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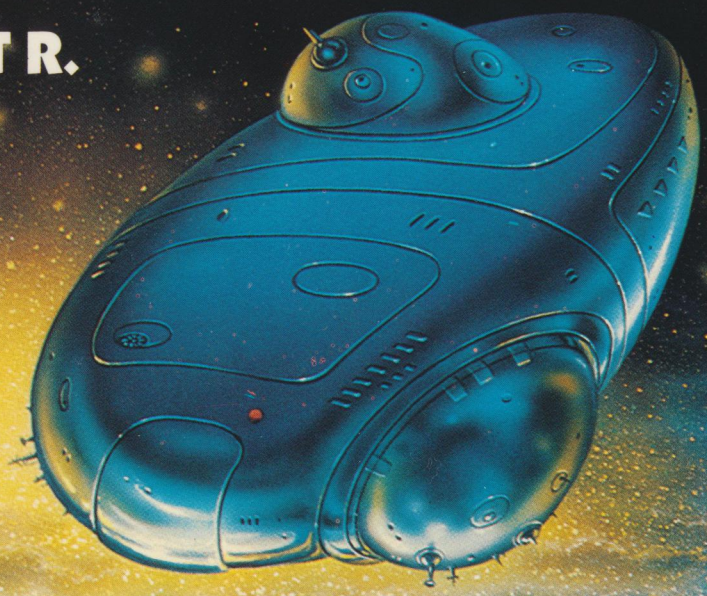

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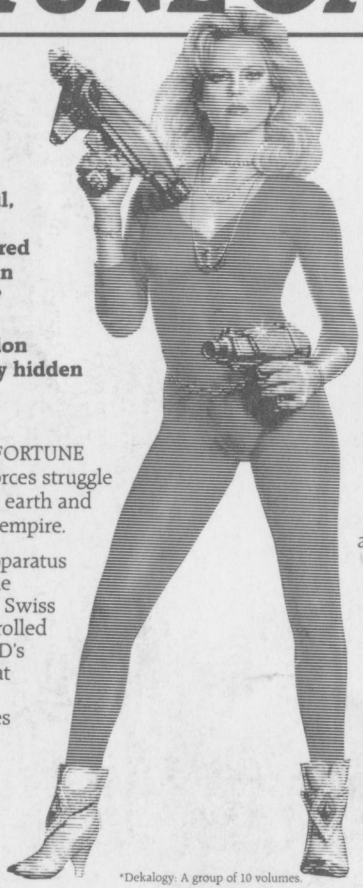

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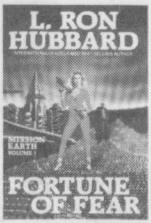

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Vol. CVI No. 12
December, 1986

Next Issue On Sale
November 14, 1986

$19.50 per year in U.S.A.
$2.00 per copy in U.S.A.

Cover by David Hardy

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Indicia on Page 6

Guest Editorial

THE SEASON OF THE WITCH

Rick Cook

In *Politics: Law and Ritual in Tribal Society*, anthropologist Max Gluckman noted that societies that believe in witchcraft usually have a theory of metacausation to support that belief.

"Briefly," he writes, "it may be asked of every unfortunate happening: 'How did it happen?' and 'why did it happen?' . . . Azande (a Sudanese tribe) answer these whys by saying that a witch malevolently caused that elephant to kill that hunter on that occasion or that granary to fall just at the moment there were people sitting in its shade."

Of course the Azande understand perfectly that the hunter died because the elephant trampled him and the granary fell because termites had eaten through the supporting stilts. They know that it is dangerous to hunt elephants or sit in the shade of a rickety granary, and they take precautions. But if someone is injured or killed anyway, then obviously there is witchcraft afoot and the witch must be found and punished.

With the notion of witchcraft comes the witch smeller, the person who can detect the witch responsible for an evil deed. Nineteenth-century Europeans were horrified and fascinated by the notion of witch smelling. To them it was obvious that an innocent victim was singled out for punishment by the bones or flywhisk of the witch smeller. To these observers a witch smeller was deluded at best and more likely a malevolent charlatan.

The anthropologists who came later saw it differently. As Gluckman and others have pointed out, accusations of witchcraft were an important force for social control in many cultures. A person who did not honor obligations, created mischief or bad feeling, or who enriched himself or herself at the expense of tribe or clan was liable to be smelled out as a witch. Far from being

crazy, the witch smeller was acting to reinforce the deeply held beliefs of the society and to maintain the society's balance.

Some anthropologists saw an important cathartic effect in the smelling out and punishing of a witch. In small communities where the death of even a single person was a universial tragedy, finding someone to blame served to focus and release the tensions caused by the death. In purely rational terms there was nothing anyone could do, but the theory of meta-causation gave an outlet for grief and anger. Punishing someone made everyone feel better about what had happened—except of course, the poor "witch."

All of which makes the notion of witches and witch smellers more comprehensible and none of which makes the notion of witchcraft any less irrational.

Seeking causes when tragedy strikes is not per se irrational. Neither is punishing a person who caused a tragedy through intent or carelessness. The irrationality enters in the insistence that there is *always* someone at fault.

In a strict legal sense it may be true that someone is always to blame. Law and custom may maintain that someone caused the accident, and the good of the tribe may require that the "perpetrator" be found and punished. It may be socially useful to do so.

But objectively it is still nonsense. The granary did not fall by witchcraft, a witch did not direct the elephant to trample the hunter, and the person who is punished for causing the accident had nothing to do with what happened.

The essence of meta-causation is that it extends the notion of cause beyond the bounds of rationality. In a universe where meta-causation operates, an accident is by definition impossible because bad things are not random occurrences.

The problem with witch smelling is not just that it infringes on the civil liberties of the witches. It also shapes—to their detriment—the societies that practice it.

Anthropologists have noted that societies with these beliefs are often obsessed with a fear of witchcraft and sorcery. Much of their time and energy goes into defending themselves against the threat of witchcraft. Fear of witches colors their relations with everyone around them. These cultures buy the catharsis and reinforcement of social values of witch smelling at the cost of increased tension and diminished choices.

"These beliefs—or similar ones—are not found among tribal peoples because of any biogenetic difference between them and ourselves," Gluckman says. "It is only a brief 300 years ago since legislation outlawed accusations of witchcraft in England. Some 150 years ago there was an outbreak of accusations of witchcraft in Massachusetts."

And, Gluckman could have added, we are still smelling out witches today.

We don't call them "witches," of course. But modern Americans believe in meta-causality just as firmly as the people who employ witch smellers. Whenever something bad happens to us, we go looking for the culprit. If there is no obvious culprit (or often, even if there is), the witch smellers among us

apply the logic of meta-causation to find one.

In our society, witch smellers go by many names. We call them "lawyers," and "reporters," and "Congressional committees," and "public-interest advocates." Not everyone we call by those names is a witch smeller, but we have a sizable corps of witch smellers ready to go to work when trouble strikes.

Like the Azande we understand that disaster or tragedy has particular causes, and like them we try to correct those causes. But also like them, we go looking for the cause behind the cause. Here we often move from the rational to the non-rational.

Our society is more complex than the societies with overt witch beliefs, so our version of meta-causality is more complex. The focus for our witch smellers are decisions made by the people con-

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Analog Science Fiction/Science Fact is published 13 times annually by Davis Publications, Inc. at $2.00 a copy in U.S.A., $2.25 in Canada. Annual subscription $19.50 in the U.S.A. and possessions, in all other countries, $24.20 payable in advance in U.S. funds. First copy of new subscription will be mailed within eight weeks of receipt of order. When reporting change of address allow 6 to 8 weeks and give new address as well as the old address as it appears on the last label. Second-class postage paid at New York, NY, and at additional mailing office. Canadian 3rd class postage paid at Windsor, Ontario.

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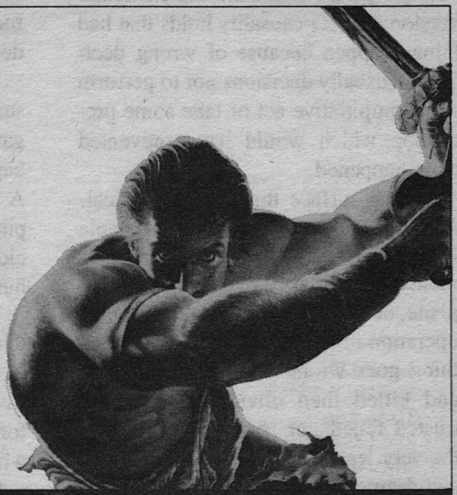

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nected with the accident. Our particular version of meta-causality holds that bad things happen because of wrong decisions—usually decisions not to perform some propitiative act or take some precaution which would have prevented what happened.

On the surface this is quite logical. After all, we have trusted these people to make decisions for us in important matters, such as the design of a jet plane, development of new drugs, or the operation of a nuclear reactor. If something goes wrong and people are hurt and killed then obviously those we trusted failed our trust and deserve at the very least to be publicly keelhauled and drummed out of their positions.

The problem is less with the overt reasoning than the way we apply it. Whenever something goes wrong, the decisions and the cirumstances surrounding the disaster will be examined, pawed over, and sniffed through looking for the "witch." We *know* that someone caused things to go wrong, and eventually, of course, we find someone to blame. All of this is handled with the maximum of publicity to give us all the catharsis of the experience.

But some accidents are simply inevitable. If meta-causality recognizes no accidents, the real world contains no certainties. Living means making decisions based on imperfect information and often in the case of massive amounts of conflicting data. We can study, we can estimate, but ultimately we must decide without knowing everything.

This means sometimes the decisions will be wrong and sometimes that leads to tragedy. When a major accident occurs, the witch smellers come out in force to question every aspect of the decisions leading to it.

Please note: a witch hunt is not the same as an investigation. An investigation is aimed at understanding what happened and preventing it in the future. A witch hunt is looking for someone to punish. One of the oddities of our society is that we often conduct our witch hunts and our investigations in parallel.

Now a decision maker can avoid the witch smellers. All he or she has to do is always pick the lowest-risk alternative. That way there is little or nothing for the witch smellers to batten onto when something happens.

Of course the price of this security is paralyzing inertia, and the closing off of any high-risk, high-gain strategies. Resources needed elsewhere have to go into maintaining defenses against the witch smellers.

All this might be worthwhile if it prevented accidents, but it doesn't. Accidents, tragedies, and disasters are all part of being alive. We can reduce them, but we cannot eliminate them.

The case in point for all this is, of course, the *Challenger* disaster.

Since *Challenger* blew itself to bits in front of millions of horrified spectators, we have been told repeatedly that the space shuttle is not safe.

The astounding thing about this conclusion isn't that it's wrong, but that anyone feels the need to state it. Of course the space shuttle isn't safe. The Space Age is just over 25 years old and at our stage of development no space vehicle can be safe. The best we can say

is that our space vehicles are probably safer than airplanes were at a similar point in their history.

Even beyond the risks inherent in space travel, the shuttle is dangerous and the people who designed the system knew it. This is not a conspiracy, this is not incompetence, and it is certainly not the fault of the people who designed and built the shuttle. It is a fact of life.

The original shuttle designs called for much safer, more practical vehicles with faster turn-around times. Go back and look at the reports of the American Society of Aeronautics and Astronautics from the mid-to-late 1960s and compare what was proposed with what we actually built.

A shuttle built to those early concepts would not have been as safe as an airliner, but it would have been a lot safer than what we finally got.

But it would have been more expensive to develop and build and that was the rub. Congress refused to give NASA enough to build the fleet of vehicles it wanted, so the space agency and its contractors set about designing a shuttle it could afford. Budgets were slashed and the program was stretched out at the behest of a Congress that was generally uninterested in space.

The proposed shuttle fleet was cut from 10 to 4. The totally reusable stages went. The atomspheric maneuvering engines were scrapped. NASA committed itself to a design program that was premised on everything's going right the first time. There were other, more subtle, compromises.

The result was an amazing piece of equipment. One of America's proudest achievements. But it was nowhere near as good or as safe as what we had originally wanted or what we could have built.

crew. That is inevitable in any exploration. By saving money and doing things the way we did, we made such tragedies more likely.

The *Challenger* was destroyed when the seal in its right solid fuel rocket booster failed. The logical thing to do in a case like this would be to throttle back or jettison the boosters. Only you can't. Throttlable liquid-fuel boosters were eliminated as an economy measure early in the design phase and there is no way to get rid of the boosters while they are still burning. They would tear the wings off the orbiter if the crew tried it.

The other end of the flight is equally dangerous. The orbiter is a high-speed glider with the sink rate of a well-worn brick. There is enough hypergolic fuel, oxygen, etc. on board to virtually guarantee that a major landing accident will end in a fireball.

Perhaps we could have prevented the *Challenger* accident. In that case I would be writing this about the "*Columbia* disaster," or the "*Atlantis* tragedy." It doesn't matter. It would have happened sooner or later.

All right. Fine. The decision to build the shuttle was ultimately a political one and one of the functions of politics is to balance available resources against competing demands. If these were all the resources the richest nation on Earth felt it could supply for the most important project of the Twentieth Century,

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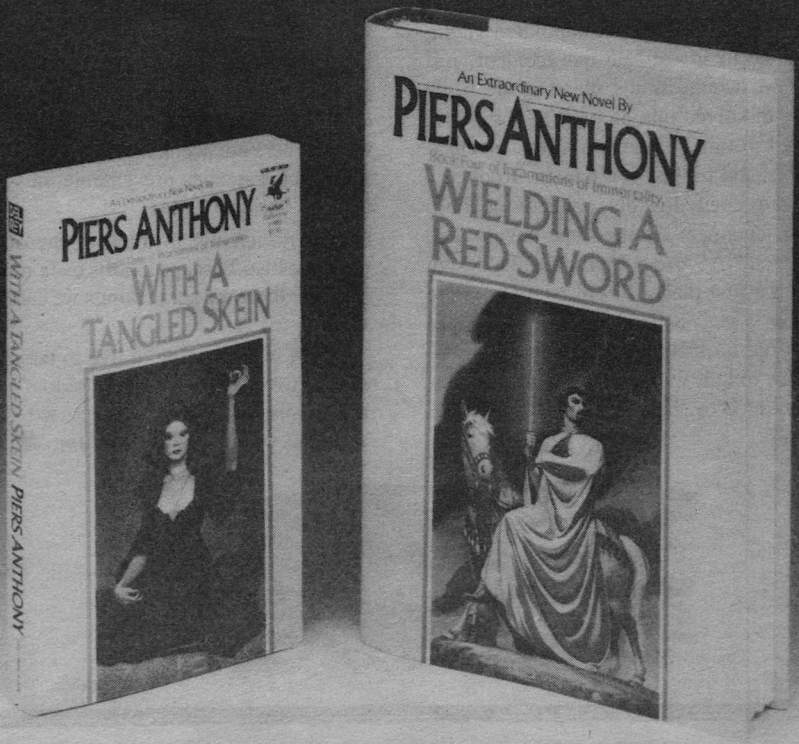

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then that is what we must use. Columbus didn't get the best ships in Spain either.

Even with the ideal shuttle we knew we would eventually lose ships and

What is *not* fine is the witch-hunt we got when the inevitable happened.

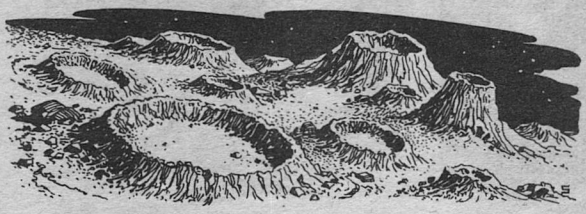
We grieved, and we appointed a committee to investigate the accident, just as we would in any plane crash. Then we dissolved into an orgy of acrimony, back-biting, finger-pointing, accusations and trial by journalism. Ironically and quite predictably, some of the loudest screamers are the same people who forced NASA to compromise the design in the first place. It will take anywhere from a year and a half to two years to fix the problem with the booster seals. How long it will take to repair the damage done by the witch hunt is anyone's guess.

So now we have a choice. We can hunt for our witches and doubtless find them. Then we can have a public witch-burning and all go home feeling better. Go home and stay there, afraid of the dark.

Or we can mourn our dead, fix what was wrong, and keep going. We can recognize that no matter what our witch-smellers tell us, no matter what we want to believe, we do not control the universe. There are accidents and there will always be tragedies preventable only at a price too high to pay.

It hurts terribly to think of the ones we have lost. Perhaps it hurts even more to admit there are some things we cannot control.

But if we are going to live in the real world, we have to face both the loss and the admission. Then perhaps we can send the witch smellers packing. ■



●Even if the propeller had the power of propelling a vessel, it would be found altogether useless in practice, because the power being applied in the stern would be absolutely impossible to make the vessel steer.

Sir William Symonds
British Royal Navy, 1837.

Submitted by G. Harry Stine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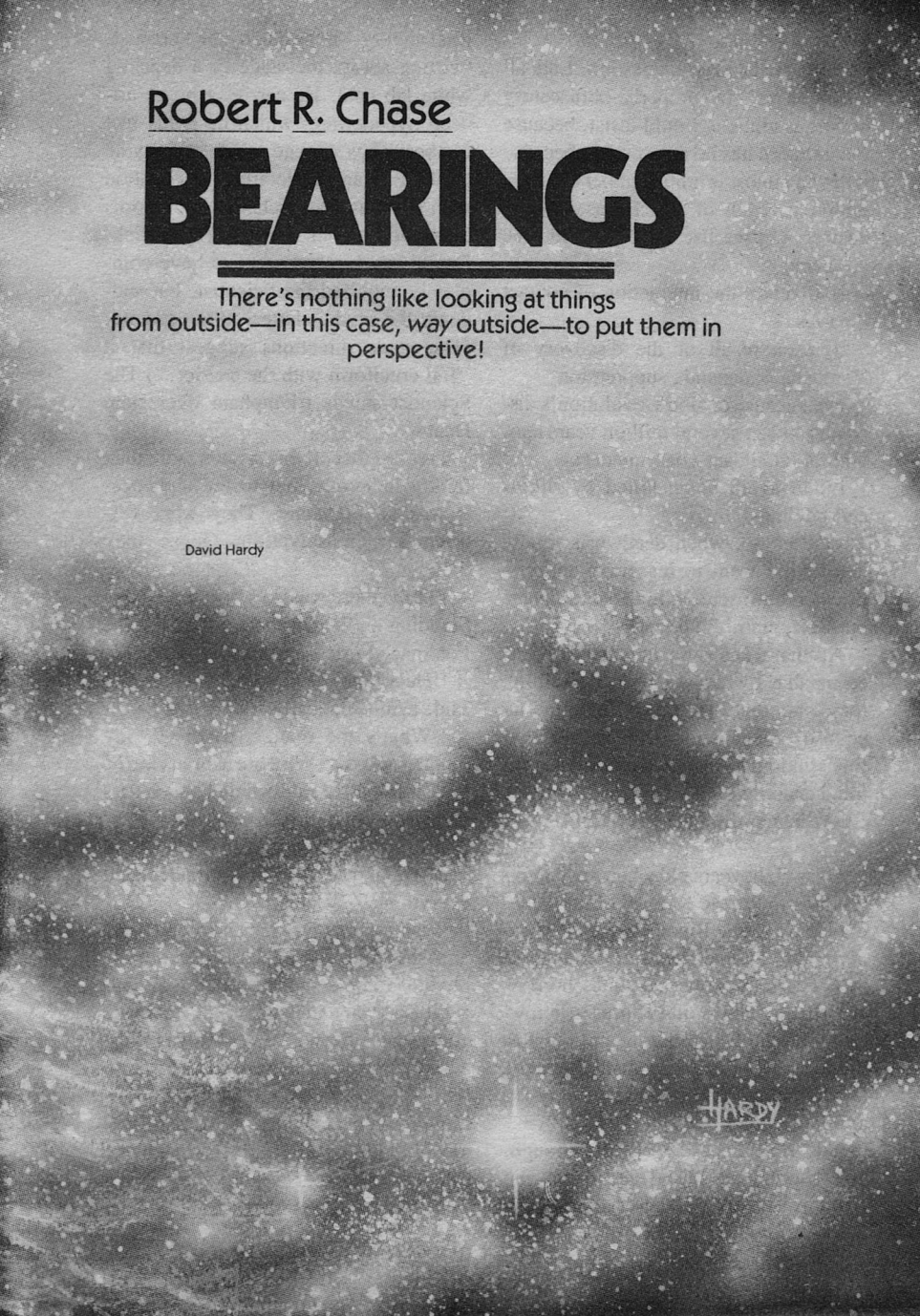
BEARINGS

There's nothing like looking at things from outside—in this case, *way* outside—to put them in perspective!



David Hardy

Why are we here?

You ask the classic question. Like all elders, I will be properly obfuscatory —not, as nihilists would insist, because the question has no answer, but because it has an almost infinite number of levels within it, each of which has its own answer. Let me list some of them. We are here:

i) to study the interaction of contact binaries

ii) as a result of the discovery of Yamoaka-Sadananda suppression

iii) because of God's/evolution's discovery of sex several million years ago, with all attendant consequences

iv) to avoid being killed by rifkins and geldings

v) because, when death was finally defeated, I went to his grave and resurrected him, setting him free to ravage humanity until the end of time.

All that takes some explanation. If it seems that I wander a bit in the telling, remember that I was once lost at the far edge of the universe and had no easy time finding my way back home. My mind encompasses all that and more, so I have much distance to cover.

I was eight years old when my parents took me to the old Kennedy Center Opera House to see Binoc's *Masque of Immortality*. I remember little enough of it: dancers in exotic costumes hurtling across the stage; stolid choruses in towering headdresses chanting a minimalist music which was occasionally haunting and hypnotic, but more usually droning and dull.

I do remember the climax, though. The Hierophant lies dead, miter and crozier scattered. Death advances for his final victory—to be met by the Scientist, twirling across the stage in a dazzling white lab coat. He carries a huge, art-deco hypodermic, which he holds like a saber. They engage, saber and scythe clashing in an accelerating syncopation with the music as orchestra and chorus crescendo to an ear-splitting shriek. Death's dark robes seem to have completely engulfed the Scientist, but suddenly the scythe clatters to the ground. (The stage directions suggest that it "fall cruciform with the crozier.") The Scientist stands triumphant over slain Death.

I realize that all this sounds more than faintly ludicrous, but to the audience, it was an epiphany. They were witnessing their salvation. Or so they thought.

For me there was no spiritual ecstasy. Standing on the terrace overlooking the Potomac, I cried and cried and cried.

"He's just over-tired," my father said, sympathetically.

"What's the matter, darling?" my mother asked. "Why are you crying?"

"Gran'pa," I said, when I got control of myself enough to speak. To my astonishment, I saw that that one word was enough for them to understand everything.

Gran'pa taught me how to play checkers and, later, chess. Despite an obvious fondness for me, he was always a bit testy and never willing to make concessions for me because I was "just a boy." That just drew me closer to him. The world was unwilling to take him seriously any longer because he was too old, just as it would not take me seriously because I was too young. We were perfect company for each other.

He died of a stroke six months after NIH announced the preliminary results of it neuronic regeneration procedure, and four months before it was made available to the public. Four months before old age was banished forever.

What sort of immortality is it, do you think, in which Mozart and Isaiah, Sequoyah and Lao Tse, Newton and the wisest, most considerate man you have ever known stay dust, while every half-baked mediocrity who just happens to be in existence when the elixir of youth hits the mass production lines is guaranteed life as long as the stars shine in the sky? A just man can come to only one conclusion.

It sucks.

Utopia arrived between my eighth and twenty-second year. Immortality was only the beginning. Cheap fusion power eliminated the politics of scarcity. Repetitive drudgery disappeared with the advent of Jeepers—general purpose robots. The wealth generated by these two advances alone eliminated poverty worldwide.

Maybe it was a reflex, a feeling that there *must* be something to worry about, that gave rise to organizations like the Rifkin Society. Its members agonized at length about the Sun's slow progression to red giant, the heat death of the universe, proton decay, and the necessity for immediate action to avert all these catastrophes.

There was a real dark side, had they wished to pay attention to it. In India, the Thuggee cult was reborn. Suicide clubs provided a fashionable excitement for decadent aesthetes. Dark Angels strove to restore a universal balance with ritual murder. Some psychologists wrote dissertations on the pace of unassimilated change, the destruction of traditional lifestyles, and, inevitably, Freudian deathwish. Most chose to ignore all such manifestations—especially as they became more bizarre.

I was invited to join one of the more socially acceptable forms of mass psychosis when I applied to the Solar Observatory for my first astronomical position. It was controlled at that time by Geldings. After my academic qualifications were disposed of, Robin, my interviewer, dwelt with dreamy, pastel intensity on the advantages of "cleansing." Our breeding, he said, was for aggression, for violent procreation. Both quite unsuitable now. Evolutionary progress was a continual history of refinement, of discarding unnecessary appendages. Tails and claws, fangs and pelts had been happily cast aside in this liberating process. Would I not wish to be liberated from that organ whose hormones were responsible for so much of the atavistic violence afflicting society?

I would not. I was engaged to be married in six weeks. "Cleansing" had its place on my list of priorities just above decapitation.

I obtained an assistant's position at the Lunar Farside Observatory. Margarite found a small ("cozy" was the realtor's term) underground apartment which our joint salaries were able to make bearable. We filed reproduction papers with the Human Resources Department immediately, figuring that by the time the fifty-year waiting period expired we might be able to afford room for an extra member.

There was no argument, no sudden

moment of disillusion. Slowly, though, there was a distancing. With her election to the Planning Council, we saw less and less of each other. I worked over notes for publication in an empty apartment under the eyes of rows of stuffed animals.

I came across a century-old essay by a Scots-American science fiction writer. He wrote that a starship, hundreds of light-years from Earth, would find itself adrift without reference points, the stars themselves made inconstant by an inconceivable shift in distance.

(Silent tears slid down my face during that first hour as I read and took notes. Do not ask me why. Dark Angels and Geldings were not alone in insanity. I think everyone back in that Golden Age was at least very close to it. We had to be.)

