am I stretching too far to see why the Strugatskys' characters don't mesh with American convention? Perhaps, but I wonder. How much is satire? How much is genuine social criticism, perhaps missed by the censors? In his introduction, Sturgeon notes that the Strugatskys show a fondness for and a belief in people as individuals. He's right, but is such a fondness incompatible with clear vision?

The Second Invasion from Mars is the "diary" of a retired teacher, concerned with his pension, who observes the consequences of an alien takeover. Flashes in the night herald change, new seeds are offered the farmers to replace traditional crops with a tasty blue grain, money is replaced by stomach juice, rebels arise and fade away, drug peddlers—whose wares interfere with stomach juice production—are removed. Can we draw any parallels with history? By doing away with capitalists, did the Communists make income more closely associated with the worker's production? Do capitalists hinder pro-

duction? Do Communist basic principles really taste better? Does their acceptance mean a reduction in the variety of life?

In *Invasion,* both theme and treatment seem alien to the modern American reader, and both for the same reason. Both seem archaic, anachronistic, belonging more properly to earlier times. The flavor of the Strugatsky prose reminds one of Verne: of the measured rhythms of a nineteenth-century drawing room, of the slow, reflective pace we have killed off with our demands for directness, for to-the-point speech and writing. Yet this flavor, this alienness, should not deter American readers. *Invasion* shows a wryness, a wittiness, and that appreciation of people that we can enjoy.

Even without the enjoyment, there are the academic, sociopolitical connections we can draw. They alone will make translations of Soviet SF worth buying for some people. This is even true of our second package, **New Soviet Science Fiction,** a collection of fourteen short stories which Sturgeon bills as showing the authors at the top of their form. If he's right, we don't have much to worry about, at least in SF. Like the Strugatskys, most of the writers represented here sound archaic to the American ear (or is it the fault of their translators? Let's be fair, after all). Worse yet, some of them seem woefully short on the sort of general knowledge we think essential for an SF writer—Anatoly Dneprov's "Formula for Immortality" is flawed by profound ignorance. Still, many of the stories are worth reading. Ilya Varshavsky's "The Violet" is poignant; his "The Duel," however, is trivial nonsense and his "Plot for a Novel" is trite and passé. Vladen Bakhnov's "Beware of the Ahs!" is a nice satire on the quantification fetish. And Vadim Shefner's "A Provincial's Wings" is the best story in the book, and a good one anywhere. In a plain style, Shefner describes what happens when a rural mail carrier invents wings so folks can really fly. It's a satiric tale, but also a gentle, poetic comment on genius, freedom, and place in life. Shefner loves to puncture stuffed shirts, yet he recognizes and loves those who are genuine, unpretentious, and not above themselves.

To continue this month's theme of foreign SF, I have three Australian novels from Void Publications (available as priced and postpaid from Cory & Collins, P.O. Box 66, St. Kilda, 3182, Australia). They represent the one variety of foreign SF with which American readers have some familiarity: largely because, written in English, it needn't be translated. Too, the writers are, of course, more familiar with American conventions—most of the SF they read is in English and hence American.

The first of the three is Jack Wodhams's **Looking for Blücher.** Wodhams is familiar to readers of these pages, for he has contributed many short stories, most of them readable and enjoyable. The same adjectives apply to *Blücher,* but the book also warrants "zany," "weird," "surreal," and the like. You could even call it "Goulartesque."

The story? An astronaut, apparently embarked alone on a long voyage, is kept sane by a psychic simulator which allows him to construct and enter detailed, realistic dreams. The project director is annoyed that the dreams have but one concupiscent theme, and he lets a psychiatrist enter the dreams to jolt our hero out of his rut. The shrink, posing as Napoleon, is followed through the dream link by one of his patients,

a psychopath who favors the guise of Blücher, the true Nappy's Prussian nemesis. Director, shrink, and wacko then conspire to frustrate our hero's dreams to the aching blue-ball point, Blücher gets loose in dreamland and aims himself at our hero, and the hunt is on in a world where inconsistencies are *verboten,* where blank spots in a scene's specs can hide dames, regiments, or vampires, where disaster can be avoided by punching a "reset" button and setting up a new dream. Our hero eventually gains the upper hand despite the interference of the director's own newly aroused concupiscence. Therapeutic potentials emerge, and our hero fights for the privacy of his fantasies. Names change as our hero goes from Count Alsace Sapor von Ruttenin to Speedar Phelt to Phelt Keister; his sidekick from Weegals to Winkle to Weevel; the director from Baldcock to Ballsocks to Balkedcock.