I wrote an article on the problem. Insufficiently rigorous for the technical journals, it found a home in *Solar Living*, which paid enough for Margarite and me to take a week's flying vacation in the Heinlein Caverns.

You might think that with that background, I would have quickly grasped the implications of the Yamaoka-Sadanada effect. I don't recall even seeing any of the original papers on it. Even Colonel Rucha Sattayarak's instantaneous transit to Pluto in the GDX-105 seemed to have no immediate relevance to me.

Only when the data-retrieval computer of the newly formed Galactic Survey kicked out my name alone in response to a literature search did I realize what I had done.

"For hundreds of years, navigation on Earth's high seas was, in theory at least, very simple. During the day you had the sun. At night, you had the North Star. Converting the degree distance above the horizon gave you your latitude."

I took a sip of water, covertly evaluating the hall. Alert, attentive faces gazed back at me. Some were even beginning to take notes. Those in the auditorium were actually the smallest part of my audience. The lecture was being beamed to several orbitats as well as dozens of locations Earthside.

"Off-planet navigation is just as straightforward. As long as you know the date and time accurately, you triangulate an acceptable fix from any two visible planets. In actual practice, measuring the radio-signal time delays from the navsats in Earth and Jupiter orbits can give you your positions within half a kilometer."

There were nods of agreement. Most Galactic Survey applicants were veterans of the multinational space forces or of the commercial interplanetary carriers. I was reciting to them their basis of existence. That should make what would follow even more discomforting.

"Now, consider your position in a starship equipped with Maya drive. You touch a button. Instantly, the star fields shift. There are no recognizable constellations. Radio signals would take years, maybe thousands of years to reach the Solar System. How do you determine where you are? How do you get home?"

A concerned murmuring greeted this, but no hands. Everyone was afraid of making a fool of himself before the cameras. Those same cameras were part of

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the reason I wanted to keep the class moving.

"Come now, ladies and gentlemen. Let us not be docile. This question was first propounded by the editor of a science fiction magazine way back in the 1960s. Surely there has been enough progress in the interim for one of you to at least hazard an answer."

A hand shot up. I nodded. "Sir."

"You don't have to worry about star fields any more than old time submarine commanders needed detailed knowledge of the ocean floors. Inertial guidance was extremely accurate, even then. What I'm saying is that monitoring your drive functions should tell you where you are all by itself."

My questioner was obviously an engineer. On one hand, his statement was completely correct. It was also extremely dangerous.

"Sir, do you have a complete understanding of the Yamoaka-Sadananda mathematics behind the Maya drive?"

"No," defiantly.

"Do we have enough operational history to establish characteristic failure modes for the Maya drive?"

"If it fails, you don't go anywhere so you don't have this problem."

I allowed a skeptical elevation of my eyebrows. Several of the questioner's neighbors looked distinctly uncomfortable. I, on the contrary, was enjoying myself. The point was important. The engineer might be obstinately wrong, but he was at least thinking, and with luck he would force the rest of the class to think as well.

"Have you ever made a mistake in programming a computer or in operating any other machine?"

"No." Laughter.

"Then you have my congratulations as well as my envy." More laughter. "Any other suggestions?"

A woman in the third row raised her hand. "You could locate the Andromeda galaxy, and the Magellanic Clouds, and triangulate."

"Unless you are deep in a nebula or at the galactic core, you could," I agreed. "Remember, though, that Andromeda is two million light-years away. There is going to be precious little angular difference in its location over any thousand light-year span of the Milky Way."

Suggestions started to come more quickly: supernovas (fine if you can wait a century or so between navigational fixes), bright 0 stars (too often blocked by nebulae or other star clusters), and even my own favorite: pulsars.

"The answer is that we will use all the methods you have suggested and others as well. The operational philosophy of Galactic Survey is that there is no such thing as too much redundancy.

"However, pulsars will be the framework of our navigational observations. They are ubiquitous, scattered more or less randomly throughout the galactic disk. Their signals penetrate through dust clouds and spiral arms. Each has a unique radio signature. This signal slows with time. Therefore, identifying a pulsar immediately positions you on a sphere a given number of light years in radius. Your second pulsar may reduce your location to a point, though more likely it will be a circle. The third pulsar will always give you your location at a point.

"We have reasonably good pulsar

maps of the nearer parts of our own Orion Arm of the galaxy. We are nearly as confident about the adjoining areas of the Perseus and Sagittarius Arms. Beyond that, our data is very sketchy.

"Furthermore, our temporal perspective is even more limited than our spatial perspective. Pulsars do not slow in a perfectly smooth fashion. They slow in starquaking jerks. For a given pulsar to be completely reliable as a galactic lighthouse, it should be recalibrated at fifty light-year intervals.

"There you have the basic mission of Galactic Survey: to sail across the stars charting their dangers and wonders. Completion of this task will take most of a hundred years. Then the real adventure can begin: the star-system-by-star-system exploration of the Milky Way!"

"You were good today," Margarite said as I slid into the booth across from her, "if a bit hyper toward the end. They seemed to understand your main points, and your enthusiasm certainly was infectious."

"Thank you," I said, embarrassed by the praise. "I felt like such a fraud stepping before the cameras like some great authority."

"There is no need for that," Margarite said sharply. "Galactic chose you and they are very pleased with your work."

"My colleagues are not going to accept this situation for long," I said as a Jeeper rolled over with our food. "Survey has already been getting inquiries. Political pressure will be next."

"Is that why you have applied for a berth on a Survey ship?" Margarite asked.

I started. For more than two weeks I had been trying to summon up the courage to tell her of my decision. Since we had just made up after a major argument, I had hesitated to do anything which might disturb the peace. Yet, somehow, she had found out.

"Margarite, I—you know I'm not the most distinguished theoretician in the field. Sure, I can do acceptable work for Survey, but there are dozens who can do better.

"More importantly, this is the first chance for astronomers to do real field work since the exploration of the Solar System was completed. I want to see the stellar nurseries in the Orion Nebula. I want to study the accretion disks of black holes, witness contact binaries as they approach and merge, puzzle out the distinctions between super Jovians and dwarf stars."

I said more in the same vein. All of it was intended to convey one thought which I did not dare put into words: *I am not doing this to get away from you.*

"Typical missions should only take six to eight weeks," I said. "If they get started at all. Survey is very worried that it will be scuttled by rifkins and geldings before it is properly launched."

I cringed mentally, expecting an outburst. Instead, her lips parted in an absolutely radiant smile. She reached across the table to take my hand.

"Don't worry about that," she said. "The announcement will not be made until this evening, but I can tell you now that the anti-Survey forces were defeated by voice vote."

"Wha—?" I spluttered. "How—?"

For the first time it occurred to me that Margarite's work on the Planning Council might be more than just a time-wasting hobby.

"What caused the change?" I asked when I could finally speak coherently. "The rifkins and geldings have all the emotionally powerful arguments, stupid as they are. What if the Maya drive malfunctions? What if you step into a supernova? What if you bring back a plague? Or draw the attention of unfriendly aliens? These people have successfully illegalized skiing, sky-diving, and swimming in jurisdictions where they are strong. I hardly thought they would tolerate starships."

Margarite's smile had become smug. "Survey advocates pressed the argument that only by using the Maya drive could we find a home for humanity when the Sun enters its red giant phase. They then stated that no one really knows where the Sun is on its evolutionary curve, or just when it will begin burning helium."

"That's preposterous! It's been established for centuries that it will be millions of years—"

"The rifkins went into a complete panic," Margarite said, laughing. "They swung over to the Survey side, and their votes made the difference. The first ships should be ready in less than two months.

"There is just one thing," she said, sobering. "You just asked that poor engineer if he understood Yamoaka-Sadananda mathematics. Do you? Is the Maya drive safe?"

"No, I don't," I admitted, replying to the first question, "and I certainly don't understand the Hindu metaphysics Sadananda invokes in his explanations. For that matter, though, how many people understand Maxwell's equations describing electromagnetism, which are the basis for everything from our lighting to all lunar subsurface transportation?

"What you need to know about the Maya drive, unless you are a physicist or the engineer in charge of that part of the Survey ship, is minimal. The drive creates a field which stresses space. The easiest way for that stress to fall back to an equilibrium state is for the spacecraft to move."

I squeezed the back of my hot dog bun, propelling the hot dog through its medium of mustard and ketchup.

"Apply critical stress quickly enough, and you move without having to traverse intermediate points."

"And if your exit point is occupied?" Margarite asked reproachfully.

"Suppose you walk into a wall, or a piece of furniture?" I replied. "If you are more massive, it gives way. If it is more massive, you bounce back."

"Only, if you bounce back, your critical stress can't be dissipated by transition, and so it transforms to thermal energy. My sources say that that sort of flashback would yield almost as much as the explosion of a mini-black hole."

"That is an exaggeration," I said uncomfortably, "but, yes, it could be a problem. We will make sure it doesn't happen. Nobody wants to throw away eternity on a stupid error."

That last was a rifkin paraphrase with which I was in complete agreement.

Margarite blinked rapidly, and forced her face back into a smile. "In that case, let's make the next few weeks good

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enough to make you very, *very* careful."

Odd little cramps knotted my back. Despite faithful execution of the prescribed exercise regimen, and the exquisite, custom-molded comfort of the acceleration couch, I was still suffering the effects of constant weight at one g. Living too long on the Moon really weakens you, no matter what the physical therapists say.

Various dials and readouts glowed a comforting yellow-green. I watched the stately progression of vector numbers with approval. Ever since leaving lunar orbit, *Prince Henri the Navigator* had been accelerating at a steady one gravity. In just a few minutes, the numbers would decrease to zero, and we would be motionless—with respect to the center of the galaxy. With respect to observers on Earth, we would seem to be flying very quickly indeed, having shed the Moon's motion around the Earth, the Earth's motion around the Sun, and the Sun's motion around the galactic center.

I glanced to my left, over the sloping bank of instruments which enclosed me in a semi-circle. Indira Yuvannidas's small chin was bathed in the soft glow of her readouts. Her face was shadowed above her cheekbones, except for her eyes which glowed cat-green. She piloted the *Prince Henri* with an impersonal absorption in her task. Right now she was guiding us high above the solar plane.

Imagine a toy gyroscope lying on a table. The solid, rotating part of the gyroscope is the plane of the Solar System. The table is the plane of the Milky Way. To attain a due galactic north heading, Yuvannidas had to coax *Prince Henri* into an orbit above the solar plane, which only comets might have traced before.

Behind us, intent on their own consoles, sat Captain Hwang and First Mate Czeczko. The titles were supposed to be only a concession to tradition: Survey was aggressively nonmilitary. This first shift they were largely redundant. Later they, and Indira, would rotate every eight hours to ensure that there would always be someone on the bridge to command the ship.

The rest of the crew was below decks. Of the three, only Dixon, who tended the fusion generator which provided *Prince Henri* with all of its power, fit the general definition of engineer. Garston and Battista, although they bore the titles of Chief Engineer and First Engineer respectively, were both physicists doing field work. The Maya drive was their charge. Should they decide that the drive was becoming unreliable, they could order us to return home. Even if this meant overruling Captain Hwang.

All twenty-four places of one readout bank did an owl call.

"Zero point," I announced.

I could see Hwang's nod from the corner of my eye. A low-voiced order to Yuvannidas, and the entire ship seemed to exhale. Only the elastic snugs hugging hips and legs kept me from floating into the cabin as acceleration eased and ceased. The sudden absence of the engine's humming made my ears want to pop.

"Crew members of *Prince Henri the Navigator*: attention to orders." Hwang's

voice was crisp; perhaps I only imagined a trace of boredom. Our actual briefings had been long and thorough the day before. Hwang was now reading a synopsis for the benefit of the video cameras relaying the start of our mission to (we hoped) billions of breathlessly interested voters.

"We are directed by Galactic Survey to ascend just above the galactic disk. Thence we are to leave the Orion Arm, striking directly toward the galactic center, traversing the Sagittarius and Centaurus arms, ceasing our inward penetration only when we attain the Three Kiloparsec Arm. Bearing galactic west, we shall follow the edge of the Three Kiloparsec Arm for up to 1000 light years, focusing our attentions on the galactic core. Completing these measurements, we shall bear directly back to Sol, charting all stellar phenomena of scientific interest or navigational usefulness.

"Are there any questions?"

Silence.

"Very well, then. Navigator Peterson, a course heading, please."

I had worked these all out at Farside and stored the data in ship memory on coming aboard. Nonetheless, I repeated all the calculations, partly to impress our audience, more importantly to catch any errors. There were none. A three-dimensional starfield appeared on my main screen, an orange-red line slicing through it.

Hwang took this course onto his own screen, did a few checks, and transferred it to the Pilot.

"Ms. Yuvannidas, ninety seconds at one gravity, heading due north."

The guide stars in my three sighting scopes swung in ellipses before settling back in the crosshairs. That was important. You can consider the Maya drive a device which extends a ship's vectors by giant steps. After even a light-year, the slightest error in heading can convert itself into a discrepancy of millions of kilometers. There is no time for mid-course corrections.

"Dr. Garston." Hwang had switched on his throat mike. "Prepare the drive for a hundred light-year step."

"Sir."

The thrumming increased. A flicker, almost imperceptibly brief, ran across my screens and dials as the fusion generator adjusted to the rapidly increasing power drain.

There were just enough seconds to think about the Maya drive. Maya: a Sanskrit word for illusion. In Hindu cosmology the entire universe was illusion. In Yamoaka-Sadananda mathematics, the unbounded, expanding universe we observe today and the dimensionless singularity which existed the instant before the Big Bang are equivalent states. All distance is therefore illusory.

Under the stress of the Maya drive, a starship's existence in the universe is suppressed. It vanishes. But—here is something that might have surprised the ancient Hindu mystics—illusion, like mass-energy, angular momentum, and various quantum factors, is conserved. The starship must, immediately, appear somewhere else.

Some illusions are very much worth holding onto.

"Ready on your command, sir," from Garston.

"Ms. Yuvannidas, when you wish."

I was still subconsciously tensing

when I realized that the constellations in my screens were no longer the same. I keyed up the first step screen from the memory banks and superimposed it. After a little more than a minute, I realized everyone was waiting for me to speak.

"Step accurate to the limits of our data and instrumentation."

There were at least two cheers in my earphone. I had not been the only one tense.

As Survey had instructed, *Prince Henri the Navigator* began ascending what even then was called the galactic escalator. Taking one hundred light-years a stride, it took us eighteen steps to get above the disk.

Earth, by the way, is located in a thin section of its spiral arm.

Each step averaged only fifteen minutes. Since *Pearl of Celestial Beauty* had charted this exact route four weeks ago, my astronomical observations were perfunctory, relating mainly to ensuring that each step had been made with the required precision and that nothing of momentous import was occurring in the immediate stellar neighborhood.

Even though I took new sightings for each step, ran my calculations, and then checked against the pre-flight course I had prepared, it was hard to keep my mind from wandering. I thought about the other crewmembers, how stiff and formal we had been at our introductory party, until Indira had convulsed us all by solemnly addressing Dr. Battista as Dr. Battasti.

Mostly, though, my thoughts wandered to Margarite. The last two months had been the most radiantly joyous time of our life together. To call it a second honeymoon is too pale a phrase. Couples only begin to know each other on their honeymoons. It takes years of hard work and constant attention to learn what secret gestures most delight the mind and body of one's mate.

A few times I had been frightened by my own happiness. Was Margarite this eager to be getting rid of me? That thought made no sense. Given the *laissez faire* social mores, any time she wanted to take a lover or simply walk out, she could.

A more realistic fear concerned my own motivation. Did I seriously want to leave such domestic bliss? Yet everything I had told Margarite about why I wanted to go was still true. Moreover, although I could not define it, I suspected that somehow this Survey mission had catalyzed the improvement in our relationship.

"End of the first leg," I announced. "We are in the corona."

"Ms. Yuvannadis, ninety seconds deceleration at one gravity," Hwang ordered.

This time, after I called out zero point, the *Prince Henri* pivoted ninety degrees.

"Forward screens," Hwang said.

Everyone is spoiled by astronomical photographs, all of which are, to various degrees, overexposures. Even the dim lighting of the bridge was enough to wash out all but the brightest stars.

Hwang adjusted the image intensifier by two clicks. The gasp I heard was, I think, my own.

We were still too low above the disk to see the gaps between the spiral arms. Instead, we saw a tumultuous surface of stars stretching off into the distance.


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They clumped together in billows, fell away in valleys parsecs deep, then built together to even greater heights beyond. A storm-tossed sea at night, I thought, but so enormous that it would take hundreds of thousands of years for wave crests to sweep through the arms.

Far, very, very far away, a brilliantly luminous wall rose and curved together near the top of our screen. Globular clusters hung in space around it like jewels on a crown. Everything was embedded in a diffuse, scarcely visible matrix of dim, red stars.

We were now almost twelve hours out from the Moon. Although this was well into the second shift, and we were all very tired, every one of us wanted to see this next step. This would be the true beginning of our mission. We would shift into space never before traveled by humankind, on our way, if not to the core itself, then to the very boundaries of the core.

I prepared our heading and transferred it through Hwang. Yuvannidas could establish our vector in the proper direction while I checked over the calculations for the step itself. Now that we were in the corona, our "seeing" distance had been raised exponentially, while the likelihood of stepping into anything unexpected had decreased in reciprocal fashion. This step would be two hundred fifty light-years long. After which, I fully intended to assemble a club sandwich and a glass of sherry in the galley, and leave astronomical observations to the automatics for at least eight hours.

Step.

The sudden silence told me something was wrong even before the NEGATIVE CORRELATIONS began flashing across my displays. I stole a quick glance at the main bridge screen. Total darkness, save for a dozen small patches of light so dim I half-thought they might be retinal feedback.

Czeczko was running systems checks, on the chance that our sensor systems were somehow at fault. Hwang switched methodically from camera to camera.

Light spilled onto the bridge when he switched to the aft cameras. It was a galaxy, flailing through darkness like an arthritic octopus. If it were roughly the size of the Milky Way, we would have to be at least two thousand light-years above it.

Nothing matched it in the ship's memory banks. Trying desperately to make sense of what I was seeing, I started the astronomical observation sequence—

And stopped short. The galaxy was hurtling toward us at 90 per cent the speed of light!

"I trust you all had a pleasant night's sleep and are prepared to discuss our current problem with unemotional clarity."

Hwang's sarcasm registered through the remnants of my sleeping pill-induced haze. A few hours before, words had been exchanged in tones little short of hysterical. Realizing that we were in no immediate danger, Hwang had ordered everyone to quarters. We were to take one sleeping pill each and sleep at least eight hours.

"I don't know how the hell we can do that," Dixon had objected. "I don't think anyone should leave his station

until we discover where the hell we are and how we're going to get home."

"Ms. Dixon," Hwang had replied, "our present predicament may have no precedent in human history, but if one does apply, it is that of William Bligh and the crew loyal to him when they were set adrift by mutineers. There is some dispute as to whether or not Captain Bligh was a sadistic tyrant. There is no dispute that Bligh's nearly miraculous voyage back to civilization was made possible by his excellent seamanship and by the strict discipline which he imposed on his remaining crew. I take him to be a good example. I do not intend to invite or permit argument."

"We shall continue discussion in an orderly fashion," he now said. "I will choose speakers. A speaker will continue uninterrupted until he is finished or I cut him off. Is this understood?"

Hwang had not raised his voice. Yet, though his words were not even directed at me, I had to repress an involuntary shiver. It was suddenly very easy to credit the stories of his grandfather's role in the Korean reunification.

"Navigator Peterson," Hwang said, cutting through my reverie, "I monitored one of your lectures in Seoul. You detailed so many approaches to astral navigation that I could scarcely make note of them all. Has any one of these allowed you to locate our present position?"

My seat was suddenly very uncomfortable. "No sir," I said. "Our memory banks contain sufficient data to identify any member of the Local Group. The Octopus is definitely not a member."

"Why can't you—" Czeczko caught himself, glancing quickly over at Hwang. "Begging your pardon, sir. Request permission to speak."

"Granted," Hwang said drily.

"Dr. Peterson, your own Farside Observatory has published pictures of galaxies billions of light-years away. Why isn't their data in our memory banks?"

"Because if it were, it would do us no good at all," I said shortly. "To say they are billions of light years away is to give their distance in time as well as in linear measure, even with the Maya drive. Even if we had a picture of the Octopus in our banks, it would be unrecognizable because it would be eons out of date.

"Furthermore, I can assure you that if any galaxy like this one had been discovered, I would have heard of it and remembered it. Observe."

At a touch, the Octopus appeared on my screen. I put it on general feed. "This is really much odder than it appears. The light is appreciably blue-shifted by our high closing velocity. If we were motionless relative to the Octopus, it would look like this."

The screen dimmed and reddened. "As you see, M-type stars dominate. The amount of dust is extremely low. I might have supposed this an oddly-mutated elliptical rather than a spiral galaxy at all."

Spectra and graphs replaced the image of the galaxy. "These are the overall element abundances. Hydrogen is only twenty per cent! Helium is three times as abundant as in our portion of the universe. Most bizarre are the readings for the heavier elements, which are

five to six times as abundant as they should be."

"Very educational," Hwang said. "I am sure the paper you prepare on this will set the scientific community in ferment. Should you return to write it."

He turned his questions to Yuvannidas. We re-enacted how she took my bearings to set the vector, how she then transferred the step coordinates from me to Garston, who translated them into suppression factors in programming the Maya drive.

"Every other step we took set us precisely in the desired portion of space," Yuvannidas said. "There were only two variations in the last step: the *Prince Henri* had changed vectors by ninety degrees, and the length of the step had increased from 100 to 250 light-years. Even if my heading had been off by several degrees, the only result would have been in height above the galactic disk."

I could sense Hwang's growing frustration. This should have been a crucially important fact-finding session. It was degenerating into a forum for demonstrating that, whatever had happened, it had not been the speaker's fault. I felt appropriately guilty. After all, I had set the tone.

Engineering was next. Predictably, Garston showed that his section had performed in an irreproachable manner. Dixon was hardly worth examining. Her fusion reactors might, with sufficient ill-treatment, fail. A highly-trained saboteur might have made them blow us all to ionized gas. That, however, was the range of their failure modes.

Garston and Battista reported that they had checked each other in deriving the suppression factors and in typing them into the drive computer.

"What about component failure?" Hwang asked.

"Our telltales don't indicate it," Garston replied. "We have tested them by cross-checking the suppression fields to the extent we can within the *Prince Henri*."

"Are you implying that measurements outside our vessel are necessary?"

"They could be very useful," Garston said hesitantly, "only—"

"We have no automatic transceiving equipment on board," Battista said bluntly, "nor tools to make any."

"State plainly your recommendations," Hwang ordered, with poorly-concealed impatience.

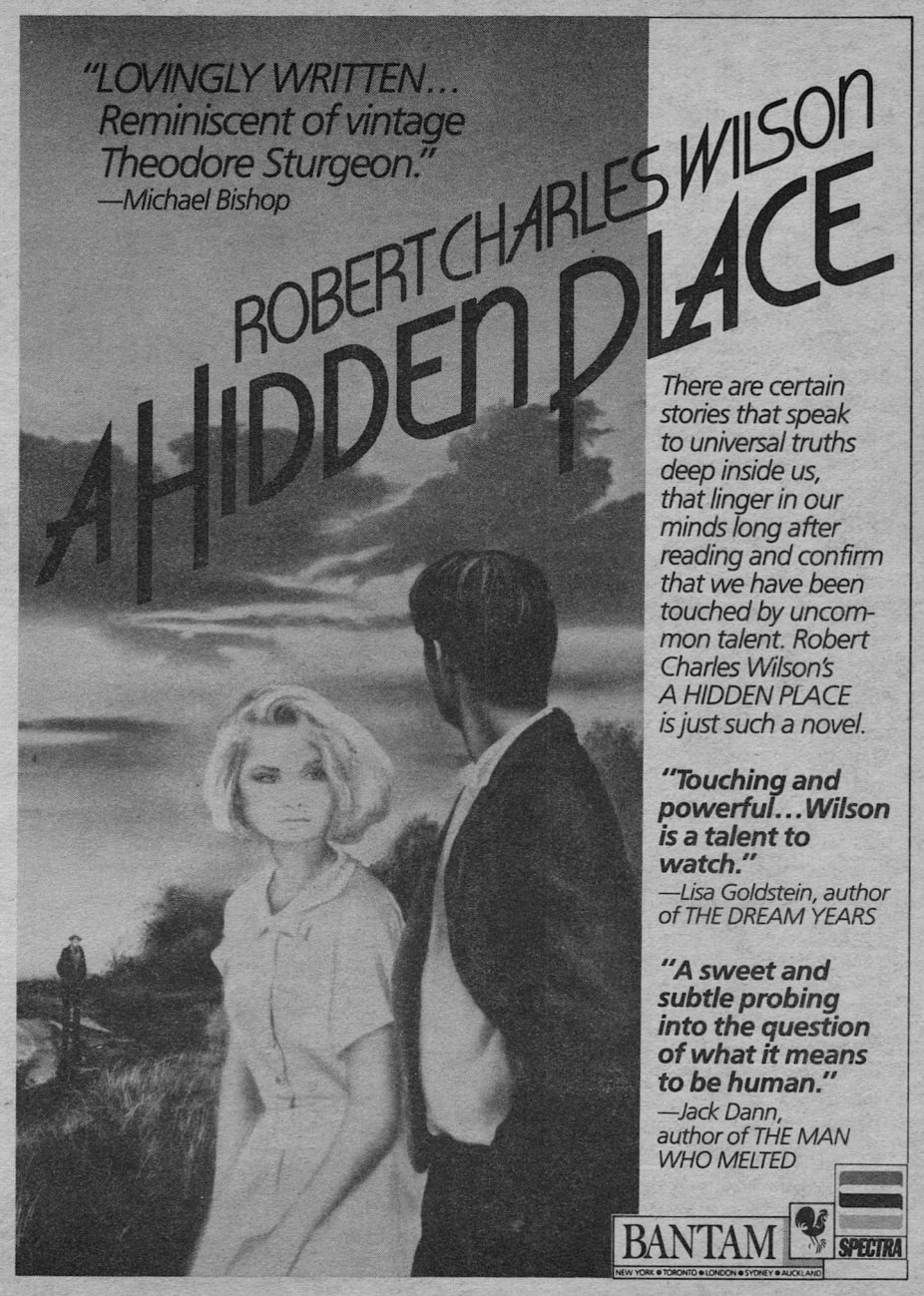
Less than an hour later, I fully appreciated Garston's reluctance. I floated in darkness, taking readings from a jury-rigged hand display, hoping they meant more to Garston than they did to me.