The book is a catalog of adolescent dreams in conflict with adult authority. It is funny, a howling scream at times. It is deftly done, witty and swift and smooth. If it is also baffling—if the reader wonders how the devil the whole business got started, what the technical premise is, how the problem of time lag and distance disappears—the pace soon swamps the questions. Read the book if you can find or order it, or wait awhile and it will surely appear in this country.

The second Aussie is David Lake's **The Fourth Hemisphere,** the fifth in his "Breakout" series, which includes *Walkers on the Sky, The Right Hand of Dextra, The Wildings of Westron,* and *The Gods of Xuma,* all published here by DAW. (A series? Only *Dextra* and *Westron* seem related at all, as I recall.) In *Hemisphere,* Euram and Redside confront each other across a dead Earth's moon. War is imminent. Euram puts one man aboard the first starship to claim a world for democracy. He arrives, finds that home has gone silent (presumably destroyed), and lands. He finds humanoids whose males resemble gorillas and whose females resemble human males, and a civilization which, while capitalist, is medievally cruel. He confronts sexism, racism, and a budding Freud before joining a Columboid expedition to what he calls hopefully the Fourth Hemisphere. There he finds a communal culture of men and centaurs, a higher civilization which offers and withholds the saving of humanity.

Does *Hemisphere* sound pretty standard? It isn't, really. Hero Andrew Adams confronts too many turnabouts for that. As his expectations are contradicted at every turn, Lake's story becomes more meaningful than it might seem at first glance. Lake's basic point is that there can be an interstellar "survival of the fittest" based not in conflict and competition but in philosophy: that killer sapients fail to reach the stars, while cooperators do. The idea may not be profound or original, but Lake expresses it well.

The third piece of Australiana is Wynne Whiteford's **Breathing Space Only.** The only one of the three clearly set Down Under, it portrays a world of pollution triumphant. Civilization occupies the mountain heights in an enclave of technology powered by hydroelectricity. Savagery dwells below the smoggy clouds, where life is nasty, brutish, and short. The descendants of Earth's first interstellar colonists return to trade technology for history, but the enclave's directors refuse contact. Hero Roy takes matters into his own hands, learns Morse in twice-record time, and signals the or-

biting starship with an airport light. His motivation is a suspicion that the starmen have the secret of immortality. They do, and they agree to give it to him and his two women friends, although they must leave Earth to enjoy the boon. And only later does Roy discover the awful price he must pay.

This book, more than the other two, could use a translator's touch, for there are words and expressions unfamiliar to the unAustralian ear. Yet the language doesn't interfere greatly, at least not for SF readers so used to half-understood jargon thrown in for "flavor." A greater defect, if I must find one at all, is simply that though the story is well written enough, it offers nothing very new. Its future is familiar to anyone who has been reading SF long, and even the price of immortality is not startling. Of the three, I think this the least likely to find American publication.

And now for a few Americans. Lee Correy, perhaps better known as G. Harry Stine, has a fourth SF novel out, **Star Driver.** It concerns the discovery of a reactionless drive (remember the Dean Drive?) by the research crew of a relatively small New England company; corporate efforts to quash it as unprofitable; researchers' efforts to keep it out of the hands of DOD SECRET-stampers; and a unique solution to the twin problems of publicity and proof: Put it in a small plane, turn off the engine, and take it up to jet airliner altitude, all as a substitute for the scotched plan to orbit a DC-3. At 36,000 feet, " 'Center, tally-ho!' came the call from one airliner. . . . 'I don't believe it. We're right under him now—and his prop is stopped dead! And . . . he's maintaining altitude!' "

Hokey, of course. Melodramatic as all get out. But given that such a drive is possible, might not its initial development go something like this? Why not? Besides, it *does* make a cracking good story, full of action and excitement, and with a modicum of suspense.

You say you want something better? Something that uses a technology so advanced that it might as well be magic? Something set in a richly embroidered world, peopled with painfully real characters? Then try Joan Vinge's **The Snow Queen.** It's probably the best novel I've read this year, and I review it even though I never got a review copy. Instead, Dial sent me a copy because I'm a SFWA member, hoping to persuade me to vote for the book when it hits the Nebula ballot. They made a good move, too—they've got my vote, and they'll have yours as well if you'll rush out and buy it. Do that. Please.

The story is set long after the collapse of the Old Empire, a star-spanning civilization. In recent centuries, one world has reachieved star travel via black hole "gates" and has unified a handful of worlds in the Hegemony (colloquially called "the Hedge," a usage that makes me wonder if Vinge meant the connotation of unofficiality, of illegitimacy, that follows the association with the old term "hedge priest"). The Hegemony rules the preindustrial world of Tiamat, whose binary star orbits a star-gate in such a way that it is reachable only for 150 years out of 250. During these 150 years, Tiamat is dominated by a technophilic subculture, the Winters, who enjoy and sell an immortality elixir drawn from the blood of sea beasts, the mers. During the remaining 100 years, the rustic Summers rule, worshipping Our Lady the Sea, holding the mers inviolate, and consulting the Sea's avatars, the sibyls, for knowledge. Yet the sibyls are a product of Old Empire tech-

nology, and the knowledge they offer is not that of dreams, but true.

The story opens as Winter's reign nears its end, and the Snow Queen plots to ensure her continued control when the off-worlders and their gadgets must leave. She has herself cloned illegally, and the clone, Moon, is raised a Summer, becomes a sibyl, and loses her love, Sparks. Sparks then becomes the Snow Queen's consort as Moon finds a path offworld and returns in time to seize the reins of a world.

Two tales are intertwined in a marvelous epic here, those of Sparks and Moon. Both analyze the painful struggle for knowledge and a sense of destiny, and this is the explicit theme of the book as a whole. Vinge handles it masterfully, powerfully, satisfyingly, and I can only pray that she can do as well again. If she can, we will be blessed for years to come.

And now for a chorus of "I never thought I'd see the day!" SF as propaganda! An SF anthology from Sierra Club Books! **Dream's Edge,** edited by Terry Carr, is full of disaster tales: ecological, pollution, and population, all doom and gloom, and mostly fair to very good stories. Carr, Silverberg, Le Guin, Aldiss, Anderson, Busby, Panshin, Van Scyoc, Sturgeon, Lafferty, Herbert, Niven (and more) are all represented. My own favorite is Howard Waldrop's "The Ugly Chickens," an account of how a dodo was found in a backwoods chicken coop (quibble —*Scientific American* does not publish people photos).

SF as propaganda? Why not, after all? We dream of the future, we dream promises and warnings, and any outfit whose business concerns such matters should be able to find stories aplenty to dramatize their message. What saves a magazine from the charge of propaganda is that one issue can easily contain two or more opposing messages, leaving only the entertainment as the vehicle's purpose. The same is true of many anthologies, all except the theme jobs, and *Edge* is really just another of those. It comes from the Sierra Club, I suspect, only because it happens to grind their axe. Will it do them any good? I doubt it. SF readers will be the main customers, not those who need the message, and too few of them will find the book for it to generate much income for the Club's coffers. Want to help them out? Buy a copy and give it to your favorite lover of the status quo.

I say we dream, as writers and readers of SF. That's a truism for you, well embodied in Carr's title and in Charles Platt's **Dream Makers,** a collection of interviews with writers of the genre, from Asimov to Moorcock, from Aldiss to Pohl, 29 in all. The style is informal, descriptive, and friendly, not the too-common rigidity of question and answer. It's effective, and from what I know of Algis Budrys, it's fair and accurate, especially in conveying the ambience that surrounds a man. Want to know more about your favorites? Buy it and read. Be warned, though, that it is hardly complete. Platt has left plenty of room for a sequel or two.