Czeczko's voice was crisp and mechanical in my helmet speakers: "Five, zero, zero, niner."

My umbilical curled away from me, vanishing long before it joined the black dot which was the *Prince Henri*. Save for the fact that it occulted part of the Octopus, the vessel would have been totally invisible.

"Dr. Peterson."

I jerked myself to attention and read my series of numbers. It was impossible to resist speculating that if the drive were faulty, what Garston intended to be sub-critical stresses might flash over the suppresion point. *Prince Henri the Navigator* would vanish, leaving me to drift in unending night.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What, you may wonder, could be easier work than floating through the void, doing nothing but reading a set of numbers from time to time? Any number of things. Just raising the hand display before my helmet so I could read it meant fighting the pressure suit, which continually tried to straighten my arms. My breathing rasped harshly in my ears. Every fifteen minutes or so, I would lose track of the *Prince Henri*, and then my heart would nearly explode in my chest until I located the vessel again.

When reeled in, I needed no sleeping pill to send me into deep and dreamless slumber.

I was at my station running simulations when Hwang came on deck. He gave a grunt, which may have been approval breaking through his now-constant irritation. Intent as I was on my calculations, I hardly noticed him. The remaining crew members brachiated to their stations promptly at change of shift. Yuvannidas, who had taken the previous watch, would overlap into the first hour of this one, in case her input was needed.

"Dr. Garston, your report, please," Hwang said.

My earphone picked up the sound of a throat being cleared. "Well, ah, there were several anomalies which looked quite promising at first," Garston said. "However, computer analysis which takes into account the statistical inaccuracies of our sensing systems showed no significant discrepencies."

"You are saying that the source of the anomalies lies in inaccurate testing equipment rather than in the drives?"

"Yes, ah, yes sir."

There was a long pause. "Then, as our great-grandfathers might have said, we have good news and bad news. The good news is that we have a superbly functioning spacecraft crewed by a band of dedicated perfectionists. The bad news is that either the whim of the gods or a basic misunderstanding of the theory of the Maya drive has cast us megaparsecs from our solar system with no means of determining our direction home, much less of actually returning there."

The silence was uncomfortable.

"I, eh—" I coughed. "I have a suggestion."

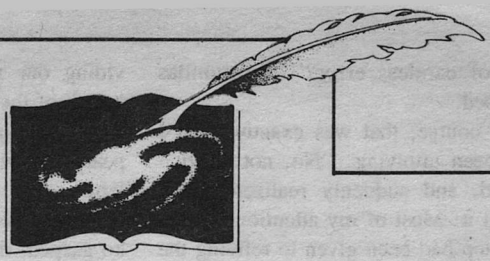
Attention focused on me with a laser's intensity.

"Proceed," Hwang said crisply.

"I think our checks have ruled out misfunctioning of the navigational and drive equipment. Now, although we cannot rule out the possibility that our plight is caused by some unknown phenomenon related to Yamoaka-Sadananda suppression, we can nonetheless ignore it, since such a complete unknown suggests no course of action. That leaves human error.

"As our pilot has noted, no conceivable bearing error could have thrown us so far off course. A step coordinate error might have, however. You may have noted that the coordinates in question contained long strings of zeroes and nines. If one of these sequences were transposed—say, the way one might switch the syllables in an unfamiliar name—the length of the step might be radically extended."

"Are you accusing me of making that



About L. RON HUBBARD's

Writers of the Future Contest

by Algis Budrys

The Writers of the Future contest substantially rewards at least twelve talented new speculative fiction writers each year. With no strings, every three months it confers prizes of $500, $750 and $1,000 for short stories or novelettes. In addition, there's an annual Master Prize of $4,000. All awards are symbolized by trophies or framed certificates, so there's something for the mantelpiece too.

There's also a Writers of the Future anthology, which I edit. (There was one last year, and there's another one just out as you read this.) It offers top rates for limited rights in the stories. These payments are in addition to any contest winnings. The anthology is distributed through top paperback book retailers everywhere, and is kept in print and on sale continually. All that's required to win or to be a finalist is a good new story, any kind of fantasy or science fiction, no more than 17,000 words long, by writers whose published fiction has been no more than three short stories or one novelette. Entry is free.

The contest deadlines in 1986 are March 31, June 30, and September 30, and there are First, Second and Third prizes for each three-month quarter. At the end of our year, a separate panel of judges awards a Master Prize to the best of the four quarterly winners. So one person will win a total of $5,000. Judging panels include or have included Gregory Benford, Stephen Goldin, Frank Herbert, Anne McCaffrey, C.L. Moore, Larry Niven, Frederik Pohl, Robert Silverberg, Theodore Sturgeon, Jack Williamson, Gene Wolfe and Roger Zelazny, as well as me. Matters are administered so that the judges are totally independent and have the final say.

It seems hardly necessary to embellish the above facts with any enthusiastic adjectives. This contest was created and sponsored by L. Ron Hubbard and the project will continue in 1986 and try to do some realistic good for people whose talent earns them this consideration. For complete entry rules, and answers to any questions you might have, write to the address given below:

Don't Delay! Send Your Entry To:

Writers of the Future Contest
2210 Wilshire Blvd., Suite 343
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Or, you can find the rules—and examples of winning stories, plus informative essays by some of the judges—in either of the Writers of the Future anthologies. They're original paperbacks and cost $3.95 each.

Good luck.

—Algis Budrys

sort of careless error?'' Yuvannidas snapped.

Of course, that was exactly what I had been implying. ''No, not at all,'' I said, and suddenly realized that I meant it. Most of my attention on that last step had been given to reliving the previous evening's love-making with Margarite. It was not at all implausible that I had misplaced a few digits.

''What I mean is that transposing vowels and numbers is a similar kind of mistake. Certainly, I may have been the guilty party myself.''

''There are several sequences such as you mention,'' Hwang said thoughtfully. ''How do you know which one was transposed?''

I touched two keys, calling up the program I had been working on earlier. A white line originated at the right of the screen, over a stylized spiral galaxy labeled MW. It extended the width of the screen, ending over a spaceship silhouette with the legend PH. The questioned step coordinates stretched across the top. Irregularly-spaced sets of numbers showed in red. Looking closely, you could see corresponding red dots on the white line.

''Early twentieth century astronomers established that, with a very few local exceptions, all galaxies in the universe were rushing away from the Milky Way. It was quickly realized that the speed of recession increased directly with distance. This relationship was quantified as Hubble's Constant, in honor of the astronomer who first recognized it. Current calculations give its value as 57 kilometers per second per megaparsec. Since we are traveling at .9 lightspeed with respect to the Octopus, simply dividing our velocity by 57 gives the length of the step we took.''

All but one of the red dots disappeared. It was the one farthest to the left.

''Fifteen billion light-years!'' Czeczko gasped, disbelievingly.

''A bit more, actually,'' I said.

''These calculations do not match exactly,'' Hwang noted.

''No, sir,'' I admitted. ''However, I believe that local, gravitationally induced motion accounts for all discrepancies.''

''Why didn't you say this yesterday?'' Yuvannidas asked sharply. ''You said you had no idea where we are.''

''I said that our data banks were unable to fix our position from our obser vations. That is precisely true. I an having to give you an estimate from cosmological principles. There was no point in teasing the crew with this if we had no way of getting home. And until we were able to rule out mechanical malfunction, I saw no reason to add to our stress by suggesting that *anyone* had made any sort of error.''

Hwang, uncharacteristically, relinquished control of the discussion. Without his guidance, it veered between personal acrimony and repetitive restatements of basic positions and cautions. It all came down to this: My scenario 1) was consistent with verifiable facts and 2) suggested a course of action that would get us home. No one else could provide a theory which did either.

Less than three hours later, I was transferring new step coordinates to Yuvannidas. ''Please understand, it is extremely unlikely that we will step

back to where we started. I have tried to correct for them, but gravitational torque from the Octopus, even the friction of the interstellar medium, which is considerable at our relative velocity, have both altered our vector in ways not precisely calculable. As long as we step somewhere within the Local Group, I will be well satisfied."

Yuvannidas repeated the coordinates loudly, biting off each number, insisting that both Hwang and I check each number to ensure that it was transmitted correctly. Her thoughts were as clear as if carved on stone and hung in the air: *No matter what happens, this time it is NOT MY FAULT!*

The countdown marched briskly to its conclusion. At Dixon's command, the fusion generator spat forth an incandescent beam of power at the carefully pre-programmed Maya drive. In less than a nanosecond, such strong and conflicting fields arose and clashed that the continued existence of *Prince Henry the Navigator* became intolerable.

The Octopus vanished. Small dots of light washed over my screens. Stars—no, much too far away. Galaxies, scattered like jewels across velvet.

NEGATIVE CORRELATION . . .

. . . NEGATIVE CORRELATION . . .

. . . NEGATIVE CORRELATION . . .

They were expanding away from us at .25 lightspeed.

"There is no need for you to look so glum," Yuvannidas said. "Nobody considers you responsible for our . . . situation."

I looked up from the tea bulb I was nursing. The very small galley area forced any occupants into something like intimacy. The last thing I felt like dealing with was sarcasm at close quarters.

To my surprise, Yuvannidas's expression was totally sincere. It dawned on me that my lack of success had exonerated her, at least in her own eyes.

"We are clearly much closer to home than when we were out beyond the Octopus," she continued. "Your theory brought us out of shock, and served to focus our energies. Most of the crew assumes that all you need do is refine your calculations and we will be back in the Orion Arm.

"In fact," she added mischievously, "if we can find our way back to Sol from as far out as we have been, the accomplishment should be impressive enough for each of us to earn a full fertility quotient."

"Unless they decided that getting into this fix in the first place was so dumb that we should all be thrown into the mule pool," Dixon said. She put down her tray across from Yuvannidas.

I must have had a particularly blank expression.

"You did hear, did you not, about the new rules of the Human Resources Council?" Yuvannidas asked. "It was all anyone was talking about before we left."

"I was a bit preoccupied," I admitted, "between finishing up courses for Survey and planning for this mission. Besides, I guess Farside tends to be a bit insular."

Dixon chuckled, taking a big bite from her microwave-heated sweet roll. I was asking what she meant by that when Yuvannidas interrupted.

"You must know about the long-

standing discontent with the way the Council has allocated the fertility quotas."

I nodded.

"More than three months ago, the Council published new rules, for the first time making merit as important as seniority in accumulating points. Each one of us received fifteen bonus points just for volunteering for such a dangerous mission.

"But you have distracted me into a lecture. All I intended was to cheer you up. My mind just happened to make the association with fertility as I considered the method."

I stared at her blankly for a moment, not understanding the offer. Then, my face heating with embarrassment, I turned to Dixon.

She grinned. "I like to see how people react under pressure."

Somehow, as I flailed and spluttered, my eyes came to rest on my wedding ring.

"Ah," Yuvannidas sighed. "You are one of those Marital Chastity people. How sweet. Dumb, but sweet.

"Still," she said, pushing away from the table, "it appears we will have plenty of time if you wish to reconsider your philosophy."

I stared after her. She had just given me the answer to a question whose very existence I had forgotten.

The universe exploded from omnipotential nothingness. Circular rainbows, denoting temperature gradients, rushed inward and vanished as the perimeter roiled outward. The rate of cooling slowed toward the center. I typed a note for later investigation.

"Dr. Peterson."

Hwang's right hand grasped the back of my chair. His torso sloped upward behind me. One foot anchored itself in a ceiling handhold.

How can anyone in such an awkward position maintain such implacable dignity? I wondered.

"It is absolutely necessary that I be completely informed on each crew member's efforts to locate the factor that threw us off course and to get us back home," Hwang said. "You withheld your conclusions about the reasons for our first misstep because, you said, you feared the possible effects on crew morale. I understand such considerations. You must understand, however, that it is my duty to make these judgements.

"That is why I am concerned that you are still withholding important information from me."

"Well, sir, I am really not sure—"

"The basic points are obvious," Hwang continued, ignoring the interruption. "The Maya Drive extends any vector indefinitely—but only in a straight line. One can get a rough estimate of the length of a given extension by measuring the red shift at the exit point. By my calculations, a twenty-five percent red shift means that we have over- or undershot our mark by something over four billion light years.

"We can even eliminate one of those two points. What most confused me about the Octopus was that it was *approaching* us at .9 lightspeed. Only as you explained how you had plotted our position could I visualize us as being in the outer layers of an explosion. It then made sense that galaxies in one direction would be blue-shifted as much as they

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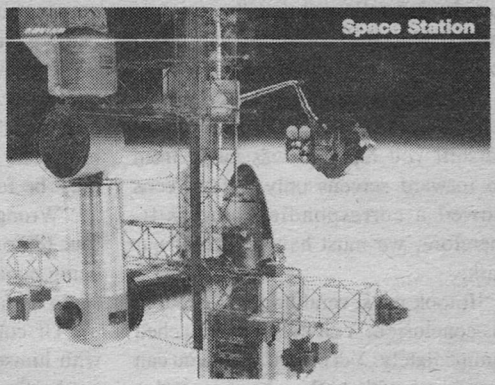

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were red-shifted in the opposite direction. It also followed that the point of greatest blue-shift would be the direction back to the point of origin.

"My own measurements of the star-fields reveal that the twenty-five percent red-shift you reported was taken from the forward screens only. Aft screens showed a corresponding blue-shift. Therefore, we must have overshot our mark.

"It took me several hours to come to this conclusion. You must have reached it immediately. Yet even though you can provide us with both a bearing and a distance, you have remained silent.

"Explain yourself."

On my screen, megaparsec-wide clouds of dust and gas were clumpling into long stringy structures, kinking with oddly-placed bulges. In the next few seconds, they would collapse into groups of galaxies.

"If it were that simple," I said, keeping my eyes fixed on the simulation, "we would be back in the Milky Way by now. The fact that we are not argues strongly that something is very wrong either with our drive system or with the basic structure of the universe.

"I am increasingly convinced that the problem is with the universe."

Hwang was silent a moment. "How can this be?"

I shook my head wearily, rubbing my eyes. "Forgive me. I overstated that. The universe is in fine shape. Our understanding of it, however, has been intellectually sclerotic. Our assumptions have led us far astray.

"Let me give you an example. Suppose we were back at the Farside Observatory. Our telescope locates a quasar. Examination of its spectrum and application of Hubble's Constant gives a distance of four billion light-years. Question: how far away is the quasar?"

Hwang frowned, suspecting a trick question. "If Hubble's Constant is correct," he said carefully, "the answer must be four billion light-years."

"Wrong! That is how far away it was four billion years ago. All other things being equal, it should now be a fourth again as far away."

"Of course!" Hwang said, irritated with himself. He frowned. "That cannot be the source of the error, though, or we would have undershot—"

"I took it into account and we still came out wrong," I agreed. "That is why I believe it is time to rethink the basics."

I pointed to the screen. "Matter explodes from the null point, its density decreasing with the cube of distance. As a result, it cools more rapidly toward the perimeter. Galaxy formation starts at the edges and precipitates, as it were, inward.

"That is why the Octopus looked so strange: red stars, high metal content . . . All that material has been cycled through the stellar furnaces six or seven times."

"This theory explains what we saw," Hwang said doggedly, "not where we saw it."

I turned my attention back to the screen. "Look more closely. Gross gravitational effects, throughout most of the universe, tend to cancel each other out. Near the perimeter, however, almost all gravitational attraction comes from the center. Therefore, the outer layers slow down more quickly than the inner layers.

"In short, Hubble's constant isn't. It's value diminishes from the center to the edge."

"How much?" Hwang asked.

I called up a graph. "I don't know. I have only two data points which, as you can see—" A succession of curves writhed across the graph as if alive—"fit an infinite number of slopes.

"However, there is one additional constraint: the original step coordinates." They appeared across the top of the screen. "The correction we attempted assumed that the most extreme zero-nine sequence was transposed. We found that was too extreme. I propose recalculating our positions on the assumption that the error was in the second set of values."

"Do it."

This countdown had an almost relaxed air. As Yuvannidas said, if we did not come out right this time, we would just refine our computations and try again.

"Step," Hwang announced.

A brilliant white pinwheel spread across the main screen.

"The Milky Way," Czeczko said softly.

"No," I said. "That is Andromeda." I patched in the rear cameras. A thin blue-white disk slashed diagonally across the darkness. "That is the Milky Way."

"We have been through much," Hwang was saying. "We have experienced one of the most terrifying experiences that can possibly befall star travelers and have triumphed. I have no doubt that if we were in contact with Galactic Survey, we would be ordered back to base and given a month's recuperative leave while our control programs were rewritten to make future unintended voyages impossible.

"On the other hand, we are only a few days behind schedule. I judge all of us to be in excellent physical and emotional health. Our original mission is still uncompleted. Our stores are far in excess of our projected needs.

"You can probably discern my own preference. Nonetheless, since my title of captain is little more than a concession to tradition—" The irony was literally breathtaking—"I shall bow to the will of the majority."

There was a long moment of silence. Yuvannidas was the first to break through the apprehensive stillness.

"If we run home immediately, rifkins and geldings may use our reaction to justify their own fears. Our control programs may be long in the rewriting. In the meantime, Survey stagnates. Questions concerning the safety of the Maya drive will be reopened. When, if, Survey is allowed to operate again, it may find its mission greatly curtailed.

"If, however, we report our adventure in the manner of a footnote to an otherwise succesful mission—" She left the thought uncompleted.

There was little further discussion. The vote was unanimous.

Mottled brown highlands swung slowly below us. Every so often, small clusters of green would roll over the horizon, shocking the eye: domed farming complexes, greedily drinking in the Sun's energy. Looking closely, I saw that each green bubble was fringed with darkness too straight-edged to be natu-

ral. They were massed arrays of solar cells, hoarding power for the two-week-long night.

"Welcome back, *Prince Henri.*" The voice of Lunar Orbitmaster coming over the earphones was as clear as if he were two steps behind me, rather than nine hundred miles away. "You are three days late. Galactic Survey was getting worried."

"Our voyage was unexpectedly interesting," Hwang returned blandly. "I took time for extra observations."

"Fascinating, I'm sure," Orbitmaster said. "Okay, I have orbital data for a berth at the Selene III docking facility. Stand by to copy."

Yuvannidas tapped in the indicated descent path. There were short, precise bursts of deceleration. We began to fall through shell after shell of holding orbits.

Our secondary receivers picked up the regular newsfeed. One headline caught my attention. DARK ANGELS SABOTAGE REGENERATION FACILITY. I scrolled up the accompanying text. In a radical and alarming departure from their normal mode of bombing regeneration clinics, a team of Dark Angels had adulterated medical supplies with minute amounts of a still unidentified nerve toxin. Nearly five hundred patients had died within a week of their annual treatments.

I fought involuntary admiration. Five hundred deaths, horrible as they were, did little to further the design of the Dark Angels. But to associate Regeneration Clinics with death, to make patients regard them with fear and so postpone the necessary treatments, to have their bodies grind weeks and months closer to possibly irreversible degeneration. . . . This showed an intelligence and sharpness of perception which belied their reputation for mindless violence.

"We are linked with Lunar Telenet," Czeczko announced. "Personal calls may now be made."

I tapped in my apartment number. Margarite was probably off at some Planning Council meeting. With luck, though, the answering chip would have the number of the meeting room and be able to connect me to it.

The phone was answered almost immediately. Margarite's face, wide-eyed with excitement, blossomed across my screen.

"They just announced that your ship was back—" she began breathlessly.

"I will be taking a shuttle down from Selene III in half an hour," I interrupted. "Not long after that, I expect we will have video journalists breaking down our door. After that, I don't know when we will be able to get any time to ourselves. Can you get away? Now?"

"Why—wha—yes, of course!" The vehemence of her reply surprised me. "Where?"

"The Mass Driver."

"That's more expensive than Heinlein Caverns," she said doubtfully.

"It is the only place where I can be sure I won't be disturbed," I said. "It is also worth the expense for the celebration I have in mind."

"What is—oh, never mind. I'm wasting time. I'll be there."

The original mass driver was a two-hundred-meter long magnetic rail. Built a century before, it had been used to propel processed ore into Earth orbit.

Those mines which had not played out had been made obsolete by advancing technology. But the rails were still in place and power was cheap. . . . A new breed of entrepreneurs bought up the plant at auction. Cargo carriers were stripped down to the rail carriages and rebuilt in diamond-shaped frameworks of gleaming steel, from which hung triple-layered panes of duraglass. The best chefs were hired. More importantly, in an overcrowded solar system, absolute, luxuriant solitude (or equally absolute, private intimacy) was offered for sale.

Our chairs, themselves properly luxuriant, clasped us tightly, directing our gaze down the track. There was a muffled thud, felt in the buttocks, as our food cannisters were stored in the aft compartments. The hologram of a safety attendant demonstrated the activation systems for sleeping nets and shower-vacs, ending with an explanation of emergency procedures for donning skin-tights should a meteroid depressurize our cabin. She then winked out.

A gentle pressure settled us into the chairs. The rail blurred as it rushed at us. The almost imperceptible floor vibration suddenly ceased, and the lunar surface dropped away.

The auto-chef produced a shrimp and sausage appetizer along with pressurized cans of champagne. I savored mine slowly. It would be almost four hours before our thrusters kicked us out of orbit.

"That is marvelous," Margarite exclaimed as I finished an abbreviated account of *Prince Henri*'s odyssey. "You've done more to advance interstellar exploration in two months than had been planned for the next hundred years. The Human Resources Depart ment will have to—"

"—issue us a fertility chit?" I suggested. "There is no need even to consider it. In fact, you can forget all about the HRD."

Margarite went pale. "What do you mean by that? Why do you think I have wasted so much time on the Planning Council trying to better our standing?"

I held up a placatory (I hoped) hand. "A few weeks ago I was spouting off to Captain Hwang about how fossilized ideas kept us from understanding the size of the universe, what it is doing, and our place in it. At the time my concern with these matters was in trying to find a way home. Now that I am back, I realize that our whole race is in much the same predicament.

"In short, I mean that in less than eighteen months the HRD will be irrelevant. In five years, it will be forgotten."

"You have my attention," Margarite said. Her eyes warned me that it had better be good.

"All right, then. What is now, and has always been, the main motivating force in human society?"

"To live long and well," she said, automatically repeating the motto of the Regeneration Service.

"Define your terms."

". . . not one of your bloody students," she muttered, eyes flashing rebelliously. She tossed her head. Weightless curls did a slow-motion oscillation about her head. " 'Live long' means just what it says. 'Well' means, well, having a good standard of living, being able to do what you want, having political and economic freedom."

"Wrong. Those are all secondary considerations. To live long means to ensure the continuance of the race, not necessarily of oneself. To live well is to be able to pass on the best of the accumulated cultural heritage to as many succeeding generations as possible."

"Deep thoughts from a fourth-rate astronomer!" she said. The words had no sting. If I were right, I was touching the most sensitive core of her being. "Why are you the only person to realize this?"

"Because to do so would surface a seemingly irresoluble conflict. Self-preservation used to be the necessary means to the end. You could not have children, much less raise them, unless you were first of all alive to do either. Now regeneration techniques have turned a necessary precondition into an either/or choice.

"The Geldings are partially correct —hold on, I just said partially! They have identified the problem and recognized its source. Their solution is akin to curing a headache by decapitation. At the same time, they are not radical enough. Sexuality is more than a matter of gonads: it's chiseled into the chromosomes of every cell in our bodies.

"Dark Angels attack the problem from the other end. If immortality leaves no further room for additions to the human race, then immortality can be forceably curtailed."

Margarite picked absently at her stuffed snapper. The Moon's surface crept by to my right. Far behind Margarite, almost on the horizon, another Mass Driver capsule, brilliant with reflected sunlight, arced into orbit.

"You can't be right," she said finally. "If we were that biologically controlled, every company selling birth control devices would have gone bankrupt ages ago."

"Their success caused at least in part the situation I am describing. How long have we had effective birth control available to humanity generally? More than two centuries! I don't have any figures, but my guess is that during that time relatively few couples have chosen to be childless. What they have chosen is to space their children and limit their numbers.

"As for those who have chosen to leave no offspring—well, they have selected themselves out of the gene pool. Don't you see that the inevitable result of two hundred years of birth control must be to breed for fertility?"

"And then Regeneration makes that all but impossible." Margarite sighed. "I don't see how any of this makes HRD obsolete."

"The Human Resources Department was obsolete the day Sattayarak successfully tested the Maya drive. The *Prince Henri* has demonstrated how limitless our reach has become. As soon as our voyage becomes public knowledge, every subnational and ethnic group with the necessary capital will be outfitting its own starship. They won't even have to find Terrestrial worlds to be successful. The Moon proves that. Habitats can be constructed in any solar system in which the necessary materials have cooled sufficiently to be usable. And in those habitats, people will be able to do as they please."

Margarite began laughing. "It can't be as good as you say. What about all those demonstrations that unrestrained

breeding eventually results in a mass of flesh expanding faster than lightspeed?"

"We are not talking about *unrestrained* population growth. Moreover—"

I hesitated. "I hope I am wrong, but future generations may look back on this era of mass psychosis as a golden age. Many homesteading groups will fail, either through insufficient preparation or internal dissension. Some of these failures will be fatal to their participants.

"And even with all the universe open to us, certain parcels of real estate will appear more desirable than others. Lacking a central coercive authority, many will settle their disputes by direct action."

I fell silent, thinking how much I had only hinted at. Mass migration, disease, warfare . . . All the indicia of what the Chinese call "an interesting time." I tried to smile, but my facial muscles refused to cooperate.

"You see, life will be very much more worth living now, but at a price. Death has been set loose among us again."