Do you teach SF? Then this book may be just the thing to increase interest. Betting on that, I've already put it on the "must buy" list for the course I start teaching in January (along with both the Soviet books). Many of the writers covered will show up in the current magazines I want the students to read (yes, *Analog* is one), and I expect Platt's book to add a dimension to the reading and discussion of what is being done in the field right now. ■

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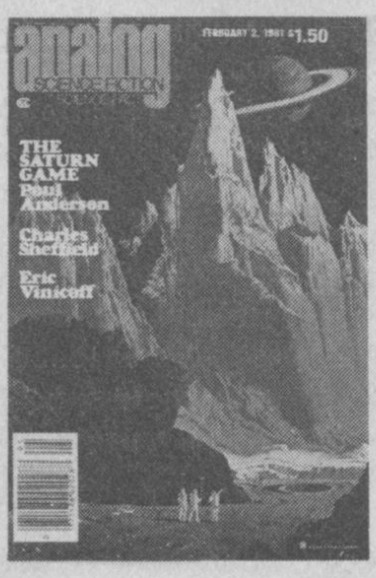

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BRASS TACKS

The volume of mail we received on G. Harry Stine's November Alternate View—such as the samples below—suggest that he achieved his purpose of stimulating thought on the subject. Unfortunately, it also seems that at least as much feeling as thought was generated, and one without the other can be dangerous. There are two main points which I personally find disturbing in a great many of the comments I've heard on "both" sides of this controversy. One is the tendency to bandy about labels such as "the environmentalists" and "the pro-technologists." (The two are not mutually exclusive—I consider myself both—and I've known few people whose views were actually very much like the stereotype that extremists of either group have of the other.) The other idea that bothers me is the "either-or" attitude: full-speed ahead or stagnation. Despite clichés about "both sides of the question," very few questions really only have two possible answers. Isn't it about time we spent more time looking for others instead of giving up because we know two, neither of them very satisfactory?

Dear Stan:

Re: "The Alternate View" by G. Harry Stine in November's Analog.

I am, no doubt, among many who have written expressing disgust at Harry's technological destruction of whales or any other species. I was, literally, shocked to read his viewpoint. I couldn't believe it, so I re-read his article a couple of times.

It is really a sad state of affairs to read of the destruction of whole herds of elephants in Africa, either as an outlet for guerrilla warriors' anger or just as a supply of ivory. It is tragic to hear a youngster turn to his parents in a natural

history musuem to say: "I wish they still moved." My wife and I had tears in our eyes; we realized that zoos would be the only place that we could see living species existing.

A matured, technologically advanced society could co-exist with an ecological environment. You don't measure a civilization's advance by the number of species that it has put on the extinction list through habitat destruction or sterilizing our world. *Homo sapiens'* arrogance is a terrible weakness and disease.

I was shocked by Harry's article because he has advocated moving industrial processes into orbit to allow us to turn Earth into a garden planet. What is a "garden world" without whales, elephants, or eagles? Why can't Harry remember that each and every species is unique to our world and not found anywhere else in our solar system? What would he feel if we discovered that our varied species only existed (or had existed) on this planet? Perhaps planet Earths are much rarer than we imagine and each Earth species' death (terminated, slaughtered) is a galactic or universal loss. How would he feel in "Taylor's" place on a *Planet of the Apes* scenario?

CHESTER TWAROG

Aurora, CO

Dear Mr. Schmidt:

Three cheers for G. Harry Stine ("The Alternate View," November 1980) for giving the environmentalists something to think about. All too often they forget that there is a cycle to all things in nature, from the smallest amoeba to the Universe itself. It is a cycle of beginning, existence, and death, and it holds as true for people and planets as it does for the species which man is wiping out.

In nature this process is called evolution. Species compete, and are replaced by newer, stronger creatures, more "fit" to survive. What many people, and especially the environmentalists, often forget is that man just happens to be the most numerous, and most dangerous, predator on this planet. As a predator, it is his job to prey on the lesser species. It is not something to be particularly proud of or happy about. Like Mr. Stine, there are some creatures I would like to be able to see, but which are now extinct. But I am just as happy not to have to fight it out with a herd of American bison to get to work in the morning. Nor would I like to argue with a dinosaur about right of way on the freeway.

Now, it is possible that we will put our foot in it and do so much damage to the ecology that this planet will become unfit for habitation, human or otherwise. But I can guarantee that the situation won't be avoided by dictating solutions, which is just what the environmentalists and the bureaucrats try to do. If they must stick their collective nose in the kitchen, let them dictate the ends to be reached; and let wiser, more knowledgeable heads find the means.

This is not to say that some precautionary measures would be amiss, and the best precaution I can think of is a good space program. That way, if we do ruin this world, we may have some descendents who can learn from our mistakes. If nothing else, it would give us a frontier: to strive against, to give the young people a place to stretch, to try to become better than their parents, to, ultimately, better the human race. There are risks, of course. Betterment of the race probably won't mean betterment of the race on *Earth*. The best of any species tends to wander the farthest afield. It is also possible that we

may meet some species in space which is just a little stronger, just a little more "fit" to survive. (I tend to doubt this, but it is probably just ego. I happen to think there is no nastier, more dangerous creature in the whole universe than a human with his back against the wall and determined to take as many of the enemy with him as possible.) I certainly don't see any reason to believe we're alone in this universe, but we're obviously safer, from a racial standpoint, if this imaginary enemy has to destroy many planets than if he only has to destroy one.

I won't say this will be cheap; change, especially progress, never is cheap. But money spent in research is never thrown away. Already our space program has paid for itself many times over with advancements in medicine and other technologies.

We really don't have much choice. We either go full steam ahead, or we stagnate. And stagnation means racial death, just as surely as anything else we may do in the future.

ALLEN POTHOOF

Richardson, TX

To The Editor:

I was extremely disturbed to read Harry Stine's recent "The Alternate View: Some Notes about Change." To describe environmentalists as "anti-humanists" is to do an injustice to both, since they must share many attributes to be complete. For example, the environmentalist believes that humanity is big enough to feel diminished by the loss of other specie, is wise enough to recognize the interrelatedness and interdependence of all living things, and is humble enough to respect the biological diversity from which he arose. The environmentalist believes that man is sufficiently innovative and, at the same time, sufficiently ethical to use technology as a tool to protect other forms of life, even while advancing our own.

If we feel obligated to use the dead bodies of specie which we have driven to extinction as stepping stones in our expansion into the universe, then we are not yet worthy of that quest!

TERESA AUDESIRK

Columbia, MO

Sir:

In "The Alternate View" (November 1980) some striking charges were made about flood control around Phoenix, Arizona—of the "Isn't that absurd and outrageous!" variety. Having once been professionally interested in flood control and in land-use planning, I sent Mr. Stine's horror story to a friend who is a land-use planner in that vicinity, for his comments. I cannot quote him directly, but then, Mr. Stine didn't say where he got his information either. The rest of this letter is what my source told me.

During the past three years Phoenix has *not* had four 100-year floods and a 500-year flood. The maximum flow on the Salt River was 170,000 c.f.s. in February '80, which could be called a 100-year flood, but no more than that. There have been several 50-year floods. The Agua Fria River (separate basin) had two 100-year floods. The press talked of a 500-year flood in February when such an event was conjectured *if* Roosevelt Dam on the Salt were to collapse (it didn't).

The proposed Orme Dam is primarily a storage dam and only secondarily a flood control dam. Construction of the dam was blocked by President Carter for numerous reasons, among which the eagles were not prominent: (1) It would submerge the Fort McDowell Indian Reservation (in large part) and the burial

grounds. (2) It would seriously impair recreational use of the rivers involved. (3) It would threaten the safety of upstream dams. (4) It would cost a lot.

Most of the property losses that occurred were suffered by people who had built and developed within designated flood plains, contrary to repeated warnings of officials; and many are going back to build again.

The Central Arizona Water Control Study says that the cost of the Orme Dam is too high for the benefits to be achieved.

My friend concludes: "The cheapest and best flood control method is the 'nonstructural' alternative, which would create significant measures to keep people out of the flood plain now and forever. The local public attitude is 'When the Salt River is dry, it is referred to as the river bottom, but when there is water in the river, it is called a flood.' You would think that people would wonder why they call it the Salt *River*."

J. B. LAWRENCE

San Bernadino, CA

Dear Editor,

A fascinating part of G. Harry Stine's "The Alternate View" (11/80) is his version of the Orme Dam controversy in Arizona. He said Orme Dam was opposed "because" of five eagle nests.

Stine did not consider worth mention, obviously, the fact that the dam would inundate the homeland of a tribe of Yavapai Indians. Nor did he mention workable alternatives to Orme, which would cost the taxpayers millions of dollars less.