Now don't look so sad. Like most youngsters, you take everything too personally. It is *not* true that your mother and I gave up immortality so that you could live. If you are entertaining any such notion, it just proves that you have not been paying attention—another characteristic of youth, if I may say so.

What I have been saying is that your mother and I chose to enjoy life to the fullest, and your birth was one consequence of that decision. A limit on our own immortality was a separate consequence of that choice.

We are necessarily breeding machines but that is not all we are. If you will humor an old man's notion, I would suggest that it is not even what we are primarily. Rather, we are appreciators. Our purpose is to appreciate the eleven dimensional intricacy of sub-quarks, the mystery of singularities, the balance of a marshland ecology, the symmetry of a Bach motet. The unpredictable differences of strangers and the comfort of old friends.

The geldings offered a mutilated immortality. The rifkins were worse. Seeking to eliminate anything that might possibly be dangerous, they would have alienated us from the entire universe and each other. Theirs was an immortality of fear.

Not that I was completely omniscient. How was I to know that the Dark Angels would elevate the entire company of the *Prince Henri* to a status near sainthood? Or that some rifkins, in reaction, would try to kill us, as if our deaths would undo anything.

Distant field work seemed advisable. By the time things settled down, it had become a habit.

So that is why we are here. If we go into the observation dome, you can see the two stars of Beta Lyrae swinging each other through the sky, spiraling out a billion kilometer scarf of hydrogen among the stars.

Come join the dance. ■

NOT IN MEMORIAM

● It has recently been reported that the author known to *Analog* readers as P.M. Fergusson has suffered an untimely demise.

"Oh God, he was too young to go! So vivacious, so vital, such a promising newcomer—" (Can it, Virginia! *I* got things to say.)

As a matter of solace to those intelligent and sensitive readers who were preparing wakes, black arm-bands, or other ostentatious signs of mourning: please be informed that I am not now, nor to the best of my knowledge ever have been, deceased. Nor do I plan to achieve that unenviable state (Yes, Virginia, that's a personal opinion) within the near future.

I am still alive and well and living near Louisville, Kentucky. (Yes, Virginia, I know it's debatable as to whether anyone is alive and well in the Louisville, Kentucky area), and I am still placing words on paper in a semiliterate manner. (*Yes,* Virginia, I know that's debatable too. Now sit down and put a gag in it before I flatten your smiling little face with a coal-shovel.) Where was I? Ah yes. I am still among the living, still writing Science Fiction (Brrrwhang! Smart-mouth kid never learns) and still tending to the needs of a wife, two children, a Kawasaki Ninja and an increasing number of cats and tropical fish.

To those of you whom the rumor reached and caused grief, I am sorry. It was a bit of a surprise to me as well—after all, if one is deceased, one would generally like to be informed of the fact. To those of you who had hopes, sorry about that and Maine (that's in the uppa U.S., don't you know).

P.M. Fergusson

Thomas Donaldson

NEW MATTERS

Quarks, hadrons, bosons, Grand Unification . . . Modern particle physics has achieved outstanding insights. However, this article isn't about where particle physics has been; it's about where it's *going*. The weak and strong forces between particles extend only for atomic distances. We can only apply nuclear forces to mold matter on nuclear scales. We'll see that despite this, particle physicists have theories which may yet produce truly spectacular applications.

Since physicists are still far from understanding matter, we shouldn't take these theories *too* seriously. Ten years from now they'll be forgotten. The devices I'm suggesting depend on physical phenomena not yet discovered, which may never be discovered. But they do tell us the *sort* of devices particle physics may someday produce. When current theories are forgotten, others, with even more fascinating possibilities, will take their place.

Industry in a solar civilization

The idea of engineering applications of *particle physics* at first seems bizarre. We spend billions to make synchrotrons three kilometers in diameter. For this price we get a very small mass of highly excited nuclear and particle states. *Useful* yield has been poor. True, particle physics research has produced a host of medical and industrial applications of the accelerators themselves. But *particle physics* itself? You must be mad!

But let's look at particle physics from the perspective of a *solar* civilization, say 300 years in the future. We have nuclear fusion spacecraft on scheduled monthly flights to Pluto. Most of the human population lives in space, in gigantic space stations individually tens of kilometers in radius. Standard Deuterium Co. of Jupiter mines Jupiter's atmosphere on an industrial scale. Fusion reactors catalytically burn ordinary hydrogen.

Furthermore, once in space structural sizes aren't limited by gravity forces but by far smaller *tidal* forces. Freeman

Dyson worked out years ago that quite ordinary materials could build structures 1 million kilometers in diameter. Accelerators only 3 kilometers in diameter look *tiny*.

In 1986 the steel blast furnace and the oil refinery are fundamental units of heavy industry. They do chemical reactions at chemical temperatures (perhaps quite high). Measured by our current scale, they're big and costly. The 24th century equivalent of the blast furnace would do *nuclear* reactions at nuclear temperatures. It would also be big compared to a 24th century scale. This means (let's say) 40,000 kilometers in diameter (almost 4 times more than the Earth). In a Solar civilization, we will expect nuclear accelerators on a cosmic scale. In fact, we could not *do* industrial nuclear reactions on smaller scales.

Where would these industries go? In an urbanized Solar System, the logical place is the outskirts of the city, past the orbit of Pluto. Nuclear chemistry demands large quantities of energy and materials. That means regular transport of hydrogen in massive quantities to the outer Solar System. It means equally massive transport of finished products back to market in the inner Solar System. Economically critical industries become politically critical, too.

Of course, nuclear industries only make sense if we have nuclear reactions to use. So here are some ideas.

Bulk antimatter production

Robert Forward and others point out that antimatter makes a very good rocket fuel (JBIS 35 [1982], p. 391). It can even drive a starship. But bulk antimatter could also become a major spaceship fuel *within* the Solar System. By Forward's figures, antimatter powered spacecraft can easily attain velocities of one-third c. At 1-g acceleration, Mars is only a week away. Speeds are limited by bearable accelerations more than attainable velocities. Even industrial orbits of the Solar System would take only a few weeks.

Unfortunately current cosmology suggests the universe contains far less antimatter than matter. If we want antimatter we'll have to make it. *High density storage* is also a problem.

At least three roads to solving the storage problem exist. Hydrogen gas is *diamagnetic*: it gathers at points of minimum magnetic field strength. Hence we can store antihydrogen gas in magnetic bottles. We can also levitate *charged* antihydrogen pellets in *electric* fields. Finally, hydrogen takes two different quantum forms, ortho and para. R.R. Zito (JBIS 35 (1982) 414) points out that we can store antihydrogen in para form on matter surfaces at .77 degrees K under a magnetic field without it reacting with its container. We might store antimatter in bulk by encapsulating it in microscopic containers, each of which maintains the needed magnetic field.

None of these ways can yet attain high densities. We have a long way to go.

Production is quite another problem. Forward imagines a plant producing 1 gram a day at a power level of 100 million megawatts. Chapline (*JBIS* 35

[1982], p. 423) proposes a plant producing 5 grams antimatter per year at 1 million megawatts. His proposal produces less antimatter than Forward's, but scales to arbitrarily high volume production. Finally, DG Crowe (*JBIS* 36 [1983], p. 507) and H. Hora (*Optoelectronics* 5 [1973], p. 491) propose using *high power x-ray lasers*. Lasers can produce as much as 1400 grams per year at a power input of 1 million megawatts. However, Crowe's proposal is less detailed.

Even without designing a facility, ordinary physics gives us ideas about what antimatter factories would look like.

Producing antimatter in bulk requires energy production (through hydrogen fusion) followed by conversion into antimatter and matter in equal quantities. We can expect inefficiencies. Let's suppose that 50% of energy produced radiates as heat and the rest goes into antimatter production. Heat radiation requires a radiator. A Solar civilization needs much more than *grams* of antimatter. We can therefore work out just what the physical scale of an antimatter plant has to be.

Antimatter fuel plants producing 100 tons per day of antimatter must dissipate heat from 200 tons per day converted entirely to energy. This suggests a radiator area about 3700 km on a side (see Box 1 for calculations). Since a Solar civilization would consume much more than 100 tons per day, we can expect many plants of this kind, in orbits far from the Sun. Individual plants might be smaller than this, but total radiator area stays the same.

An antimatter factory would consist of many banks of *producers* (synchrotrons or lasers), a *storage and cooling area*, and *radiators* for waste heat. Of course, it would also include docking facilities and "packing" facilities to store the antimatter pellets produced and load them onto "tankers" for transport to market. Figure 1 shows a diagram of an antimatter fuel plant.

Bulk antimatter production also raises a *major theme* of industrial particle physics. We make *new matter*, of kinds formerly very rare or even never before

BOX 1: Radiator sizes for waste heat

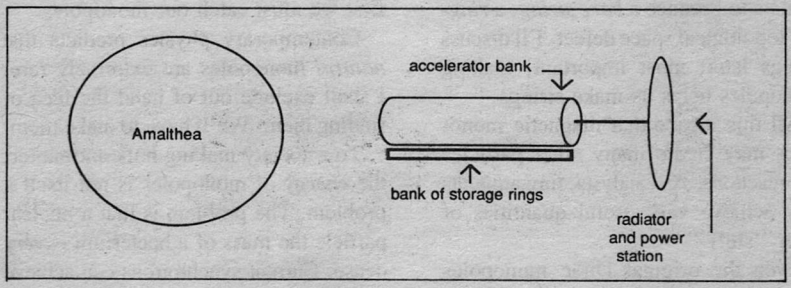
The largest parts of space factories are radiators for waste heat.
An antimatter factory producing 400 grams per year requires 100 million megawatts of power. I'll estimate size of radiators by supposing that all of this energy is waste. NASA has studied radiator sizes for nuclear power plants in space (JH Pitts, CE Walter J SPACECRAFT 7 (1970) 259). We need about 250 square meters of radiator for 2.5 megawatts power. This works out to a square radiator about 100 km on a side.
Although these structures are very large they'll probably not be very massive. A system of very thin-walled heat pipes ought to work. Since they are in orbit these radiators need no massive supports against gravity.

FIGURE 1: Diagram of Antimatter Factory

Here is a diagram of an antimatter factory. The factory shown produces about 400 grams of antimatter per year.

It consists of a large *bank of ringlike accelerators* (10 to 40 km in diameter), all stacked in a hollow cylinder, a second bank of smaller *storage rings* where the high velocity antimatter is held and cooled, and a nuclear power station with its radiator. The radiator is very light but is the largest part of the structure.

Since the antimatter factory is in orbit past Pluto, solar power stations cannot power it. Only nuclear power can do that.



Antimatter factory. The picture of Jupiter's moon Amalthea (150 km diameter) shows the scale of the antimatter factory.

existing in the history of the Universe.

Magnetic monopoles

We know antiprotons exist. The really important particle products of the 24th century are those we don't yet even know exist. For starters, let's consider industrial production and use of *magnetic monopoles*.

Magnetic monopoles are particles carrying a single magnetic pole just like an electron carries a single electric charge. Current physical theories predict their existence. Perhaps conveniently, they also predict *natural* monopoles will be fantastically rare. Presently these theories have produced not one verifiable magnetic monopole.

Dirac's original theory of magnetic monopoles left their mass unknown. Current theories of monopoles (which may be wrong!) predict very massive monopoles, as massive as a bacterium (10^{-8} grams). Relativistic monopoles will ionize matter very efficiently. Magnetic fields will accelerate them easily. They will induce *direct* currents in solenoids.

Current theories say monopoles will catalyze decay of matter into energy. They will also cause very complex changes to the vacuum nearby (on atomic scales), inducing many particle reactions other than simple decay. They may also combine with charged particles to cause a new kind of object, the *dyon*, possessing both electric and magnetic charge.

Some current mathematical ideas about the vacuum suggest it can have *defects*

which behave very like defects in a crystal. One such is a *string*, linking two monopoles or a monopole and an antimonopole. *Strings* are topological changes in space itself rather than physical linkages of matter. Making monopoles will make such a defect in space. Monopoles and antimonopoles can annihilate to produce a *bare string*, a *ring-like* topological space defect. I'll discuss strings later; most important, making monopoles helps us make strings.

All this means that magnetic monopoles may create many other particles and reactions. As catalysts, tiny amounts may achieve very useful quantities of other "stuff."

Even the original Dirac monopoles might allow interesting electrical devices. We might imagine a rectifier which uses monopoles. Since monopoles efficiently ionize matter, we might use them to create a plasma for nuclear fusion, to create magnetohydrodynamics, or to chemically break down and manipulate matter. Perhaps they would allow *miniaturized* magnetohydrodynamic power generators or very high power density rectifiers.

Their most direct use is *monopole catalysis*. For high yields we would need dense matter. We might imagine a device which worked like a laser fusion reactor, except that the beams compressing the matter pellet are monopole beams. Once compressed, the monopoles catalyze decay, producing energy at a high conversion rate. Monopole reactors could burn any fuel. (Nuclear reaction catalysis by novel particles is a long-standing theme among particle physicists (cf. BL Ioffe et al *Acta Phys Pol* B B12 [3] [1982], p. 229)

Monopoles hitting an atomic nucleus will also catalyze decay of single protons or neutrons in that nucleus. This means efficient devices for *bulk* transmutation of matter.

So monopoles would be useful. But first we must catch our monopoles.

Contemporary physics predicts that *natural* monopoles are extremely rare. I shall exclude out of hand the idea of finding them. We'll have to make them.

To a society making bulk antimatter, the *energy* of monopoles is not itself a problem. The problem is that a nuclear particle the mass of a bacterium is *very* dense. Current synchrotrons can achieve about 240 Mev per meter of diameter. A Mev is 1 *million* electron volts. To make monopoles we'd need accelerators about 100 million trillion kilometers in diameter. Improvements are needed.

Current best is 1 Tev, or 1 trillion (thousand billion) electron volts. A monopole is 10 trillion times more energetic. Physicists have lots of schemes to achieve higher energies. These include laser accelerators and several schemes using relativistic electron beams to produce the accelerating currents. One of the most effective theoretical schemes is a *beat-wave accelerator* (Tajima and Dawson) which can attain a theoretical maximum of 5 BeV/m. Beat-wave linear accelerators only 200 meters long could produce 1 TeV. For a monopole, we'd need about 2 trillion kilometers acceleration length. A 1 million km accelerator, in space, needs an improvement factor of about 2000 to

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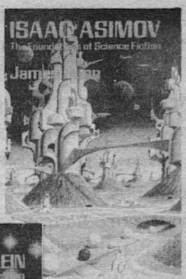

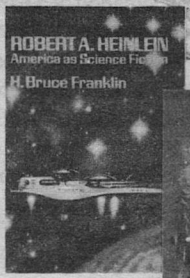

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make monopoles. We accelerate particles by making them traverse a 1 million km path 2 million times. Monopole factories would probably look like present synchrotrons (a ring), but operate by different principles on a far larger scale.

To use monopoles as *catalysts* we need only a few. We'd make monopoles by *pair production*, creation of a particle and its antiparticle. Monopole factories would include extensive facilities to separate monopoles and antimonopoles produced. Figure 2 is a schematic of a monopole factory.

We'll hear more about monopoles later. They may constitute the raw material for the *string factory*.

Strange matter

Someday lists of the *stable* forms of matter probably won't end with protons, electrons, and ordinary atoms. Physicists have already proposed other *possible* forms of stable matter. We needn't be stopped by their mere nonexistence in nature. We go out and make our own.

Proposals for *strange matter* began with the Princeton physicist Edward Witten (*Phys Rev* D 30 [2] ;0b1984], p. 272). He observed that current theories of quarks do not forbid stable combinations of quarks much larger than a proton.

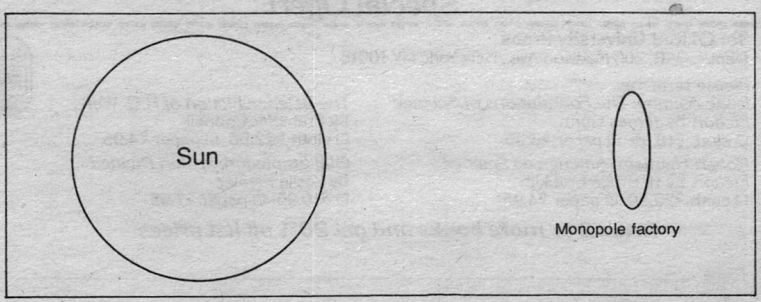
Quarks have properties that resemble electric charge: *flavor* and *color*. The 3 flavors are up, down, and strange. An excess of strange quarks can make the combination stable but *unlike* ordinary matter, which has net strangeness of zero.

E. Farhi and R.L. Jaffe worked out many properties of strange matter (*Phys Rev* D 30 [11] [1984], p. 2379). Strange particles will have radii smaller than an

FIGURE 2A: Scale of the Monopole Factory

This diagram shows the scale of a monopole factory, which at 1 million km diameter is about half the diameter of the Sun.

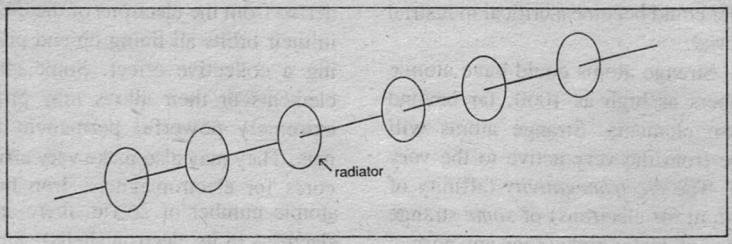
Particles accelerated in the monopole factory will take about 3 seconds to go completely around the ring. They must circumnavigate for 100,000 minutes, or almost 10 weeks, before they acquire enough energy to create a monopole by their impact with others going in the opposite direction.



A monopole factory would be a ring-shaped accelerator over half the diameter of the Sun. It would not be very massive, however. It would be a hollow tube 3 to 4 meters thick in its minor diameter.

FIGURE 2B: Closeup diagram of a monopole factory
Because of its scale, we would probably power the monopole factory with nuclear reactors spaced at intervals along the ring. Each reactor would have its own radiator.

At close distances, it would be even less evident to us that the monopole factory was a ring than it is evident that the Earth is a sphere.



Closeup view of the monopole factory. Power stations would be placed at regular intervals along the ring. Each station would have a radiator for its waste heat.

electron and masses from about that of lithium (6 protons mass) up to indefinitely large. Strange particles with atomic weights less than that of lithium decay radioactively. They do not become radioactive as their mass increases. Instead, their ratio of charge to mass goes down. At masses over 10 million, they absorb their electron clouds, becoming neutral. Lower mass particles combine chemically with ordinary matter and with one another. Each "chemical" species, though, will have many stable isotopes.

Only a few scientists have made searches for natural strange elements. Strange elements may explain some anomalous cosmic ray tracks.

Even ordinary matter, in crystals, proteins, and solutions, shows an immense variety of properties and combinations. We can expect at least as many from these new substances. Strange particles extend the periodic table far beyond the known chemical elements, with a richness of properties even greater than present chemistry. We could have "elements" with as many as 1000 electrons around a tiny nucleus. Here are some possibilities:

1. Strange atoms will behave like much heavier isotopes of ordinary atoms of the same charge. This means higher specific heat and higher boiling and melting points. Deuterium has melting and boiling points of $-254°$ and $-249°C$ compared to hydrogen at $-259°$ and $-252°C$.

Unfortunately computational chemistry makes no precise predictions (see Box 2). We *might* have *strange water* solid at room temperature. *Strange rubber* might make a high temperature flexible material. *Strange methacrylate* might be a high temperature plastic. The mechanical properties of alloys of *strange mercury* might also become very interesting. *Strange tungsten* might withstand far higher temperatures than normal tungsten.

High temperatures are important for any heat engine. Nuclear reactors, chemical reactors, and rocket engines need high temperature materials. Strange matter could become a critical industrial material.

2. Strange atoms could have atomic numbers as high as 1000, far beyond known elements. Strange atoms will range from the very active to the very inert. The *electronegativity* (affinity of the atom for electrons) of *some* strange atoms will be far higher than any normal matter. This means very energetic chemical bonds, high electrode potential, and high dipole moments (which affect the kind of chemical bonding the atom will achieve). Strange atoms might produce very efficient electrodes or materials very resistant to high temperatures.

3. Magnetic properties of an element derive from the electrons of the element in their orbits all lining up and producing a collective effect. Some strange elements or their alloys may produce extremely powerful permanent magnets. They may also make very efficient cores for electromagnets. Iron has an atomic number of 26 (ie. there are 26 electrons in its electron shells). Strange elements might allow an improvement in magnetic properties by as much as 30 times.

4. Strange matter could also produce new long-range forces (not electromag-

BOX 2: Melting and boiling points for heavy isotopes

I do not know any way to easily predict melting and boiling points of bulk quantities of heavy isotopes. There is no simple relation between these temperatures and molecular weights. Chemists HAVE worked out a qualitative relation giving separation between two phases (say, liquid and gas) for two different isotopes. It states that:

let $a = \frac{(N_1/N_2)_{vap}}{(N_1/N_2)_{cond}}$ give ratios of two phases for isotopes 1 and 2

m = atomic mass of heavy isotope
m' = atomic mass of light isotope

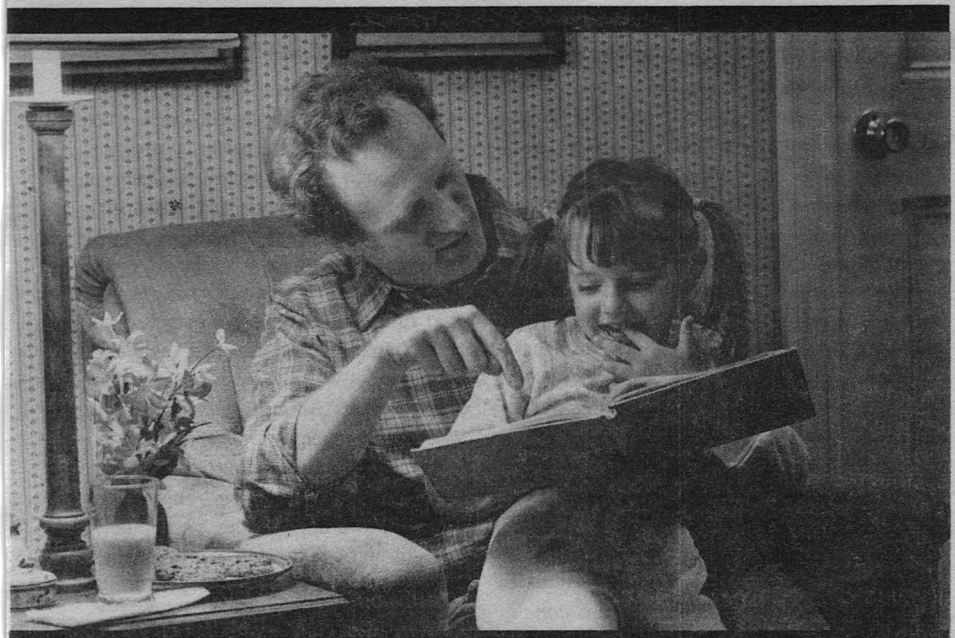
then:

$$(1) \quad \log a = \frac{1}{24}\left(\frac{h}{kT}\right)^2 \left(\frac{1}{m'} - \frac{1}{m}\right)b$$

where b is a constant

(JB Bigeleisen et al *Equilibrium isotope effects* in ANN REV PHYS CHEM 24 (1973) 407). However most chemical work on the problem (of which there is a good deal) consists of evaluating the constants EMPIRICALLY rather than calculating them from first principles. For hypothetical heavy isotopes this doesn't work.

Just to illustrate the magnitude of possible difference, one substance $KH_3(SeO_3)_2$ undergoes a crystal phase change at 70 degrees LESS than the deuterium form $KD_3(SeO_3)_2$ (cf p.432, Bigeleisen et al).



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netic) on nearby atoms.

Moody and Wilczek, in an interesting paper (*Phys Rev* D 30 [1] [1984], p. 130) show that *ordinary* matter might produce a weak force measurable on a scale of centimeters. (The weak nuclear force is the same as that involved in radioactive beta disintegration. It usually arises only on nuclear scales). Strange matter might produce far stronger weak forces.

These weak forces arise from interactions with light particles such as the *axion*. They would depend on the *cube* of distance. At distances less than about .2 cm these forces can exceed gravity, increasing even more at shorter distances. Weak forces due to interactions between electrons and axions are *controllable*. Interactions with nuclei of strange atoms would also produce weak forces.

We can't expect any *directly visible* forces, but they will be 1000 to 1 million times stronger in strange matter. Axion forces might actually affect the chemistry and physics of strange matter at a microscopic scale, forming crystal phases impossible for corresponding ordinary compounds. When switchable, these phases could change on command.

LI Okun (*Sov Phys Jetp* [USA]—*Zh Exsp Theor Fiz* [USSR] 79 [3] [1980], p. 694) has also suggested new long-range forces.

5. Finally, strange matter will contain strange quarks. These attract *massive neutrinos* far more powerfully than ordinary matter. Strange matter will therefore do the same. We can imagine antennas to send and receive neutrinos on a practical small scale, a high resolution neutrino astronomy, and communication devices using neutrinos.

6. Strange matter would have even more properties in nuclear physics. Even though strange matter is stable at ordinary temperatures and pressures, temperatures of only 10,000 to 50,000 degrees will start fusion reactions with ordinary matter. This reaction puts out *heat* only. It would produce more energy than *chemical* reactions, but not the amounts we now associate with nuclear reactions. Strange *antimatter* would absorb all matter.

Nuclear reactors using strange matter won't need shielding. This means nuclear-powered watches, computers, cars, or light planes. It might mean a complete revolution in energy storage and transport.

For the same reason it doesn't need shielding, strange matter would make a comparatively poor rocket fuel. But we could use strange matter to cause a slow complete annihilation of matter. We simply add mass until they collapsed to black holes. These black holes then decay to energy.

How can we make strange matter? To be stable, strange matter nuclei need only be less energetic than ordinary matter nuclei of the same mass. Their mass difference gives the energy released by turning one into the other. Farhi and Jaffe suggest, in fact, energy differences per unit of proton mass of about 4 Mev. This is comparable to many ordinary nuclear reactions. The difference, of course, is the height of the energy barrier we'll have to cross to get there. We may not need high energy accelerators to make strange matter.

Particle collisions, fission, and fusion

reactions starting with existing strange matter might be one way. A strange matter factory would consist of a chain of such devices, each one feeding its products to the next, carefully calculated to cause fission into smaller stable particles which are fed back to the beginning of the chain. We'd bleed strange matter out of this cycle for use. When strange matter becomes common, early high energy production of the first seeds could play no role.

Collapsed matter and states of the vacuum

Several physicists, including A.R. Bodmer (*Phys Rev* D 4 [6] [1971], p. 1601) of Oxford, Mann and Primakoff (*Phys Rev* D 22 [2] [1980], p. 1115), and T.D. Lee (*Rev Mod Phys* 47 [2] [1975], p. 267), have suggested that high energy collisions of atomic nuclei could produce *collapsed matter*. This consists of ordinary atomic nuclei collapsed to much smaller volume and mass than their originals. A.R. Bodmer suggests that collapse could happen if the ordinary constituents of nuclei (protons and neutrons) became compressed together so much that they became *quark matter* rather than ordinary nuclei. T.D. Lee suggests nuclear compression might induce a different phase of the vacuum (exactly like water and ice). This phase would change properties of protons and neutrons. Lee's ideas even suggest a *fourth* form of matter, pure states of the vacuum in particles as large as 1 mm radius. These would decay very rapidly to mesons, however.

Compressed nuclei might decay back to normal nuclei, with half lives of millions of years. They might even be absolutely stable. Their masses could be very small or even zero. If their mass were zero, of course, creation of a compressed nucleus would release its total mass-energy.

Sudden collapse of neutron stars to compressed quark matter could cause massive explosions. A.R. Bodmer even suggests this may happen. However, the energies needed to make compressed matter artificially may make it a very poor energy source. (We'd need so much energy to *cause* compression we'd never get back enough energy in return).

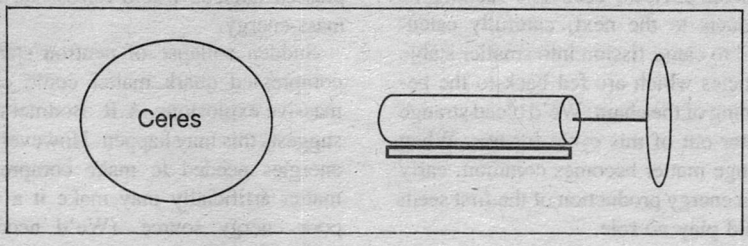
Even if such matter isn't a good power source, the *results* of compression—compressed aluminum or compressed steel—might prove very useful indeed.

Collapsed matter would be very light, but chemical bonds (coming from electric forces) would remain strong. Compressed steel would therefore have a very high *strength-to-weight ratio*. To see just how high, let's suppose compressed matter atoms of atomic weight A has a nucleus of mass A times the electron mass. This means compressed matter with a mass of 1/2000th the mass of its ordinary matter counterpart. It's also likely to be superconducting at normal temperatures.

One design for a Bussard ramjet becomes just barely possible with high temperature superconducting magnets and materials 2000 times stronger than the best conceivable today (B.L. Matloff, A.J. Fennelly, *JBIS* 27 [1974], p. 674). To societies making collapsed matter, Bussard ramjets lie just at the limit of their engineering abilities. (To us they are totally out of the question!)

High strength-to-weight ratio means

FIGURE 3: Diagram of Collapsed Matter Factory
Here is a diagram of a collapsed matter factory. It resembles the antimatter factory, but on a scale at least 10 times larger. Just like antimatter factories, collapsed matter factories must exist in near-interstellar space, with their own power source.



Collapsed matter factory. The asteroid Ceres shows the scale of the collapsed matter factory. A collapsed matter factory would resemble an antimatter factory and even use similar technology but be 10 times larger. (Diameter of Ceres is about 1000 km).

we can make things very small (less bulk) and very large. We could build structures 2000 times larger out of compressed steel than out of ordinary steel. Large rotating space stations have a maximum radius (using contemporary carbon fibers) of 300 km. A *compressed* carbon fiber space station could equal 600,000 kilometers radius, almost half the size of the Sun, with a land area equalling 10,000 Earths.

Because the atomic weight of compressed elements is so small, they will have lower melting and boiling points. Referring to Box 1, we see that the difference may still be small.

Liquid collapsed matter should behave very like liquid helium only more so. It will be only 1% of the mass of helium. At normal temperatures it will show clearly visible quantum effects. Collapsed atoms won't be localizable. Liquid collapsed matter will be superfluid *at normal temperatures*, with currents lasting indefinitely and able to climb out of containers. It may transmit heat very efficiently through heat pipes.

A.R. Bodmer suggests that meson forces binding together ordinary protons and neutrons might even extend, in collapsed atoms, far enough to bind collapsed atoms to ordinary ones. Binding of particles within a nucleus is far stronger than chemical bonds. If so, collapsed matter might produce a new order of "chemical" combination between substances, depending upon forces now only seen in nuclei.

Such forces could make very dense substances with melting and boiling points far higher than ordinary matter. Here's one way to look at it. Collapsed matter can afford to be 2000 times more dense (in atoms/cm^3) than ordinary matter and remain useful. Even 20,000 times more dense is not too dense. Collapsed matter in this form, therefore, might make substances extremely resistant to high temperature, conceivably up to the tens of thousands of degrees.

These would be mesonic combinations of collapsed matter. Since high temperature materials allow very efficient energy production, they'd have great industrial use. If we found some way to stabilize them against decay, T.D. Lee's vacuum states 1 mm across might also make high temperature materials.

Like strange matter, collapsed matter may contain excess strange quarks. It will therefore show the same affinity for neutrinos. Using high strength-to-weight ratios, neutrino detectors of collapsed matter might be very light or else extremely large. Large detectors will have corresponding ability to detect faint sources. Like strange matter, collapsed matter might also produce new long-range forces.

Collapsed matter may undergo characteristic nuclear reactions. Bodmer suggests that it might absorb ordinary nuclei, releasing mesons and producing atoms of collapsed matter of higher atomic number. We might use this reaction, of course, in production.

How could we make collapsed matter? Bodmer, Mann, and Primakoff all suggest that collapsed matter may neatly explain some characteristic cosmic ray events. These are called *Centauro events*. A very energetic particle strikes an atom in the atmosphere and produces a shower of many particles. Some event of this sort would happen if collapsed atoms collided with ordinary matter. The collapsed matter could break apart. Centauro particles have energy of about 1 million Gev. Using the Tajima-Wilson beat-wave accelerator, at 5 Gev/m we need linear accelerators only 200 km long. A solar civilization, in space, can easily make such accelerators.

Collapsed matter factories, therefore, would consist of banks of accelerators producing initial collapsed nuclei. We then accelerate these raw materials to collide them with normal atoms. They absorb the normal atoms, releasing mesons. We could build up quite extensive series of collapsed atoms this way.

Strings and their uses

I've already discussed strings briefly. The vacuum itself may have phases just like phases of matter. Strings are dislocation defects in space itself.

Strings may seem unpromising items of technology. Strings contain energy (similar to the energy of dislocation in a crystal) and therefore have mass. For a long time, since the idea of strings first arose, physicists thought them only detectable through gravitational effects. Massive strings may have even caused condensation of galaxies. But masses of this order won't be reachable in only a few centuries.

More recently, the very interesting possibility arises that strings may actually be *superconducting* (cf B.S. Skagerstam, A Stern *Phys Rev* D25 [6] ;0b1982], p. 1681). Furthermore, it's clear that we can make strings (though not massive ones) by making magnetic monopoles and their antimonopoles. Strings will connect the pairs. After annihilation, a pair leaves the connecting string behind as a loop.

We might use superconducting strings to transmit *and* store energy. *I'll suppose here that we can somehow actually*

do this. Since strings haven't yet even been found, much less do they have any verified properties, this is pure speculation.

Strings will pass through ordinary matter as if it's not there. Their energy increases in proportion to their length. There's no clear limit on their length. We might even transmit currents over planetary distances.

Any such energy-transmission device will obviously have great industrial importance. Even energy transmission over interplanetary distances becomes important. Power stations in the outer solar system could feed the energy inwards for our use. In fact, ability to draw energy from indefinite distances *looks like* violation of conservation of energy-mass.

Unfortunately we would probably have to maintain these strings by feeding in energy. While transmitting to moving bodies, a string would change length, releasing and absorbing energy. We store the energy by lengthening another string! Strings will lose energy by gravitational radiation at rates proportional to their length. Unfortunately we don't have any strings, hence don't know the exact proportionality constant, but this limits the exact length over which we could transmit energy.

We can make strings by making magnetic monopoles. We separate monopole pairs, then bring them together again, letting them annihilate. String factories would look like monopole factories.

New matter and new laws

Some of these kinds of matter may presently exist in the universe, though rare. Others may never have existed. By making new matter we move into a physical realm which may never have existed before in the history of the universe.

We base our current physical ideas upon behavior of ordinary matter. A very interesting series of papers by Fischbach, Haugen, and others (*Phys Rev* D [USA] 32 [1] [1985], p. 154) suggests that at ultrahigh energies Lorentz invariance (the fundamental equations behind special relativity) may fail to hold. This opens up fascinating possibilities for new matter. It need not obey current physical laws, which depend entirely upon experiments using ordinary matter.

Of course we don't know exactly what violation of present physics such matter may show. Among those suggested by these papers are violation of conservation of angular momentum, energy (or velocity dependence) of physical parameters such as the force between two charges, or violation of the equivalence of gravitational and inertial mass.

Any one of these could make a big difference to technology. Imagine, for instance, a space drive converting angular velocity from a high velocity rotating disk of *collapsed matter* to linear velocity. Again, changes in the force between two charges might let us manipulate charged or uncharged matter in new ways. Ways to separate gravitational from inertial mass might allow some form of antigravity. The distinction between these devices and ordinary matter devices is that they simply could not work without new matter.

Particle physics and economics

Contemporary particle physics is a leading scientific frontier absorbing billions of dollars. Discoveries made with the large accelerators let us peer into the future much farther than any branch of physics devoted to more immediate goals. To a civilization controlling the entire wealth of the Solar System, particle accelerators even larger than present day ones become affordable to single occasional crank. When backyard tinkerers can do particle physics, that's when we'll see deep engineering applications. That may not take many centuries after the Solar System is tamed. ■

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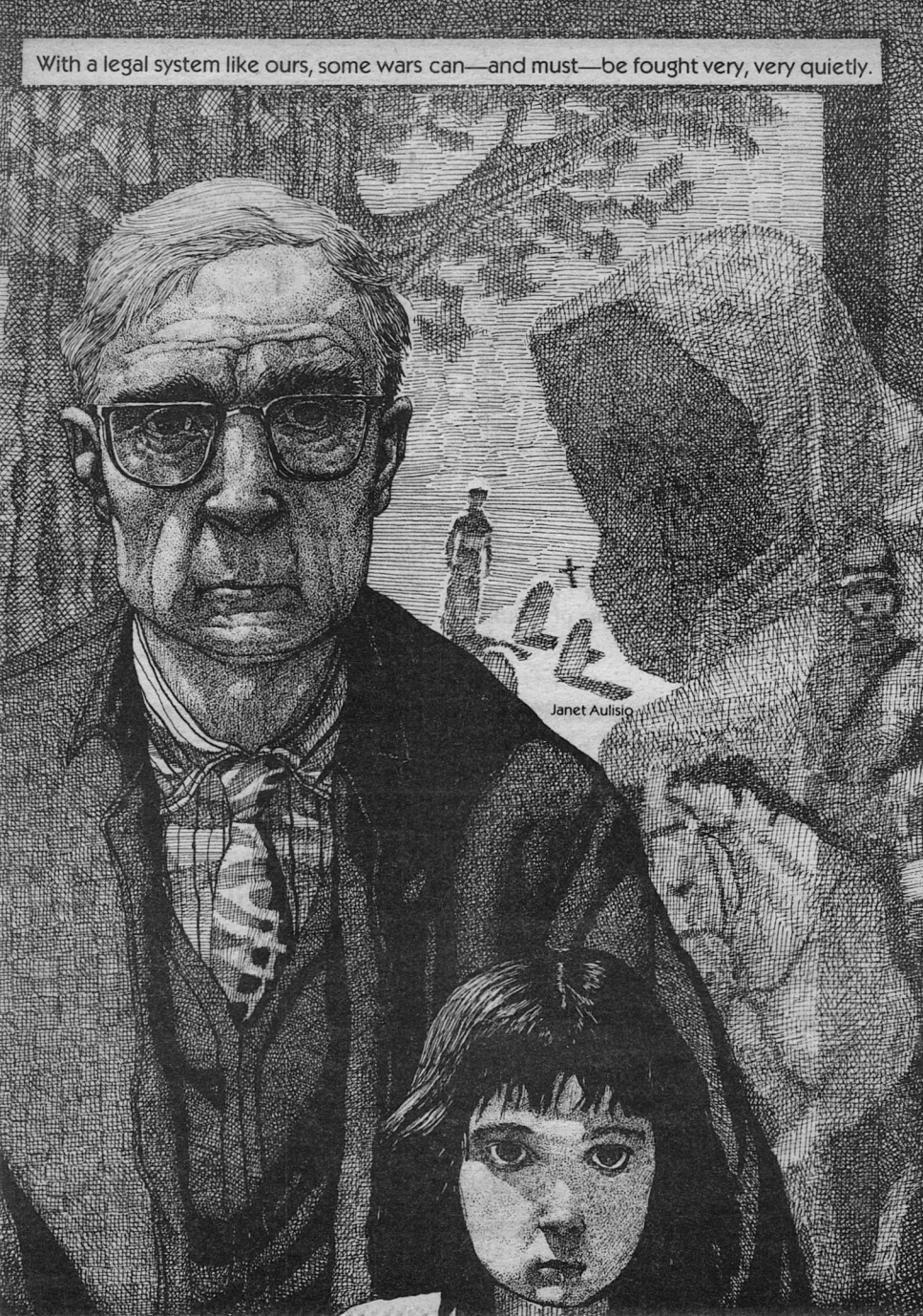
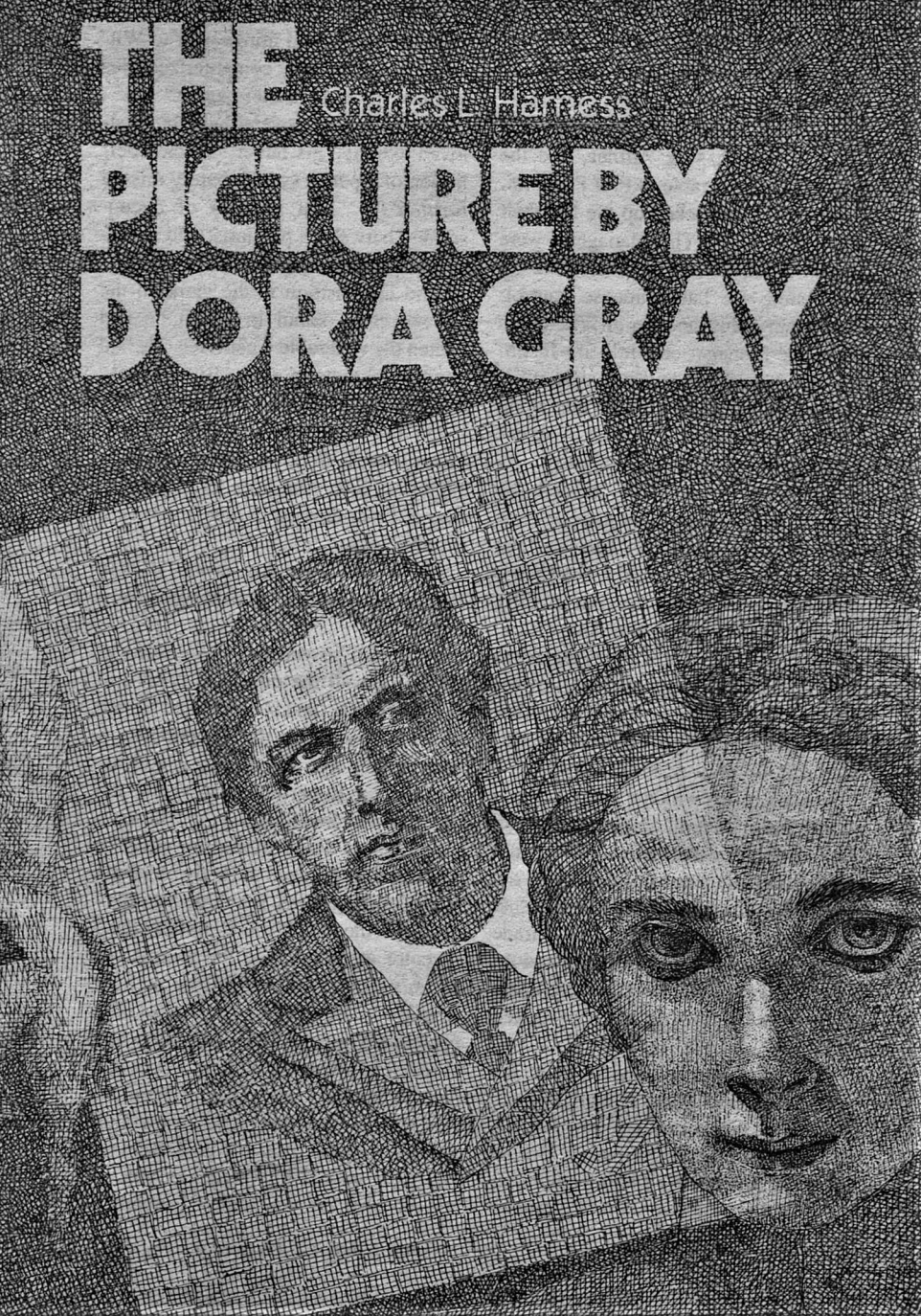

With a legal system like ours, some wars can—and must—be fought very, very quietly.
Janet Aulisio

THE PICTURE BY DORA GRAY

Charles L. Harness



1. Staff

"And Pop, here's one for you. We'll call it the Immortality Case. She wants you to see her this afternoon." Witcover, the Managing Partner, slid the folder across the table to P.O.P. Justin. As the old man picked up the file their eyes met briefly. The Manager's were narrow, hard. Justin's showed no expression. He had immense control. Immortality? Just another of Witcover's jabs. The Manager couldn't fire Justin. His theory was, if he made life sufficiently miserable for him, the aging lawyer would quit. But Justin wasn't going to quit. Not yet, anyway. As Witcover well knew, he needed the money. Besides, his father had been one of the founding partners. The law firm still kept Justin *pater* on the letterhead, with his dates of tenure. An awfully long time ago. Pop had the same office. Between the two of them, they had worn out a dozen mahogany panels and swivel chairs when they jammed their chairs against the near office wall and propped their feet up on a desk drawer.

Justin's office window looked out on a tiny park, several stories below. In early spring he watched the crocuses and daffodils push up and unfold around the little bronze fountain, and soon after that the pink magnolias. Then the parade began in earnest, with forsythia, dogwood, and azaleas. Then the birds came to his window-sill feeder. They talked to him.

Witcover had complained about his desk. (Cluttered desk, cluttered mind. Or was it vice-versa?) True, Justin's desk looked a teensy bit messy. But he never had any trouble finding anything. He used the visible system. Too many times he had turned things over to Witcover's meticulously computerized files and had never seen them again.

His walls were covered with his best-loved exhibits: his father's framed definition of a patent (which barely missed *Bartlett's*): "That remnant of a conspiracy between a plagiarist and his attorney which escapes the Patent Office."

And the position in the game in the college chess simul in which he had beaten the venerable Kharovich. He had announced mate in eight. Big K's only loss that night. Ah, those were the days.

On the south wall, two by Renoir. Good copies. *Boating Party*, *Girl with Watering Can*. The little girl reminded him of Erin, dressed in blue at her fifth birthday party.

He would miss his office if they forced him out. A pox on you, Witcover!

As part of his vendetta, Witcover was giving him all the dogs: the crazy impossible stuff—and people—that should never have got past the receptionist. A few months ago the Manager had assigned him Robertlee Beauregard and the Copper Sword Case. ("He *is* a Beauregard, Pop; treat him nice!") "Quench the blade in the body of a male goat fed only ferns for three weeks," declared the black-robed hollow-eyed inventor as he dropped the weapon on Justin's desk, "and it will be as hard as steel." "You're sure it's not just copper-coated steel?" the attorney had asked. The prospective client's eyes had opened in wide innocence. "Would I deceive my own lawyer?" Justin took a small magnet from his desk drawer. He could almost lift the blade with it. "Well what do you know!" breathed

the inventor. "The treatment makes copper magnetic!" They smiled at each other as Justin studied the man's turned-around collar. "Are you a genuine clergyman?" "I am." "What denomination?" "I'm working on a new religion. Meanwhile I preach on Saturday mornings." "Where?" "In Lafayette Park, across from the White House. But you won't tell Grandma Beauregard, will you? It upsets her." "Not a word. What do you do on week days?" "I play around with holograms. It's sort of a hobby. Doesn't amount to much. Not important like my religious inventions." "Religious inventions?" He knew right away he should not have asked. Beauregard said, "I've got an incantation to protect houses from witches and demons. Can you get me a patent on that?" "I don't know," said Justin carefully. "Sounds more like somethng for a copyright." "How about patenting a computer program for dating the origin of the human race?" "Tell me about it." "The theory is simple," explained the part-time cleric. "Only human beings have souls. A person's soul weighs one hundred grams. When a person dies, his soul leaves the Earth. So the Earth is constantly losing mass. Of course, it is also picking up known amounts of space dust, meteorites, and so on. The net change in earth mass, though small, is measurable, and can be determined by changes in dates of eclipses, gradual slowing of the Earth's rotation, and other astrophysical means. So you extrapolate the net weight loss back into time, and that way you can pick up the exact date when the soul-loss started, and *that's* when *Homo sapiens* first appeared. "You've fixed the date, of course?" Justin had asked. "I have indeed." "Four thousand and four B.C.?" "Yeah." "On a Friday morning?" The Reverend Beauregard had stared at him in amazement. "How did you know?"

Justin had later confirmed that Robertlee Beauregard was indeed a holographer of note, and that he did indeed preach in Lafayette Park on Saturday mornings. His audience consisted almost exclusively of pigeons, attracted by his message of corn-seed and peanuts. The Park guards knew him and left him alone.

So now it was the Immortality Case. At least it wasn't another one by Robertlee. He knew it had been on the docket for a couple of weeks. Apparently the client was getting antsy. Okay, he'd see her this afternoon. He opened the folder and scanned the meager papers with practiced eye. Inventor, Dora Gray. Actual tests "proved" mammalian and other life forms could be indefinitely extended with "Pro-long," a new chemical. He sighed.

"This afternoon," rumbled Witcover, staring sternly across the big table. "Don't forget. Immortality can't wait."

Couldn't resist that one, could you? thought Justin. All right, Witcover, two can play. "How's *your* Beauregard case coming?" he said innocently.

The Managing Partner became immediately defensive. He looked around the table, deliberately ignoring Justin. "You fellows have to appreciate we are dealing with a very old, very rich, and very influential Virginia family. The firm had a duty—"

"I saw in the *District Lawyer* that your personal retainer was in six fig-

ures," interpolated Justin. "*Plus* the usual one-third contingency, if we win."

Witcover coughed. "Not *we*, Pop. The *Beauregard* team is absolutely restricted. Just myself, Sayers, and Morgan. No one else is concerned. However, since you bring it up, I'll explain it to the group. Lenoir Beauregard was a cavalry lieutenant in the Army of Northern Virginia during the Civil War. In April 1865, after Lee's surrender at Appomattox, he was paroled out with the rest of the army. Under the surrender terms, he should have got his horse back—a thoroughbred mare named Polly. He didn't. He raised a big stink, and finally he sued the Federal Government in the newly re-opened United States District Court in Richmond. His action was considered uncooperative and unpatriotic, and the military commissioner ruled that Lenoir was not included in President Johnson's Amnesty Proclamation of 1868. The government stripped him of citizenship and suspended action on his suit to recover his horse. And there the case stood, with no further action on either side, until the family came to us to get his citizenship restored posthumously. Remove the blot on the family escutcheon, as it were."

"And recover the value of the mare," added Sayers.

"Yes indeed," said Witcover. "That's very important, because if I can parlay the horse into a class action, every Southern family can recover its war losses, and the lawyers will get one-third. It could run into millions."

"We could all retire," said Morgan thoughtfully.

Foster, in the tax section, spoke up petulantly. "I thought the Civil War settled all that. Why rake through the ashes at this late date?"

"Money," said Justin dryly.

"But the Statute of Limitations—" objected Foster.

"*Beauregard* was timely filed, the original case, that is, in 1870," said Witcover. "It's been pending all this time. And as for the class action, the judge has already permitted intervention of more than a dozen similar cases, with another hundred waiting consideration."

"Sir?" said a voice from the end of the table. (Justin recognized the voice of Harvard Law, but for the life of him he couldn't remember the young man's name.) "How do you handle the question of treason?"

"Ah, well put, my dear Clive," said Witcover pontifically. "Treason is of course the core of the case. If it was treason for the South to secede, then the North was right to go in and put down the rebellion, and Lieutenant Beauregard may well be thrown out of court. On the other hand, if the South had the right to secede, then the North committed a grievous wrong by invading the South, and taking the lieutenant's horse, and committing sundry other torts, misdemeanors, and felonies. Don't forget the Feds were going to try Jeff Davis for treason in the U.S. District Court in Richmond, but they dropped the case, and for a very good reason."

"As a conciliatory gesture?" ventured Clive, puzzled.

"Not at all," said Witcover. "In 1867 the Chief Justice of the Supreme Court, Salmon P. Chase, wrote a note to the federal prosecutor, William M. Evarts, pointing out that the case would

undoubtedly wind up in the Supreme Court, and that several of the justices didn't think secession was treason. He couldn't predict how the final vote would go. So he urged Evarts to drop the case, and Evarts did."