Forced removal of the Fort McDowell Indian Tribe would be, of course, just another episode in a long history of broken treaties and worse. These Indians are presumptuous; they dare oppose Orme Dam, which would, all winter, put under water their homes, their beloved land-beside-a-flowing-river, and their ancestors' graves. In summer the area would become mostly a smelly mud flat.

In line with Stine's super-macho philosophy—are Indians just another kind of animal, like the whales whose extinction he views so airily? Does he believe Indians must always be sacrificed for the real-estate profits of the dominant whites? The tone of his whole article infers that he thinks it's not only right, but natural, for a "superior" race or super-species or whatever to destroy an "inferior." This is strongly reminiscent of recent history when a self-styled super-race did its bloody best to remove an "inferior" group—Jews—from the human category.

I wonder if Stine's "super-species" is a glorious conqueror or merely a parasite upon its host, the Earth. "Inferior" Indian cultures stress living in harmony with the Earth. The current dominant Anglo philosophy is to loot, pollute and waste the Earth—"subdue the Earth"—and thicken its air with Los Angeles-type smog. So . . . what happens to the parasite mistletoe after it has subdued its host, the oak tree? It starves to death.

SHERRY COLE

Tempe, AZ

Dear Mr. Schmidt:

G. Harry Stine, in his "The Alternate View" column of November 1980, made a number of questionable statements, but I will confine myself to commenting on one: his use of the "old engineering maxim": that if a system is working one should leave it alone. That's a fine maxim, but Mr. Stine applies it too narrowly. The system in question is not the human economy but the entire biosphere. As he correctly

states, we are far from being able to model such a complex system and cannot, therefore, predict with any accuracy the consequences of our actions. Furthermore, we are now capable of altering the biosphere (e.g., by causing the extinction of species) on time scales which are short compared to the response time of the biosphere.

The environmentalists (who are no more "anti-humanist" than Mr. Stine is "anti-environmentalist") have been trying to make this point for years: in our present state of ignorance it is far safer to try to live in harmony with the biosphere than to wage war on it.

ROB DANIELL

Silver Spring, MD

Dear Stanley Schmidt,

A few comments about the November issue:

All but one of the stories was good and some were excellent. "A Greater Infinity" and "Meeting of Minds" were my favorites.

The story "The Sword Sleeps" was a sad disappointment. It simply went on and on, never saying anything. Not only was there no purpose, no story, no plot, but the author threw in his own way of talking. It took me three quarters of the piece to figure out the "language" of the islanders. By then I was so thoroughly disgusted it made no difference. By then it was predetermined that the story told no tale, held no secrets. It was just an exercise in writing words to make money.

The main purpose of this letter is to comment on "The Alternate View" section. I have to agree with G. Harry Stine's ideas on change. There have been thousands of species that have disappeared from history. I feel no sadder losing the dodo or the whale than I do about losing the mastadon or the pterodactyl. All life is sacred, and it is indeed sad to see any species die.

I also couldn't disagree more. By whose hand is it decided that by killing the whale, or dodo, or passenger pigeon, man will survive? I agree that *if* the loss of whales means man's survival, then by all means kill, destroy. But who *knows* beforehand that slaying any animal or plant will guarantee our survival?

I also disagree that logic or reasoning should be our only consideration. Emotion is what sets us apart from the blind instinct of insects and the lower animals. We shouldn't save the whales purely for emotional reasons, but neither should we destroy them for logic alone.

Mr. Stine raised a point as his own rebuttal. We have invented synthetic rubber, drugs, and clothes, and are working on synthetic fuel. Why can't we start a program of making synthetic whale-whatever? Then we can leave the whale alone. If it became necessary later to control their numbers, permits could be issued as we do now for deer and buffalo.

One last comment. Environmentalists' and ecologists' main concern should be how best to integrate man and nature. It should be how best to help nature change with man's growing needs. It should not be, as it seems now, to stop man from using nature. It should not be to stop man from progressing. Being an environmentalist should be a challenging job. It's much too simple to say "you can't do that. It's hurting nature." It's much more of a challenge to say "Here's how to do that so you won't hurt nature. . . ."

TIMOTHY L. GOEHNER

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