"The famous Chase Memorandum," offered Morgan.

"Exactly," said Witcover. "If we could find the Chase Memorandum, we could probably win a very lucrative class action. Without it, we'll probably lose *Beauregard*. The lieutenant will recover neither citizenship nor horse."

The chased memorandum, thought Justin. "What would you give for it?" he asked. (He knew he should keep his mouth shut. He just couldn't help it.)

Witcover's voice was hard. "Stay out of this, Pop. You have no sense of history. I will not approve any of your out-of-pocket charges against *Beauregard*. Three of the best detective services in the country are working full time on the Memo. We will find it without help from you."

"When was it last seen?" asked Clive.

"At Beauvoir, near Biloxi, Mississippi," said Witcover. "Jeff Davis lived there for a while after his release from federal prison. How it got there, nobody knows for sure. Perhaps a southern sympathizer in Evarts's office stole it and sent it to him, to show why Davis would never be tried. Perhaps Evarts himself sent it. It was there, then it disappeared. But enough of that. I want to go on to another matter, involving efficient use of attorney-time—billable hours, that is. Some of us—" (he glared at Justin) "—are very inefficient in this respect. Drafting the patent application should be a matter of speed while maintaining high quality. We should dictate everything. Do it *fast*. The abstract, forty-five seconds. Summary, not more than three hundred seconds. Prior art, six hundred seconds. General description, four hundred. Examples, six hundred. Claims, two-fifty. A few minutes for revision. Two minutes for a final run through the word processor. The whole thing can be finished off in less than an hour. In an eight-hour day, we can knock off eight cases."

Justin observed mildly: "Even the advertising attorneys back in the old days did well to draft two cases a week."

"Which proves how much better *we* are," answered Witcover grimly. "Some of us, that is."

Justin shrugged.

Witcover's mouth tightened as he looked around the table. "While we're on the subject, I'd like to elaborate a bit. I don't want to hear any crap about details . . . thoroughness . . . quality. This law firm is a *business*. We stay in business because we're highly competitive. We get the cases . . . mostly patents, but some general litigation too, because we're cheaper than other firms —big or little. You're darn right we watch costs. You're darn right we cut corners." He gave Justin a hard look. "Pop, you charged $95.60 against *Beauregard* last week. You mustn't do that, Pop."

"It was a c.o.d. package," said Justin. "No one else was in the office."

"That's no excuse." Witcover continued, with eyes almost closed. (Justin realized the Manager was still talking

to him. *Just* to him.) "Certain of us here would like to horn in on *Beauregard*. Certain of us here would like, say, one percent of the firm fee, which could reach into the millions. Certain of us have family problems that might be solved with a few hundred thousand. Forget it, Pop." Now the Manager was openly sneering. "Lenoir Beauregard is hardly worth your valuable time; after all, you have Robertlee. To put it another way, if God should offer you the Chase Memorandum for one dollar, you will not accept. Do you understand?"

"Yes," said Justin. His voice was without expression. Damn, he had forgotten. He could very handily have charged that 95.60—or was it 96.50?—to some other case number, even to overhead. But why did Witcover have to be such an ass? It was his memory. He *was* getting old. The jokes were cruel but true. The one about the old man reciting the three signs of approaching senility: "You lose physical strength; you lose sexual power; you lose . . . you lose . . . gosh, I can't remember number three!" Just yesterday his dentist told him the zipper joke while adjusting his plate. "The first sign of old age is when you forget to zip up your fly on leaving the john. The next is when you forget to *un*zip."

Weird. He could remember things that happened fifty years ago, but not last week.

Well, Miss Dora Gray, you're a phoney, but at least you're headed in the right direction. Dora Gray. Dora Gray. Reminded him of something. Oscar Wilde? Odd. Ah, Wilde's novel, *The Picture of Dorian Gray*. No connection, of course. He got his thoughts back on Track. Pick up Erin at school, we'll go by the cemetery, and then out to see you, Miss Immortality. I'll call you first, make sure it's okay to bring Erin.

"Questions?" Witcover was asking. "Thank you, gentlemen. Until next week, then."

When Justin thought of his granddaughter, strange words came to mind, lacey, delicate words: elfin fairy sprite pixie sylph nymph . . . She was total innocence; yet her innocence was veneered by a deep sadness. She wanted her daddy to come home. For twelve months now the poor bastard had been building an oil refinery somewhere in the Arabian wastes. Patience, little one, thought Justin. We'll get him back. Just need a little more money. A little more time. Meanwhile, he had memorized the El Al schedule out of Riyadh. Those amazing new nuclear Altairs beat the sun. Did that mean no jet lag? One of these days he'd put that call in to his son. Hang in there, Bill. Just a question of time.

Peter Oliver Paul Justin. He had been named for Civil War ancestors. Peter and Paul were brothers. They had fought on opposite sides, and they lay buried under a common gravestone. Oliver was their father, *his* great grandfather several times removed. "Peter Oliver Paul, child of God—" He had howled at his christening, or so they claimed. Served them right.

His parents' optimism for his future had ultimately gone down in defeat before the cold facts. He had not become a great chemist, nor had he achieved anything in nuclear physics. In college

Justin picked up smatterings of several sciences. He smattered the B.S. curriculum like buckshot on the side of a barn, harming no one. Unable to acquire the semester hours needed for a science major, he discovered the faculty was going to force him to take a degree anyhow: a B.A. in general arts. Yes, they made it up.

Three years later he was through law school, had taken the D.C. and Virginia bars, the Patent Agents Exam, and he was a patent lawyer. His father eased him surreptitiously into the firm. All that was forty years ago.

In school (even in kindergarten) they never had called him Peter or Oliver or Paul. It had always been Pop, just as James Ewell Brown Stuart had always been Jeb Stuart. In his formative years Pop was okay. Even after his marriage. But as time passed, the name began to chafe. Addressing a gray-haired man (with a well-concealed stoop) as Pop was just a bit patronizing, except between the very best of friends—a good many of whom were one by one very inconsiderately making the obituary columns. Some just young fellows, too: sixty, sixty-five.

Oh well. Off to pick up Erin.

2. The Cemetery

"It's her again," whispered Erin. "And she's staring at us again. Who *is* she, Grandpa?"

"I haven't the faintest idea," said Justin. "But I do know it's not polite to stare. Not for her, not for us. Come on, let's get back to the car."

He came here to St. Martin's once a month to put flowers on Clara's grave. On occasion he picked Erin up from school and they drove out together. Three times, now, they had noted the strange lady in black standing by the new gravestone across the way. Nothing odd about new gravestones. After all, this *was* a cemetery. The discordant note was the way the lady *stared*. Not at him, except for a casual glance.

At Erin.

The strange lady was petite, about Erin's height and physical configuration. Actually, she might have passed for a schoolgirl. But she was certainly no child. Look at the way she dressed. That outfit was straight from Paris. Besides which, as they watched now, she walked down the gravel path toward the private parking lot, got in a black Mercedes, and drove away. You have to be sixteen to drive in Virginia. His mind was wandering just a little. In another five years—his son and daughter-in-law permitting, and if he lived that long, he would start teaching Erin to drive. He was currently teaching her the Virginia Motor Code. "Come on," he said absently. He already had her birth certificate tucked away in his safe deposit box, next to his will. They would put in a couple of thousand miles together, then she'd take the test in some sleepy little town in southern Virginia. A piece of cake.

"Wait," said Erin. "I want to see that new gravestone."

"Hey—!"

But she was gone, darting among the rows of gray granite slabs. He followed slowly.

She was there and on her way back before he had taken fifty steps.

"Well?" he demanded.

"It just said, 'Mary.' "

"No last name?"

"No. And no dates."

"So now come on," grumbled Justin. "None of our business. We have no right to pry." They walked back to the car together. He was silent, perhaps a little gloomy. He didn't know why. Well, he knew a little bit why. We are here such a short time. We don't really begin to appreciate anything until it's almost time to leave. How stupid we are.

"Are you thinking about Grandma again?" Erin looked up at him.

"Yeah, I guess so."

"Tell me about Grandma."

"I've told you a million times already."

"Tell me again."

"She was the most beautiful woman that ever lived. She was niftier than Nefertiti, greater than Garbo, gracefuller than Kelly. She had black hair, green eyes, magnificent figure. She walked in beauty, like you, Irish."

"Oh, Grandpa!" She took his hand. "Those weren't real people, were they?"

"No, I guess not. Not really."

"How did you meet her?"

Now that, he well remembered. "We lived in adjoining apartments . . . we knocked our heads together one morning as we bent down for our morning papers. Then there was this Strauss waltz—" He sighed. His mind got all tangled up when he thought about Clara. "You wanna play hookey? Drive out in the country, maybe go to the horse show at Warrenton?"

"You know we can't do that, Grandpa. You have to go out to see your new client, Miss Dora Gray."

Damn! He had forgotten. "Yeah. Well, another time, maybe."

"Sure, Grandpa."

What would he do without this child? And just think—at this very moment some innocent pimply-faced kid is out there, playing baseball or hacking at his home computer, or whatever, with no suspicion he's already been tagged to marry Erin, father her children, and care for all of them for years and years. Hah! The big question, of course, is to find him. Not too soon. Not too late. Catch him at his most vulnerable. Except —that's exactly what my poor daughter-in-law did: signed up for engineering in college with a view of meeting a lot of eligible professional men. And so she found Bill, and they had Erin. And Bill gets home on Christmas and the Fourth of July. He couldn't even call his kid on her birthday last year. There wasn't a phone within three hundred miles. Erin, you've got to be smarter. Get a guy who'll at least stay in the country. We can get you into Harvard Business School; Yale Divinity. Med school? Nyah. Doctors have terrible hours.

"Grandpa?"

"Yeah?"

"You passed it. Make a U-turn and go back."

"Well, now, so I did. Just testing your general alertness."

With a hundred thou Bill could come home, open his own consulting office. Not impossible, Justin.

"Grandpa?"

"Yeah."

"It's *her*." She pointed through the windshield. "There's her Mercedes in the driveway."

"Nah. Lots of Mercedes around Alexandria Old Town."

"You'll see."

As he pulled up he felt a vague alarm. Erin was probably right. And if so, what did it mean? At the cemetery the woman—Dora Gray or whoever—had obviously been primarily interested in Erin. Which meant her interest in getting a patent was incidental. She had contacted his firm, calling specifically for him, because she knew he could produce Erin. He had a sudden impulse to take Erin by the hand, get back in the car, and lurch away with the wheels squealing and throwing gravel. Instead, Erin was taking *his* hand and pulling him toward the door.

Reluctantly he followed.

The house was ancient. It clearly predated the Revolutionary War. The red-tiled roof had evidently once been lead-sheathed, but the metal had vanished into bullet-molds for use against Cornwallis. A brick wall in fair repair lined a garden at the house-side. He could smell unseen flowers.

For goodness' sake! What was there to be afraid of? He had to get hold of himself.

3. Dora Gray

Yes, it was she, the petite woman of St. Martin's, still dressed in black. Child-size, yet not a child. Her dark-brown hair was plaited in coils around her head, in the classic Greek fashion. The eyelids were violet-tinted; the lips were extraordinarily red, but without lip rouge. Sphinx-like, her face held ancient mysteries. Her unlined cheeks were biological impossibilities that suggested invisible wreckage somewhere. And again he thought of Oscar Wilde's *The Picture of Dorian Gray*. And again he wondered if the names were coincidence.

She smiled. "Mr. Justin? I'm Dora Gray. Come in, please."

"This is my granddaughter, Erin," said Justin. "She'll stay out of the way while we work. Hope you don't mind."

"Of course not. Hello, Erin." She seemed to study the girl carefully.

"Pleased to meet you, Miss Gray," Erin acknowledged politely.

A kitten bounded in. Erin gave a delighted cry and scooped it up.

"I call her Armie," said Miss Gray. "Erin, you'll find some of her toys in the alcove yonder. Perhaps you two can entertain each other while Mr. Justin and I talk in the study." She led him into the next room and indicated chairs near the tea-table. Erin moved away somewhere to Justin's rear. As he sat down he could hear the sounds of play, and he began to relax.

The studio looked out on a garden, and the big casement window was opened wide. Justin inhaled in wonder and appreciation. The air was heavy with the scent of roses, which the lawyer noted were growing in profusion just beyond the window. The delicate odor of lilac laced the attar, and there seemed to be other perfumes too remote or too faint to identify. Birds flitted and twittered through the well-trimmed trees.

What *was* this? A chord sounded somewhere deep inside him. He had a sudden shock of *déjà vu*. Had he been here before? No, of course not. Something he had read? Long ago, perhaps? Possibly.

He took a quick inventory of the room.

The color-scheme was extraordinary. The walls were papered in pale primrose. The woodwork was painted red. A small statue (Hermes, he guessed) stood on a red column by the studio window. Various pictures hung from the walls: some were paintings; some were photos. He thought he recognized a black-and-white by Aubrey Beardsley. And wasn't that a portrait photo of Oscar Wilde? Next to it was framed a smaller photo of a young girl. Overflowing bookshelves on every wall. From where he sat he couldn't make out any of the titles; but he sensed immediately that she read everything.

Very interesting, he mused.

She was watching his face. "Well, Mr. Justin, shall we begin?"

"Oh. Sure. Immortality. Hm."

She laughed. It was the tinkling soprano laughter of a child. "Perhaps not quite immortality. And you are of course skeptical. I suppose, Mr. Justin, that you have on occasion processed inventions that you didn't believe in?"

He looked at her sharply. "Well, you do understand that we'd have to show a substantial improvement over the normal life span—for human beings—or for whatever species you are claiming."

"Fair enough. The average life span for *homo sapiens* is about eighty-five years. By life span we mean average biological limit for the species. Of course, some of the individuals live well beyond that. Life *expectancy* is a different term. That's the fraction of life span expected for an individual or a group. In the United States, it's age 73 and rising. These averages of course include the 'Maximum Life Potential' —MLP—which is the age at death verified for the longest-lived member of the group. For *sapiens* this is one hundred and seventeen years. That was the last and oldest Confederate veteran, Walter Williams, who died in 1959, aged one hundred and seventeen years."

"I thought," demurred Justin, "there were some instances of much older people, say in southern Russia."

"Each and every report has been checked out. Generally, it was a case of the son assuming the identity of the father to retain the farm, or to avoid military service, or some such reason. Nothing beyond the Williams case could be verified."

"Do other creatures live longer than *sapiens*?"

"Certain Galapagos turtles have been clocked at 175 years."

"Unusual."

"Quite, when you consider the maximum life span is 3 years for rats, forty for horses, fifty for apes. In mammals there's a close mathematical relationship between brain size and maximum life span; or perhaps it's more accurate to say the ratio of brain size to body weight is proportional to the maximum life span for the species. Using this ratio, we can show that the hominid average life span has doubled in the last three million years, but that there has been no change in the last hundred thousand years. We need something to get us moving again."

"So why do we finally die?" asked Justin.

"A mix of reasons. Accidents and disease take their toll, of course. But if they don't, there's still no escape. Our

body cells must finally hit the Hayflick limit, and that's the end of the line."

"The Hayflick limit?"

"Some years ago Hayflick and Moorehead showed that cultured fibroblasts divide about fifty times—no more. If your somatic cells stop dividing, you can't make even the tiniest internal repairs. This is aging at the molecular level. Our cells are programmed to perform certain vital operations. Their DNA instructs the messenger RNA to make certain essential proteins. But during all these cell doublings and redoublings, the programs accumulate errors. The error rate is small, but the accumulation finally overwhelms the enzyme repair rate. The programs crash, one after another, and the collapse is body-wide. The first real symptoms of collapse are in organ malfunctions. Muscles, nerves, liver, kidneys, one by one, begin to shut down. Each cell in each organ becomes a dying microuniverse. It can't talk to other cells. The silence spreads. Organs no longer communicate with each other. Vessels plug with waste. Invading bacteria cannot be fought. The brain falls asleep."

Justin was thoughtful. It was all true. So why fight it? *Do not go gentle into that good night*. But you were wrong, Dylan Thomas. Omar Khayyam was closer to the final possibilities: *Make the most of what we yet may spend/Before we too into the dust descend*. And he could name some historical characters who had had one heck of a good time in those last years. Goethe was in his eighties when he finished *Faust*. At eighty-eight Konrad Adenauer was chancellor of West Germany, and at about the same age Michelangelo was still designing churches. At eighty-nine Albert Schweitzer still ran his African hospital and Mary Baker Eddy her church. (Maybe a little religion helped?) George Bernard Shaw, Bertrand Russell, Leopold Stokowski—all productive in their nineties. And Grandma Moses, the geriatrics queen, still painted at one hundred. But best of all were the strange skills that only age could bring: the ability to conceal one's faults, errors, and stupidities; the ability to see through others; the ability to foresee possible disaster. Maybe.

Miss Gray was watching him sardonically.

He sniffed. Okay. Get back with it, Pop. "There are *some* immortal cells, aren't there?"

"Perhaps. The precursor cells of the sperm and ova are perhaps immortal, at least in the sense they do not appear to be subject to the Hayflick limit."

"Any others?"

She hesitated. She did not look at him when she replied. "Certain cancer cells, such as HeLa cells from cervical cancer."

He sensed that he had hit a nerve.

She seemed to surmise his embarrassment, and switched the subject. "Perhaps you are thinking, what sane person could believe in the chemical prolongation of life? So then, let us begin with skepticism. Once you have all the details, I have great confidence that you will change your mind, and that your considerable skills will overcome all problems."

It was Justin's turn to smile. On the other hand, he thought, perhaps she has a point. A patent attorney is a weird combination of lawyer, historian, sci-

entist, author, and mountebank. "All right, let us begin. Let me tell you what the Patent Office will require."

"Yes."

"The Rules recommend that the specification open with a one-paragraph abstract of the invention. That's for indexing purposes. Next they want a short description or summary, followed by background of the invention, and next a recital of the closest prior art we know about. Then the working examples, and finally the claims, defining your monopoly." He pulled a microscriber from his jacket pocket. "You don't mind if we record this?"

"No, of course not." Her voice was vague. Her eyes kept returning to the alcove off to the side. To Erin?

Justin cleared his throat. "I'll prepare the abstract after we write the case. Let's start with the summary. Just tell me briefly, and I'll convert it into the proper patent language."

"yes. The life-extension agent—I call it 'Pro-long'—is closely chemically related to juvenile hormone, $C_{18}H_{30}O_3$."

Ho boy, he thought. Maybe she is onto something. "Ah . . . juvenile hormone?"

"As a chemist, Mr. Justin, I'm sure you must be familiar with methyl-10epoxy-7-ethyl-3,11-dimethyl-2,6-tridecadienoate—$C_{18}H_{30}O_3$—an isoprenoid derivative of mevalonic acid."

"Of course," he said smoothly. And thank God for the scriber.

"And you know, of course, that insects synthesize it routinely in the corpora allata, in the base of the brain. It prevents metamorphosis. As long as the hormone flows, the insect retains the juvenile form. It molts, but does not become an adult. When the hormone stops, the insect promptly matures, mates, the female lays her eggs, and the next generation is on its way."

Justin suppressed a frown. Had he misjudged her? Perhaps it was for real . . . ? He tried to think back. "I think I read somewhere, about insectal juvenile hormone being fed to crabs, and causing molting. Apparently in some cases it is effective across phyla lines?"

She nodded.

"Including mammals?"

"Mine works on certain mammals."

Might as well ask it. "On human beings?"

"Yes."

Well, the next question was obvious. (On *you*, Dora Gray?) And she was waiting for it. But he wasn't going to ask it. Not just yet, anyway. He said instead, "Dosage? How administered?"

"In mammals, ten milligrams per hundred pounds of body weight. It can be administered in several ways. Intravenous . . . subcutaneous . . . even orally, dissolved in some aqueous fluid."

One dose?"

"Two are required. One does absolutely nothing. The second is a double dose, and it's critical."

"How long does it prolong life?"

"I don't really know. None of my experimental creatures have died of old age. Some met with fatal accidents. Some I sacrificed for purposes of autopsy. The rest I destroyed when I closed my lab. With one exception."

Justin twisted his head around to look at Erin and the kitten.

"Yes, Mr. Justin, the kitten. Armie was born on Armistice Day, November

11, 1918. Nearly a hundred years ago." She watched his face. "Does that give you enough? As to the amount of prolongation, I mean?"

His face was as blank as hers. "Yes, I think so. I'll just say, in certain cases, life is extended by a factor of . . . several times." He sighed. He was getting in deep . . . deeper . . . way over his head. "Let's go on. I'd like to talk about background and prior art . . . the Fountain of Youth—" (He was feeling a little better.) "And how about the old Norse legend of Freya's apples . . . the nectar and ambrosia of Greek mythology . . . the alchemist's elixir of life . . . all utter nonsense, I suppose?"

She smiled faintly. "Not entirely, Mr. Justin. It all goes back to the insectal juvenile hormone. Certain trees protect themselves from insect attack by secreting juvenile hormone in their leaves and woody parts. The insects eat, but after they eat, they cannot mature and reproduce. The tree is protected from future attack. But it doesn't stop there. Rain washes the hormone into the streams. Insects and various other riparian life forms—particularly crustaceans—absorb the hormone and remain in immature nymph forms. Word gets around. The natives talk. There must be a magic spring somewhere . . . a veritable Fountain of Youth. We think the legend started in India. Alexander the Great looked for the Fountain there. Merchants and travelers brought the story into the Middle East, and the Crusaders carried it on into Europe. Don Juan Ponce de Leon searched for it in Florida."

"Baseless myths," hazarded Justin.

"Who knows? If the concentration of juvenile hormone was sufficiently high, and the dosage was correct—even by accident—and if the waters were drunk at the correct stage of animal development . . . it just might work."

He considered that. "Correct stage of development . . . what exactly does *that* mean? In a mammal, say?"

Her reply was calm, almost cold. "Treatment with Pro-long must occur just before onset of puberty. The nymph stage is essential. After onset of menses, it is too late. Life would not be prolonged. There would be no effect."

Erin followed the kitten into the room. Justin didn't think she should be hearing this. But she wasn't even listening. She was trying to entice the kitten back into the alcove by swinging a paper ball on a string. In a moment they were both gone again.

Let's get this back on track, he thought. "Any other uses? How about as an insecticide?"

"Yes. It prevents maturation and metamorphosis. The immature insects can't reproduce. Treatment of the nymph or larva is required, of course."

"I'll need working examples."

"I have quite a bit on the standards: yellow mealworm . . . confused flour bettle . . . milkweed bug . . . red linden bug . . . common housefly . . . yellow fever mosquito . . . tobacco hornworm. Several others."

"Anything in other phyla?"

"Barnacles. It introduces anomalies into the molting cycle, so that the larva can't attach to a base, such as a pier or shipbottom."

"Do you know the exact structural formula of your agent?"

"Yes, I can give you that."

"Is it new? Not in the literature?"

"It's totally new."

"We'll have to include an example of how to make it."

"Basically, it's a fermentation process. But there are several steps, some of them quite critical." She handed him a folder. "It's all here, in complete detail. The medium, conditions, times, pH control, recovery, assay, everything."

He took the folder.

She said, "So what will the patent cover?"

"Actually, several related inventions. First, Pro-long as a novel composition of matter. Second, the process of making it. And finally, various claims to treatment in prolonging mammalian life, insect control, that sort of thing."

"Prolonging human life is the main thing," she said. "That's where the money is."

Justin was blunt. "The Office won't take your bare word for it. You'll need proof."

"What kind of proof?"

Was it time now for the question? Why not? "How old are you, Miss Gray?"

She did not hesitate. "I was born in 1812, Mr. Justin."

Well, there it was. He fought an impulse then and there to bid her a polite farewell. Just call for Erin and go. He said, "I think the Examiner will require documentation that you were alive, say one hundred and fifty years ago."

She looked unhappy. "There were no official birth certificates in those days, Mr. Justin. How about census records, entries in family bibles, old letters, that sort of thing?"

"Not good enough. You could find Dora Grays mentioned all over the place, and the Examiner would say she was your great-great-grandmother."

"So what do you suggest?"

"Something with your handwriting . . . your signature . . . a fingerprint . . . on something that can be dated long ago. Something experts could check out and swear to, in the Patent Office and if need be in the courts."

"My handwriting? My signature?" She was thoughtful. "I applied for a Confederate patent in 1865. I wrote it up myself, signed it, and provided a sample of Pro-long in a little vial, as required by the rules. I hand-carried it over to Mr. Rhodes myself. The Confederate Patent Office was in the Mechanics Institute Building, in downtown Richmond. Third floor. They had this big hall, filled with glass cases. Some had models, but most were empty. Hardly anybody was there. Richmond and Petersburg were nearly isolated at the time. I think mine may have been one of the last patent applications. There was a fee of twenty dollars, Confederate. Mr. Rhodes just took my papers, gave me a receipt for the money, and shook his head. He wrote something on the Petition—'No. 267,' I think. I don't believe he really saw me. I couldn't stay. I had to roll bandages with Varina that afternoon."

"Varina—?"

"Mrs. Davis."

"Mrs. . . . Jefferson Davis?"

"Of course."

He stared at her. Golly, what a show! He knew that it was all eventually going to blow up in his face. But while it was going on, it was fantastic. He said cautiously, "So your Confederate patent is

still there, somewhere in the Richmond archives?''

''Possibly. I just don't know. Mr. Davis tried to get all the official papers out when he left Richmond. I think that was on April 2. Perhaps my patent could be found. I think my handwriting and signature would be the same then as now. What do you think, Mr. Justin?''

''I—''

He was saved by a shrill whistle from the kitchen.

''My tea-kettle,'' explained Miss Gray. ''Excuse me a moment.'' A minute later she was back. ''Actually, you may have tea or coffee.''

''Tea, please,'' said Justin.

''And your granddaughter? Milk? Soda?''

''Tea,'' said Erin firmly.

''Weak,'' said Justin firmly.

Miss Gray brought it all in on a tray, with a side-dish of cookies. ''It's a very special Ceylonese tea. They have a secret leaf-fermentation formula. It has a highly aromatic aroma and flavor.''

''Delicious,'' said Justin tactfully.

Miss Gray watched Erin sip at her cup.

''It's good,'' said the girl.

The woman smiled. ''Yes.''

''I want to think some more about the proof problem,'' said Justin at the conclusion of the visit. ''I'll be back in a few days.''

''Of course.'' She smiled her secret smile. ''And you *must* bring Erin.''

4. The Picture of Dorian Gray

Justin couldn't sleep. He groaned, and sat up in bed, and tried to focus on the luminous hands of his clock. He couldn't read them. He fumbled for the audio button. ''Ten minutes after thlee o'crock in the morning,'' intoned his Japanese import. He groaned again, found his glasses, turned on the light, and sat up on the edge of the bed.

He had been half-dreaming, just before he completely awoke. Of what? Not what, *whom*. He had been dreaming of Oscar Wilde. Now that was stupid, wasn't it? On the other hand, weren't dreams supposed to be statements by your subconscious?

He stumbled to his feet, found his robe and slippers, and shuffled into the den, feeling for light switches along the way.

Somewhere on the shelves . . . several things by and about Wilde. Yes, here. *The Picture of Dorian Gray*. He pushed the spectacles back on his nose and opened the book. (If the Japanese were so damned smart, why couldn't they make spectacles that would stay on your nose?)

Chapter I

> The studio was filled with the rich odor of roses, and when the light summer wind stirred amidst the trees of the garden there came through the open door the heavy scent of the lilac, or the more delicate perfume of the pink-flowering thorn.

He let the little volume fall to the top of his desk. There it was. Dora Gray . . . your garden, straight out of Oscar Wilde. Did you take your name from Oscar's book, too? And another thing . . . how about your studio *décor?* He peered at his book shelves once more. One of Wilde's sons had written a biography. He had described Wilde's house in Chelsea. Yes, here we are. Wilde's study, on the ground floor:

"... the walls painted pale primrose and the woodwork red. A cast of the Hermes of Praxiteles stood on a red column in a corner by the window. Adorning the walls ... a delicate drawing ... by Aubrey Beardsley ... a large writing desk ..."

He lowered the book slowly. "Pop," he whispered, "just what in the hell are you looking for? *She's* crazy, and you soon will be, if you keep this up."

But he couldn't let it go. There was somethng else. That little portrait photo of a child-woman on the wall in Dora's studio. It wasn't Dora, though it certainly looked like her. It was. . . . He leafed again through the book in his hands. Yes, there it was, the identical picture: Constance Wilde—Oscar's wife.

He thought back. Who was that heroine in *The Picture of Dorian Gray?* He dropped the biography and picked up the novel again. Ah. Sybil Vane. He read:

"... imagine a girl, hardly seventeen years of age, with a little flower-like face, a small Greek head with plaited coils of dark-brown hair, eyes that were violet wells of passion, lips that were like the petals of a rose. She was the loveliest thing that I had ever seen in my life."

A precise description of Dora Gray. And Constance. Did Dora imagine herself to be Mrs. Oscar Wilde?

He frowned. That was no explanation at all. There had to be something else. Where did Wilde get the name 'Sybil'? In Greek mythology, Sybil had been a priestess in the shrine of Apollo at Cumae, and in return for some favor or other, the god had made her immortal.

Dora had not only taken the title of the book; she had also become the tragic heroine. Well, Dora Gray, or whatever your name is, you are thorough. He almost smiled. But it wasn't funny. His client was a madwoman.

Dora Gray ... the fictional Sybil Vane ... the historical Constance Wilde. And who else? There was still another. Damn his lousy memory!

Dora ... had some supernatural power commanded a nymphet, "Freeze!"—? And had her elfin body crystallized in time—the mind of a woman encapsulated within the body of a child? The years had rolled over that smooth innocence without marking it. This sprite was without outward blemish.

He knew now whom she reminded him of: *Erin.*

He shivered.

The whole affair was getting away from him.

Clara, Clara, he thought. This is female stuff. If you were only here to help me.

From his living room the mantel clock began to strike the hour. Four chimes. He was up for good. Get the coffee on. The stereo. Keep the volume low. He stood at the window a moment. The corner street lamp reflected back to him in the wet street, like a reassuring night watchman.

He drew the drapes, darkened the room, and turned on the holo.

A luminous life-sized figure materialized in the center of the room. Clara is twenty-two, fresh, buoyant, radiant. Her flowered housecoat sweeps the floor. This is exactly the way she looked when they first met. (To make this holo,

the Semi-Reverend Robertlee Beauregard had taken a pile of photos, films, descriptions, anecdotes, and made a marvelous reconstruction. "You know, Robertlee," Justin had told him, "you could probably get some really worthwhile patents if you'd let me file on your holographic inventions." "Oh, this laser-and-brainwave stuff? Forget it, Pop. Not creative." What's the use, thought Justin.) So, back to Clara. Note the sway of her arms and hips . . . the flash of her dark eyes . . . her impish grin . . . it was all there. The impact was stunning. He had brought her out several times before, but he could never get used to the imagery.

He could hardly breathe.

She beckoned. And now, music? Three-quarter time. A waltz. *That* waltz. Extra points for you, Reverend.

He walked over to her, bowed, took her hand, put his arm around her phantom waist, and they glided into the opening bars of Strauss's *Morgenblätter —Morning Papers*.

That was how they had met. They lived in adjoining apartments. Early one morning, they had opened their doors simultaneously and reached down for their *Washington Post*s. Their eyes had collided like cymbals.

She taught him to dance. He wasn't very good at it. The only number he really liked was *Morgenblätter*. Ah, Johann . . .

Just now Clara was whispering to him. Voice input? He had never noticed it before. Another plus, Robertlee! Or was it his imagination? No, it was real, at least in the sense that reality is semi-real. The expert cleric had said, "At extreme interface, one may perceive echoes of the subconscious. The holo receives and crystallizes your brain waves, echoes them back as detectable sensoria apparently emanating from the image."

He heard, or thought he heard: "Don't take Erin there again."

"Clara?" he gasped.

He stopped. The luminous figure turned through him and moved away. He whispered: "Don't take Erin . . . ? Where? Why?" No answer. The holo was returning, but she was silent, and he just stared.

His mind was playing tricks. He clenched his jaws and turned off the projector. Clara flickered and vanished.

He opened the drapes and looked down into the tracery of auto headlights on the street. He had to think. There was a very immediate problem here, and he had to solve it, because it involved Erin.

Let's see now. He had taken Erin with him to Dora Gray's. Then he and the woman had spent the whole hour discussing Pro-long. How had the lady client described the dosage? It could be administered to mammals in several ways . . . even orally. *Two* treatments required. The subject had to be immature . . . a female . . . on the threshold of puberty.

He began to perspire. The accusing sweat burst out like cold raindrops on his brow and cheeks.

Pro-long could be taken in tea.

He sank slowly into his armchair.

And now, with this sharp understanding of Erin's unwitting role in the opening scene, he could begin to reconstruct the whole drama. He had missed the way at first because he had tried to be

rational. ("Logic," Clara had once explained to him, "will get you nowhere.")

Dora Gray, we are back to you. A luminous wavering Rorschach inkblot. The literary sleuths had busily tracked down all of Wilde's sources for *The Picture of Dorian Gray*—all except the main one. To be sure, they had found Pater's *Renaissance*, and Des Esseintes in Huysmans's *À Rebours*, and they had noted Poe's *The Oval Portrait*. And of course Constance Wilde was Sybil Vane. But who was the original Sybil?

All the critics had missed her. But *he* knew.

Dora Gray. She had given the name, the gift of the face and body, unmarred by time. Only her mind had been corrupted by the passing years. This was her great secret, and the perceptive Celtic aesthete had well divined it. From his book she had designed her garden and studio. She and Wilde were like ants exchanging life histories by trading gastric juices.

Dora, you are truly real. Somewhere, somewhen, Wilde knew you. He took your name, and he made a book. When did you meet him, madame? And was there a picture? Yes, there had to be a picture. Of you? Of him? A sketch? A photo? Who made it? Where is it now, a hundred and fifty years later? Gathering dust in some anonymous English attic? Or perhaps an item listed for auction yesterday or last week or last century in settling some out-of-the-way European estate?

And what difference does it make? What do I think it might show? Compared to Erin's safety (now assured, I hope), what does the rest of it matter?

* * *

5. A Fair Copy

Monday again, and Staff Meeting.

Witcover was explaining the wave of excitement that had hit the *Beauregard* Team the previous Friday. "We found the text, the words, that is. It's not the Chase Memorandum itself, of course, but at least it's a fair copy. Chase's clerk made it as a file copy before mailing the original to Evarts. It's handwritten. There were no photocopy machines down the hall in those days." He adjusted his spectacles and read slowly:

November 19, 1867

My dear Evarts,

If Davis loses in District Court he will of course appeal, and the case must finally come here. You should be aware of a serious problem. Granted, the Union has crushed secession by force of arms. However, the right of a state to secede as a matter of constitutional law has never been decided by the Court. If that right exists, Davis is of course innocent of treason, and colossal damage claims against the North by outraged Southerners must follow. A secret straw vote of my brother justices on this question stands at four to four. I presently abstain. Recommend you delay trial indefinitely.

S.P.C.

"Dynamite," breathed Sayers (who had already seen it, but who felt called on for worthy comment for the record.)

"Nuclear," declared Morgan, awed. (He had also seen it, but was still able to reproduce his initial reaction.)

"Worthless," said Justin.

They stared at him, unbelieving.

"The CAFC won't grant your peti-

tion to remand if that's all you've got," said the old lawyer, "because the U.S. District Court wouldn't admit the copy into evidence in the first place. The clerk who wrote that is long dead. He isn't around to authenticate it. The copy violates the best evidence rule. You'll still need the original."

"Stay out of this, Pop," Witcover said icily. "The original would help, of course. And we're still looking for it. We've got a dozen FOIA petitions pending. The feds are fighting so hard we figure one of them has got to have it." He smiled sardonically. "Not to worry. We'll let you know when we find it. Meanwhile, no charges. Stay away from *my* Beauregard. You've got your own, you know. How are you and Robertlee coming along?"

Justin shrugged.

Having disposed of dissidence, Witcover turned back to the group. "I'm sure all of you saw the article in *Time* last week. Chief Justice Stadt was quoted as saying the Memo once existed. He edited the *Comprehensive Chase Letters*, you know. He's quite familiar with everything Chase wrote."

"Stadt wrote the *Zillion-Dollar Zap,*" chimed in Sayers. "He explained some humorous possibilities if the Memo were ever found."

Justin had read the book, which George Stadt had written some months ago while still governor of South Carolina. Some of the chapters were funny, true. But to Justin it seemed the humor was actually a camouflaging veneer over some somber events that *Beauregard* might spawn. At his confirmation hearing the ex-governor had been grilled mercilessly by the Northern Bloc in the Senate Judiciary Committee, and most commentators expressed astonishment that he was finally confirmed.

Fascinating, thought Justin. Suppose the Memo is found, and *Beauregard* goes on to the high court. Will Stadt let his southern roots influence him? Or will he, like Thomas à Becket, become a sudden, perhaps even reluctant adherent of the sacred canon, bound to no person. to no state, to no law except the traditions of the great court?

6. The Second Visit

On his second visit to Miss Gray's she noted instantly that he was alone. She led him into the study. "How is your granddaughter?"

"Erin's fine. Just a quick visit today, ma'am. Strictly business."

They took chairs near the open window. Justin looked out into the garden for a moment, as though collecting his thoughts. He spoke evenly, without life. "Listen to me, while I think out loud. I filed your application in the Patent Office yesterday. The Applications Branch will now give it a serial number, next it goes to the Classification Divison, and they will forward it to the proper examining group, where it will be assigned to an examiner for study. Theoretically he's supposed to take the new cases in turn. Actually, I'm pretty sure he'll take this one out of turn. He'll examine it and mail us a rejection the day it hits his desk. He'll reject on utility, or rather, on the lack of it. We need proof. No proof, no patent."

"We seem to keep coming back to that."

"Yes. So what do we have? You yourself are the best proof of utility. I

accept it as a fact that, contrary to appearances, you are indeed a very old woman. I think it likely you were indeed born in 1812. You have mentioned that your father was a doctor; considering the fact that you were eleven or twelve at the time of your treatment, *he* was probably the actual inventor. No matter. Whether you are the true inventor is immaterial just now. There are legal procedures for changing the name of the inventor. I want to go on to something else. You had a companion, Mary something or other. You probably found her long ago, as a child, and you treated her with Pro-long. Finally, though, she died. Perhaps in an accident. Perhaps of a lethal disease. I don't really want to know. You buried her, and you mourned at her graveside. And there you first saw *us*—Erin and me. And now we come to the nitty-gritty. Erin was your primary target. The patent was secondary. To you, Erin meant the possibility of another companion—a replacement for Mary. And how to reach Erin? Easy. Through me. You'd ask me to patent your elixir. You'd have us both out for tea. Am I right so far?"

"Yes."

"Ah, madame, you did indeed know Jefferson Davis . . . and Oscar Wilde, and a host of other notables. Your memoirs would be sensational. But Erin, you don't get."

She watched him carefully.

He continued. "Of all those people, only Wilde understood you. You were the model for his *Picture of Dorian Gray*. In his novel he merely changed the sex. Gray's face and body remained those of an innocent youth. Only his picture, hidden in the locked room, showed the passage of years. Your skin is a mask, Dora Gray, an innocent shell. Which brings us to an interesting side effect of the elixir: since it stops the aging process before the menarche, treatment necessarily causes sterility. You could never have children. That's why you needed a companion . . . one or more." He was silent for a time. Had he been unnecessarily harsh? Actually, it wasn't her fault. This life had been thrust upon her. If she had been given a choice, she might have elected the normal life: marriage, children, grandchildren, death. He could not judge her; but he had to protect Erin.

"You've made the decision for Erin," she said.

"Obviously."

"She's a precocious child. Why not let her decide for herself?"

"Because she doesn't know enough to make a decision, and because I do."

"You'd prefer she grow old and die?"

"Yes."

"You think that's better than living forever young?"

"As you see."

She sighed. "Does this mean I'll never see you again?"

"That depends on you. Do you want me to continue with the patent application?"

"Yes, I'd like that. I'd like to license the patent and collect some royalties. I need the money. I can't even pay the taxes on this house. It's on the market."

"I didn't know."

"How would you know? This is Alexandria, the Old Town. The zoning regulations are so strict you can't even put a for sale sign out front." Her mouth

twisted in bitter reminiscence. "When I bought this place in 1914 my nearest neighbor was nearly a mile away, and there were nothing but cornfields and trees. Shopping in Washington was an all-day affair. Things have changed, Mr. Justin."

"Yes, I see. All right, then, I'll stay with it. Which brings us back to utility. Proof of your age, that is. I have already contacted the Richmond libraries and the Library of Congress about your Confederate patent. No word yet. Meanwhile, let's see what else we can find. Perhaps we should start with your earliest memories. Your parents. Where you lived. What do you remember?"

"My father was a doctor in a little town near Atlanta. With his year under Benjamin Waterhouse in Harvard Medical School, he was actually the best qualified man in the county. He was the local apothecary, too, of course. I remember his name painted on a board, sticking out over the door, with a mortar and pestle painted next to it. He made up his own drugs and medicinals. I remember the planters' wives driving up in their buggies and buying brown-paper plasters, toothbrushes, smelling salts, soap, perfume. Medicine was beginning to wake up, but it had a long way to go. They were still bleeding patients. Bleeding probably helped kill George Washington in 1799. Vaccination against smallpox was still a novelty. The only anesthetics were alcohol and laudanum. Father had the only watch in the county with a second hand, which of course you need to take a pulse. There were no germs. It was long before Semmelweiss, Pasteur, Lister. Father made his rounds in a gypsy-top buggy, generally with the top folded back. I often went with him.

"He was a great experimenter. He had already treated all kinds of animals with his new agent. I was almost an afterthought." She spoke without bitterness.

"How old were you?"

"Eleven, I think. A couple of years after that he sent me to Miss Stone's Finishing School in Baltimore. We took the standard six-course: reading, writing, arithmetic, French, music, art."

"Art?"

"Not oils, nothing like that. Pencil sketching, water colors, that sort of thing. All young ladies were expected to have a bit of skill at it. That was before photography, and it was the simplest way to record scenes, people, visitors . . . The ladies handled the graphic arts along with the rest of the housework."

"You never married?"

"No."

"Go on."

"My parents died. First my mother, then my father. I actually took over his practice for a time. Finally, though, they began to notice I didn't age. So I sold out. I traveled. I wrote for the newspapers. I met people. Those first funny little railroads were coming in. You could get around. Villages in the hinterland were growing into towns. There was a lot of change, especially in the North. The war was coming, you know."

"Ever go abroad?"

"Once, in the late eighteen nineties."

He thought a moment. *Late* eighteen nineties? Wilde published *The Picture of Dorian Gray* in 1891. So she had met

him before that. When? How? "Tell me about your encounter with Oscar Wilde."

"Oh, you know about that. Yes, I met Oscar during his American tour, 1882, I think it was."

"I see." (Possibilities! Look for documents, *dates*.) "And afterward, I suppose you exchanged letters?"

"No. He never wrote me. All I had from him was a book of poems. He inscribed it."

"May I see it?"

She walked over to the shelves, searched a moment, and returned with a thin volume. She blew dust from the top of the book. "I haven't opened it in years," she said apologetically.

It was indeed the famous *Poems*, published in London, 1881, in mint condition, a priceless collector's item. He spread it carefully at the flyleaf. " 'To Dora, from Oscar, 23 June, 1882.' "

This Dora? the Patent Office would ask. That was still the question. Dora knew the answer, but couldn't prove it. *He* knew (or thought he knew), but no proof. Oscar Wilde once had known, but he was long dead. So none of that was good enough. How to pinpoint *this* Dora Gray, living and breathing right here in her studio, as the exact same Dora Gray who knew Oscar Wilde? There had to be a way. He was stubborn, and he was crafty, and he was a schemer. It would come to him. "Was there a *picture?*"

"A *what?*"

What indeed? He wasn't sure himself what he was looking for. "Did Wilde give you his picture? A photograph, perhaps?"

"A photo? Yes. It's there on the wall. It has the same inscription."

Justin walked over and looked at it. The youthful aesthete seemed to stare back in satyric mockery. "Could I see the back?"

"Go ahead. It slides out."

Again, nothing. "Back to the drawing board." Something was missing. Picture . . . drawing board . . . what exactly was he after?

7. Richmond in April

The Reverend Robertlee Beauregard was in Justin's office with a new and earthshaking invention. "Practically all cities and states" (he told the lawyer) "now have electronic boundary markers. For example, if you are driving along Highway Fifteen in Nevada, and you enter California, you can get a beep on your traffic monitor. I take that a step further. With my cassette the monitor will warn the motorist of certain strange laws he should know about while motoring in California." He looked at Justin's questioning face, and was encouraged. "Did you know that in Pacific Grove, California, it's against the law to molest a monarch butterfly, or to dance the tango in your own house, unless the drapes are drawn?"

Justin muttered something.

"Ah, you see? You didn't know. City ordinances. *Thousands* of them, Pop, all over the country. In New York City you can't carry an uncovered can of spray paint, nor can you read while walking down the street. In Detroit you can't loiter around a morgue or drive a car recklessly through a puddle. Texas is pretty strict: you can't go to church in disguise, and in Abilene you can't whistle at girls."

"How about Georgia?" Justin said absently.

"Well, let's see." The holographer pushed some keys on the console of the machine. The voice synthesizer began to drone in a monotone. "You are entering Columbus, Georgia, on Route One Eighty-five. The following laws are relevant. You must not get a tattoo on a Sunday . . . a Sunday . . . a Sunday . . . "

Beauregard turned it off. "A few bugs," he admitted, "but the basic idea is sound." He looked up at Justin. "Why Georgia? Are you still on that Jeff Davis kick?"

"Maybe. Let's back up. When Richmond fell, Davis fled south. We know he took certain papers with him. We don't know precisely what he took, nor what he placed with friends during his flight. We do know that not much was recovered when the feds captured him in south Georgia."

"Pop, what *exactly* are you looking for?"

"A very valuable document—Confederate Patent Number 267."

"Go on. Tell me more."

"The Confederacy had its own Patent Office, located on the third floor of the Mechanics Institute Building, in downtown Richmond. In the closing days of the war, this patent was issued to a Richmond lady, our Miss Dora Gray."

"You've mentioned her. And suppose you find it?"

"It will be in her handwriting and will carry her signature. I need both, as matters of proof in a current patent application."

"So what do you want me to do?"

"I need your best synthorama. Load it with input of Davis's actions, hour-by-hour, starting with the moment Lee gave him the bad news. Let it show whether any Confederate patents were included in the archives Davis took with him, and if so, whether the Gray patent was among them. After Davis left town, there was a big fire. Was the patent destroyed? And consider Davis's flight. He went south, through Virginia, North Carolina, South Carolina, and into Georgia. What stops did he make? What things did he leave with friends along the way?"

"Pop," Beauregard said reasonably, "you're crazy."

"Do that for me, Robertlee, and I'll file on your exorcist and soul-dating programs."

"How about the copper-hardening process?"

"That too."

"It makes copper magnetic, you know. A big advantage, quite unexpected."

"Get started, Reverend."

Two weeks later Beauregard brought the synthorama cassette to Justin's apartment. "Ready?" he asked.

"Ready." Justin leaned forward as the holo came alive in front of them. The audio was pretaped in Beauregard's best theatrical voice. The visual was also accompanied by scene-sound, plus Beauregard's best guess at relevant odors.

"It's April 2, 1865," explained the disembodied voice. "Easter is two weeks away. Lincoln will be shot in a matter of days. Disaster looms for Lee's army. But you wouldn't guess it today. It's a warm spring morning, with a gentle

breeze. The magnolias are blossoming on the Capitol grounds." (Justin sniffed. Yep. Very authentic.) "The ladies are wearing their most delicate silks to church. It is eleven A.M. At St. Paul's, the Reverend Minnigerode intones from the pulpit, 'The Lord is in His holy temple; let all the earth keep silence before Him.' A military aide hurries up the aisle to Mr. Davis's pew and hands him a scrap of folded paper."

Justin watched the little drama in growing fascination. The roof and two sides of the church had been omitted to show the action. The minuscule figures scuffled and scurried. He could hear the sounds. It was like watchig Erin put on a show in her toy theatre.

He watched the little figure of the Confederate president leave the church and disappear out of the holo. Nobody seemed concerned. Davis had been called out of church before. But then, one-by-one, the cabinet members begin *their* exodus. This is scary. The lawyer watched the alarm mount in the congregation.

Scene Two. The streets of Richmond. The retreating army begins the destruction—mostly by burning—of supplies it can't take with it. Justin watches the flashes, smells the acrid, oily smoke. "After Lee pulled out," intoned Robertlee's unctuous audio, "the fires got out of hand, and Richmond began to burn. Here we see the center of town. For three days, April 2, 3, and 4, the business section burned. Many old and famous buildings were lost: practically all the banking houses; the major hotels, the *Enquirer* Building, Belvin's Block, the Post Office Building, the State Court House, the Mechanics Institute—"

"Freeze it there," said Justin quickly. "The Confederate Patent Office was in the Mechanics Building."

"Right. The War Department was on the first two floors, the Patent Office on the third—"

"They had time to get papers out before the building began to burn," said Justin hopefully.

"The probabilities show removing several chests of records, but only from the first floor," said the inventor. "See this?" (He enlarged a section of the holo showing a military wagon loading boxes at a side entrance. Two very skinny, very nervous horses stood waiting to pull away.) "The problem wasn't time—it was transportation. They were short of everything . . . wagons, horses, manpower—"

"And the fire quite overwhelmed them."

"That it did, Pop. Proportionately, this fire compares nicely with the great New York fire of 1837 and the Chicago fire of 1871. If your patent didn't get out before the fire, I greatly fear it didn't get out at all."

"Granted. But let's see what we can trace. Jeff Davis had time, opportunity, and facilities to move a great deal of material. Let's pick up his trail again."

"Okay. The archives, money, personal possessions of Davis and his staff . . . everything . . . were loaded into two open boxcars. We go now to:

"Scene Three. Through the smoke we see the gas-lit station platform of the South Side Railroad Line. The last train out of Richmond stands there, waiting to take the Confederate government and its two boxcars of records west to Burkeville and the junction with the

Richmond and Danville Railroad, which is Richmond's sole remaining link to the South. The last forlorn exit. The whistle blows. Chuff-chuff. Off she goes. Hail and farewell, Jefferson Davis.

"Scene Four. It's eight in the morning, April 3. The bluecoats are entering the city. They'll soon get the fires and looting under control. Too late to save downtown Richmond, though."

Justin's eyes began to water. He sneezed. "Very realistic smoke."

"Not really, Pop. It's simple olfactory suggestion."

The lawyer said glumly, "Not likely Patent Number two sixty-seven got out."

"Is that all you can think about?"

"That's all I can think about."

"So we're not done yet?"

"I don't know. There were those two boxcars, on that last train out of the city."

"The synthorama stops there, but I can tell you what I found."

"Tell me."

"They—the boxcars—arrived at the Abbeville, Georgia railroad station. And there Davis paid off the troops who had accompanied him—thirty-two dollars per man, in coin. Everything was repacked into chests and boxes, and reloaded into wagons. All this by candlelight. The cavalcade moved on to Washington, Georgia, where Davis deposited the specie in local banks. Here he stayed with Dr. and Mrs. J.J. Robertson. He gave his personal luggage—a trunk and two chests—to his confidential clerk, Captain Clark. Clark sewed certain papers into a quilt, which he hid in the town. The trunk and chests were recovered when Davis and his family and skeleton staff were captured, May 10, 1865, near Irwinsville, Georgia, fifty miles from the Florida line."

"The quilt?"

"Stripped long ago. No patent, Pop. No documents anywhere. Not a single scrap of paper. Vanished. Kaput. Forget Number 267. What was it a patent on, incidentally?"

"Eternal life," said Justin. "*Your* department, really."

Reverend Beauregard looked at him reproachfully.

8. Crystal Plaza

Justin propped his feet up and slowly (lips moving) read the letter from the Patent Office. The examiner had rejected all claims in the Gray application. The lawyer wasn't surprised. One rarely got any claims allowed on the first action, anyhow. He called his client.

She made no effort to conceal her disappointment. "But *why?*"

"Basically, two grounds. 'Obvious in view of the prior art,' and 'no clear showing of utility.' What the examiner really means is, he doesn't believe us. He doesn't believe it actually works."

"So this is the end of it?"

"Oh no, not at all. It's not even the end of the beginning."

"What do we do now?"

"We ask for an interview. We go in and talk to the examiner. We argue everything, point by point. Perhaps we can work out a compromise. I'll set it up."

Mr. Trent, the examiner, had a sad sleepy face. His eyelids drooped heavily. Justin had heard of him—the MPEP was his bible. He adhered slavishly to

the scriptures, and he loved to cite chapter and verse. When his guests entered, Trent was looking moodily out the window, across the court toward the Crystal Plaza swimming pool, still closed. Trent didn't swim himself, but he felt a vicarious joy when the season opened and the young people swarmed the waters like cavorting porpoises. He turned back. Justin introduced himself and his client as Trent transferred chairs from his credenza to his desk-side.

They all sat down. Trent looked sorrowfully at Justin, then at the woman. (Did his eyes widen just a little?) Then back at Justin. "You've been around a long time, Mr. Justin. You must know I can't allow this case."

"There are indeed some problems," agreed the lawyer, "but if we can just look at them one by one, I think we can dispose of everything."

Trent shrugged and swiveled back in his chair.

"Some formal matters, first," said Justin. "True, an applicant is required to list all prior foreign applications and patents directed to the same invention. True, her U.S. patent cannot validly issue if she issued a foreign patent on an application filed more than a year before her U.S. application date."

"And she recites her Confederate Patent No. 267, of 1865," said Trent mournfully. "Aside from the question of credibility, I've got her on 102, both b and d. She's dead."

"The Confederate patent has vanished, Mr. Trent. Presumably it was destroyed in the great Richmond fire of April 1865. We will submit a sworn synthorama—"

"That won't take her off the hook. She admits it once existed. That's enough to cook the goose, Mr. Justin."

"We're rushing ahead a bit, Mr. Trent. True, under the laws of the Confederate States of America, it was a patent, even though it and all copies were subsequently destroyed. But it is still not citable in a 102."

"And why not?"

"Under U.S. law, it was not a patent granted by a foreign country. The United States never recognized the C.S.A. Therefore, under U.S. law, it was not a patent at all. I can provide cites."

Trent blinked at the lawyer. "Not a patent?"

"No, of course not."

"But it was still a document—citable as a printed publication."

"No, not that either. Confederate patents were never printed. They were submitted and circulated in handwritten form." He showed the Examiner a yellowing brochure. "This is *Tyler, Rules for Proceedings in the Confederate Patent Office, Richmond, August 1861*. Rule Ten says, 'The application must be in writing, signed by the Applicant, and addressed to the Commissioner of Patents.' Rule 83 states, 'All claims and specifications filed in the Office (including amendments) must be written in a fair, legible hand, without interlineations or erasures.' Rule 29 provides that the Office keeps the original papers, but on request will send the applicant a copy at ten cents per hundred words. And here's the Commissioner's final report, printed January 26, 1865. The last patent mentioned was Number 266, Percussion Cap Rammer, to W.N. Smith of Richmond, 6 January, 1865. Miss Gray was next, with Number 267. If

copies were needed, the Commissioner was authorized to have them made by professional scriveners at ten cents per hundred words. Commissioner Rufus R. Rhodes complained in his final annual report that nobody would work for such low wages. Miss Gray asked for a copy, but before she could receive one, the city fell. No copy of Number 267 was actually ever made."

Trent's eyes nearly closed as he studied the woman. He smiled a curious half-smile. "Ma'am, you really actually, personally filed Number 267 in the Confederate Patent Office in 1865?"

"I did, Mr. Trent. There was a twenty dollar filing fee, but I'm afraid that with moving several times, over the years, I've lost the receipt."

The examiner exhaled slowly. "Let's leave Confederate Number 267 for the moment and move on to another area. The problem of public use. Ma'am, if you have had the beneficial use of your invention for more than one year, that's public use, and you are barred."

"It wasn't public use," objected Justin. "It was secret, experimental use. No one knew. The public has to be *aware*. Furthermore," he added cagily, "if you are asserting use since the Civil War, you are admitting utility."

"Not necessarily." Trent touched his fingertips together. "The Office can assert inconsistent and mutually exclusive objections. The applicant must then deal with both of them."

"Even so, the Board would never affirm you on public use, and you know it. Look at her!"

"I am, Mr. Justin—and begging your pardon, ma'am."

"Does she look to you to be two hundred years old?" demanded Justin.

"No. Of course not. You look more like a very young teen-ager, ma'am."

She smiled at him.

"Exactly," said the lawyer. "At least we can agree on *that*. Furthermore we are submitting a medical report showing physical data characteristic of a teen-ager: the Step Tests, per Masters and per Harvard; the Kraus-Weber muscle tests; the sit-ups; fingers-to-toes; handgrip; plethysmography; and so on."

Trent shook his head slowly. "Acceptable only to show her *present* physical condition, Mr. Justin, not as proof of age. But let's look at another problem. Prolongation of life is not really novel. How about those old people in Soviet Armenia? We read newspaper accounts about people a hundred fifty, a hundred sixty years old."

"Each and every one of those reports has been checked by experts," said Justin. "I am filing copies of their published reports. The oldest verifiable claim is for a man one hundred and seventeen years old—and not in Armenia: he was born and died in the U.S."

"How about the work with butyl hydroxy toluene—BHT?" asked Trent.

"Granted, BHT extended life in mice by fifty percent," agreed Justin. "And then they died. We claim indefinite life extension. Also, BHT was never demonstrated on man or the larger mammals. There's no comparison, Mr. Trent."

Trent shrugged. "One can retard maturation in tadpoles. You need merely to withhold thyroxine. They never become frogs."

"We don't withhold anything. We

add. The whole concept is different. This is a genuine contribution, Mr. Trent, as the record clearly shows." ("Clearly." His law professors had warned him, never say "clearly." It's a superfluous, irritating word.)

"The record is indeed replete," mused Trent. "I'm impressed. One fact is outstanding."

"And that is? said Justin uneasily.

"You have good support, excellent showing, for everything except the very claim you want most: prolongation of human life."

Justin waited.

Trent said: "I could listen to an offer of compromise. Say, take the insecticide claims. Cancel everything else."

The lawyer spoke quietly to Miss Gray. "He means no coverage for the compound, its preparation, or treatment of human beings. You would get only the three claims covering insect control."

"No."

"Then you get nothing," said Trent, almost casually. He scribbled something on the Interview Report and handed the paper to Justin. "You can take this as a Final Rejection." He stood up. "I imagine you'll be filing your appeal?"

"This afternoon," said Justin.

"There's a new accelerated procedure, if you pay the extra fee and allege the national interest."

"I know."

The procedural wheels ground away, and in due time the accelerated appeal was heard by the Board of Appeals. To his astonishment, Justin found that the presiding chief examiner was the Commissioner himself, Bayard McCormick. This was unheard of. It was as though the Chief Justice of the Supreme Court were sitting in Small Claims. *Ex parte Gray* was receiving very serious attention! Whatever decision emerged, pro or con, McCormick would be on record as agreeing with it. (For what *that* was worth.)

Justin addressed his thirty minutes oral argument almost exclusively to McCormick. Finally he summarized. "It works, gentlemen. This is the kind of invention for which the patent system was created. The Final Rejection should not be sustained."

But McCormick smiled his warped, cryptic smile. "Thank you, Mr. Justin. You will have our decision in due course."

"Under the new acceleration rules, may I expect it in thirty days?"

"Do you want it now, Mr. Justin? A *per curiam?*" McCormick's smile suddenly deepened.

Justin knew then that he had lost. "No, that won't be necessary. I'm sure the panel would prefer to consider my brief, and exhibits of record." He arose, stuffed the file in his briefcase, and walked out of the hearing room.

As he drove back to the office he mulled over this continuing disaster. What had he left undone? Was there something there that he had missed? Had *she* withheld something vital?

He reviewed his original impressions. Dora Gray . . . Oscar Wilde . . . *The Picture of Dorian Gray*. Wilde had certainly got his basic idea from her. Hers was the face of eternal youth. Wilde had seen that. But why build the novel around a picture? Because, somewhere,

there *was* a picture. Or was there? He had already gone down that road. But not all the way? He had looked at a photo portrait in her studio. But suppose *it* wasn't in her studio. Suppose *it* was something Wilde had picked up during his American travels. Where had the great raconteur encountered Dora Gray? Probably at Beauvoir, the retirement home of Jefferson Davis, near Biloxi, Mississippi. Yes, she must have been there during Wilde's visit.

Justin hurried into the corner drugstore and found a telephone. He had to see Dora Gray again.

9. 23 June 1882

Justin, Robertlee Beauregard, and Dora Gray sat in a tight triangle around Beauregard's new holo system in her studio. The drapes were drawn, and the sounds of birds in the garden were muted and faraway. The gloom made Justin uneasy. Rather like a spirit séance, he thought. Do we expect visitors? "Robertlee, you and Miss Gray have spent several days programming this thing," he told the cleric, "so please explain to me, what are we going to see?"

"I don't know for sure," admitted Beauregard. "You'll have to wait until she gets into it."

"Now what does *that* mean?"

"Well, Pop, this system is different from the fall of Richmond. In that one, you and I were watching from outside. In this one, if it works, Miss Gray becomes an actual participant. When you see her as a miniature figure in the holo, that's actually *her*. Miss Gray's mind and memory are in that little figure. She sits here with us now, but she sees, feels, hears, in her holo figure. We use her brain waves to reconstruct the scene as she recalls it, and to impress a sensory hypnosis. She's *there*, but of course she's still here, too."

Good Lord, thought Justin. Big Dora, Little Dora. "Two people?"

"No, just one Dora Gray. That's the point."

Justin shook his head. It was too confusing. "Will we be able to talk to her? Ask questions?"

"You can try."

Justin asked Miss Gray: "Before we start, I wonder if you could give us a brief prolog?"

"Certainly. I was visiting Varina —Mrs. Jefferson Davis—at Beauvoir, their house on the shore, near Biloxi, Mississippi. Oscar Wilde was lecturing in Memphis. He wrote Mr. Davis, asking permission to visit for one night. Mr. D. was doubtful, but Varina insisted, and so it was arranged."

Justin tried to visualize the scene. "And he arrived in knee breeches with a sunflower in his lapel?"

"Oh dear no. That was just affectation for the lecture platform. He was quite sensibly dressed. Let me show you." She leaned over and turned the projector on. Luminous images jumped into life in front of them. Beauregard adjusted the focus a bit.

"There we are," she continued, "waiting for him on the verandah: the president, Varina, myself, and Mary Davis—a visiting cousin. Oscar steps down from the carriage. The servants help him with his luggage—a valise and a couple of small trunks. Greetings and introductions all around. We all go in-

side. Oscar goes up to his room to wash up and rest a bit."

The scene changed.

"What's going on now?" asked Justin.

"We're taking him on a tour of the house. There's Winnie's room—Mr. Davis's daughter. And downstairs—the library pavilion where he wrote. And then the front parlor, which was also the music room."

"We have to be alert for documents—pieces of paper," urged Justin. "Something that would prove you were there at the same time Oscar Wilde was there."

Dora Gray's voice suddenly changed. It was diminutive, a bit squeaky. Justin realized it was coming from the holo. "We are going in to dinner. It was shrimp creole. Marvelous local specialty."

Beauregared nodded to Justin. "She's totally under," he whispered. "She's . . . *there*. Be careful, Pop."

Justin wanted to ask what could happen if he wasn't careful. And how would he know if he wasn't being careful? But he decided to say nothing.

The two men watched and listened to the scene at the dinner table. They could actually hear the little voices. This was what Dora remembered—the people, the sounds, the moment-by-moment action. But still nothing he could use. He couldn't offer this holo in evidence. He needed something concrete.

He observed that Wilde and the ladies seemed to carry the conversation. Davis looked somewhat restrained. Finally the president said, "Please excuse me. I must retire early. Doctor's orders." He bowed to Oscar and simply disappeared from the holo. Justin wasn't surprised. It would be difficult to imagine two human beings more widely disparate in their philosophies and outlook on life.

The lawyer watched the dining room dissolve. The scene shifted to the parlor. The room, Justin noted, was typically Victorian, all sorts of clutter and bric-a-brac. Pictures on the wall, harp in the corner, fireplace between two floor-to-ceiling windows. Candlesticks on the mantel. Oscar and the three ladies were seated around the table. Mrs. Davis passed liqueurs around; everyone was laughing and talking. Oscar appeared to be regaling the group with stories about his tour. Justin listened carefully, but he caught only snatches. Probably that was the way Dora remembered the occasion: fragments and snatches. "The Missouri lead miners," (Justin heard Wilde say) "are the best-dressed men in America." And what was *that* supposed to mean, he wondered. Whoa now! What's Varina doing? "Freeze it!" he hissed to Beauregard.

The reverend did something to the controls. The action stopped. Justin stole a quick look at Dora Gray—the Dora seated next to him. She seemed to have frozen too. Still breathing? Yes, he decided.

"Can you shift it around?" he whispered to Beauregard. "I want to look over Varina's shoulder."

The scene revolved ninety degrees.

"Go ahead with the action," said the lawyer quietly.

It was now quite clear what Varina Davis was doing. She was making a pencil sketch of the visitor. Justin's scalp began to prickle. He faced Miss Gray, and he spoke slowly and quietly.

"You studied art when you were a girl in school in Baltimore. You mentioned water colors . . . "

Beauregard shot a warning glance at him. "If you suggest too much, it'll become real to her, whether it happened back then or not."

Justin nodded. He pointed to the holo. The mannekin Dora held a flat metal box, hinged open. And then everything seemed to falter.

How to keep it moving?

He said to the real Dora: "It's your water-color set. Your colors were simple. Hematite for red. Black . . . was lampblack. China clay for white. Prussian blue. Cadmium yellow. You ground the colors yourself, with mortar and pestle, the way they taught you in school. You used a sable brush. Everything is ready. You are going to make a water-color of Oscar. He is waiting." He watched the woman. The child-eyes were closed. She was trying to remember.

Ah! The holo is moving again. Fast. *Too* fast. The movement is blurred. Varina glides about the room. Looking here, there, under things. Searching for—?

It hit him. *Paper!* There's no more paper.

Varina is apologetic. She used the last sheet for her own sketch. Wait, she has found a sheet. From the wastebasket? It may not be suitable. There is something on the back. No matter, the sheet is all right. The holo-Dora takes it, begins to paint.

Keep her going! thought Justin. Maybe this is it. Keeping his voice low he addressed the living woman in the sheltering darkness: "Tell me about him . . . Oscar . . . as you paint."

She whispered back. "He was absolutely charming. I will never forget him. A tall youth, several inches over six feet. Dark hair falling to his shoulders. His eyes were blue, I think. Or perhaps light gray. They were attentive, really beautiful. He had big hands, with long fingers. And how he talked! He seemed to compose every phrase ahead of time, in his head, so as to give the words a lilt and rhythm. He described the New York Bowery in iambic pentameter."

During this, the little holo-artist worked rapidly. Time telescoped. In the next sequence she was holding the sheet by thumb and forefinger and sweeping it in slow arcs through the air to dry. As she laid it on the tiny table she frowned. Justin could see why. There was a red smudge where she had held it.

He jerked. That's *it!*

"Zoom in on the sketch," he told Beauregard.

The detail was not too clear, just a red oval. His heart bounced up and began to hammer at the chambers of his chest. He could *hear* the pulse of capillaries in his eardrums. Easy, Justin, easy. Don't have a stroke right here in her studio. Take it step by step. You don't know anything for sure. Not yet, anyhow. He tried to keep his voice casual. "Your thumbprint?"

"Yes." She seemed to answer from a great distance.

Something about her voice bothered Beauregard. "We're losing her. I'll have to bring her out soon."

"Just a couple of minutes more?" pleaded the lawyer.

"No more than that."

Justin asked quickly, "Dora, what happened to your sketch?"

"I gave it to him."

Excellent! Oscar's fingerprints would be superimposed on her thumbprint. "He took it back to England?"

"Yes, I think so."

All he had to do now was find that sketch. No . . . there was more to it than that. Back up, Pop. Rapidly but meticulously he reconstructed the scene in his own mind. Varina Davis, searching for a sheet of paper, finding this . . . in the wastebasket? Excellent texture. One side carries some sort of irrelevant scribbling, but the other side is fine. Dora ready with her water-color palette. Oscar poses, probably talking all the while. His sensuous slack-jawed languor is soon locked in forever. The little portrait is set aside to dry. He packs it next day, and it's on its way to England.

What was he missing? "Can she take just a little more holo?" he asked Beauregard. "Can we go on to the next scene?"

"One minute more—sixty seconds. I'm putting the timer on you."

"Start."

They watched a luminous miniature bedroom take shape.

"What's going on?" Justin whispered to Dora Gray.

She replied in a dead monotone. "I was sharing the upstairs guestroom with Mary Davis. We had undressed for bed and had blown out the candle. We went over to the window and looked out toward the beach." The scene changed again. It was the seaside at Beauvoir, as Dora had seen it from her window. The moonlight cast black shadows from the palm trees. Beyond the trees, almost at the water's edge, sauntered a tall figure. It was Oscar, tossing pebbles into the little waves. Today, of course (thought Justin), that wouldn't be possible. Highway Ninety runs there now.

"We stared and stared," said Dora Gray. "It was . . . unreal. He was twenty-six."

The timer rang; the projector shut off. It was over.

Justin asked her, "How do you feel?"

"I'm fine, just a little dizzy."

"Let's rest a while." Justin got up, stretched, pulled the drapes, and walked around the room. And then he was back. "So you gave him your sketch, and he took it away with him. What did he do with it? What finally happened to it? What do you remember?"

"I'm trying to think."

Justin was silent. He let his mind race ahead. The great aesthete had returned to England. His marriage and major works lay ahead, including, of course, *The Picture of Dorian Gray*. Then *The Happy Prince*, *Lord Arthur Savile's Crime*, *Lady Windermere's Fan*, and the other great plays. Then catastrophe. Prison in 1895. The bankruptcy auctioneers pillaged the house at No. 16 Tite Street, in Chelsea. If the sketch had been framed and hung *there*, it was probably now forever lost. On the other hand, Wilde gave mementos to friends. Robert Ross, who stayed steadfast through the trials, prison, and exile, returned a lot of things to Wilde.

The lawyer looked across the table

at the woman. "After prison, he went to France."

"Yes. To Berneval, on the channel, near Dieppe. He lived in a two-story house there, while he worked on the *Ballad of Reading Gaol*. It was a lovely house with a garden, trees, balconies, tile roof."

He looked at her in surprise. "Oh? You visited him there?"

"No. I merely drove by in a rented carriage. He was working, you know. I didn't want to interrupt."

Justin sensed there was more to it than that. She did not want Wilde to see her. She had gone there to pay him a visit, to renew acquaintance after fifteen years, and then on the way something had occurred to her, and she had changed her mind. He could guess. At Beauvoir, in 1882, she had evidently disclosed to Wilde the nature of her strange being. Or perhaps, with his preternatural perceptions, he had divined it. Then, fifteen years later, in France, she had decided at the last moment not to confirm her eternal childhood to the destroyed man.

"He died a few years later?" ventured Justin.

"In Paris, 1900. Cerebral meningitis. He lies now in the French National Cemetery of Père Lachaise."

"And your picture of him? Is anything coming back?"

"Perhaps—" She hesitated.

"Go on."

"Well, there's a little bistro in Montmartre. He used to drink there regularly with various dubious characters. I don't know what they called it then, but after he died they changed the name to *L'Oscar Wilde*. Over the years the heirs have acquired various Wilde souvenirs and memorabilia, some genuine, some forged. These things are hung mostly on the wall behind the bar. It's the only collection I know of, and I don't know what they have. But it's just barely possible—"

"We can find the bistro, and I can have our Paris agents check into it." He had been thinking. Something kept nagging at him. "There's just one more thing. You said there was writing on the back of the paper?" He had better find out before he went too far with this. That writing could help. Or it could hurt. It could even destroy the whole proposition of sketch-use.

"Actually," she said, "I guess it would be more accurate to say the writing was on the front. I used the back."

"Of course. But this writing . . . do you remember anything about it?"

"Not really. It might have been a letter."

"Addressed to Davis?"

"Now that's odd. I had the impression it wasn't addressed to him."

"Was it signed?"

"No name. I think there might have been initials, though. I didn't really pay much attention."

No. It couldn't be. He took a long, deep breath. "Do you remember the initials?"

"I'm sorry; I don't."

"Robertlee," said Justin, "we'll have to go back in. I want Miss Gray to look again at the writing on that sheet of paper." He walked over to the windows and drew the drapes again.

"It's risky," warned Beauregard. "She was in too long the first time."

"*I'm* ready," said Dora Gray simply.

"Your funeral," said Beauregard. He formed the image again. "Say when."

"The parlor," said Justin. "Varina hands her the sheet of paper. Miss Gray looks at it, front and back. Freeze it there, reverend. Zoom in. No, still too fuzzy to read." He looked over at her. The innocent eyes were half-closed. "Look at the writing, Dora Gray. Are you able to read it?"

The mannekin spoke. Justin and Beauregard leaned forward and listened intently. "It's dated November 19, 1867."

"Go on," whispered Justin.

" 'My dear Evarts, if Davis loses in District Court . . . ' I can't seem to read the rest."

Meaning she can't remember, or really didn't read it all, way back then, thought Justin. "You mentioned initials," he prodded gently.

"S.P.C.," squeaked the voice.

"Bring her out," said Justin.

They waited a moment after Beauregard turned the projector off, then Justin walked over to the big garden windows and pulled the drapes once more. A couple of bluejays buzzed the window indignantly. He turned back.

Dora Gray was watching him. "What are you thinking, Mr. Justin?"

He smiled a small wry smile. "I'm thinking of Philip of Macedon, ma'am. After his incredible string of victories, climaxed by his capture of Athens, he was suddenly anxious. It had all been too easy. Were the gods setting him up? For reassurance, he prayed to Zeus for a minor disaster, to sort of keep things in balance, as it were."

"Yes, I remember that from school. Actually, he may have prayed a little too hard?"

"True," said Justin thoughtfully. "He was assassinated two years later."

"So what does 'S.P.C.' mean, Mr. Justin?"

"Samuel Portland Chase."

It meant nothing to her.

"Pop," said Robertlee in a very soft voice. "That's the Chase Memorandum. Leave it alone. Don't go after that piece of paper. Don't call Paris. *Please*."

They both looked at him in astonishment.

"What's wrong?" demanded the lawyer. "Why shouldn't we get the sketch . . . and the Memorandum?"

"Because . . . of who sent it to Jeff Davis in the first place."

Justin studied the holo expert with narrowing eyes. "Come clean, Robertlee. Explain yourself."

The gaunt man looked from one to the other in morose apology. "I know it's a terrible thing to ask, after all this work. I just had no idea. The fact is, Pop, my distant great-uncle, Lenoir Beauregard, sent that Memo to Jeff Davis."

"You're not making a bit of sense, Robertlee."

The semi-cleric's voice became firmer. "But that's the way it was, Pop. When the War came, Lenoir was a staff assistant in the Attorney General's office in Washington. He should have come back home to Virginia, like everybody else, but he didn't. He stayed on in Washington. He became a Yankee. This is not generally known, Pop. In fact, the male heirs of the line pass it down, generation to generation, under oath of secrecy."

Justin was becoming more and more befuddled. "Wait a minute. Two Lenoir Beauregards? One a Confederate hero, the other a traitor?"

Robertlee shook his head sadly. "No, they're both the same man. My father told me. *His* father told him, and so on, all the way back. Lenoir was never in the Army of Northern Virginia. He was never a lieutenant. He never lost a horse. Grandmother Beauregard got it all mixed up. If the truth ever comes out, she'll just about die. They'll kick her out of the Daughters of the Confederacy."

"So what is the truth, Robertlee, the full truth?"

Beauregard twisted uneasily. "Well, you see, it's like this. Lenoir was assigned to work with Evarts on Davis's treason trial, and he was actually in Richmond with Evarts for a few weeks. He returned to Washington with Evarts when the trial was called off, and after Davis was granted amnesty on December 25, 1868, it was Lenoir's job to close the Davis file. He cleaned it out, and he sent Davis the Memo."

"So *he* was the southern sympathizer in Evarts's office?"

" 'Sympathizer'? Hardly. He just wanted to show Davis how close he had come to getting hanged."

"So why bring it all up now, Robertlee? Why are you telling us this?"

"Can't you see what's going to happen, Pop? When you give the genuine Chase Memorandum to Witcover, the courts will reopen *Beauregard*. There'll be a lot of national publicity. The investigative reporters will move in. It won't take them long to discover Lenoir Black Sheep Beauregard. Oh, poor Grandma!"

But Justin was resolute. "Robertlee, I absolutely have to have that piece of paper. Not for what Chase wrote, but for what Dora Gray put on the other side. So what do we do?"

The part-time cleric was silent for a moment. "You've got to figure a way to destroy the memo-side without affecting the sketch-side. Can you do that?"

"How in the world—?"

"You're smart, Pop. You'll think of a way. And look at what I've done for you. You owe me."

"You're right, I do owe you. Let me think about it, Robertlee."

10. For the Record

"Witcover? Justin here. I found the Chase Memorandum. Thought you'd like to know."

"The original Chase, eh, Justin? Not a clerical copy, not a photocopy, not a typed rescript?"

"Exactly."

"And you have it right there in your hot trembling little hands?"

"In a manner of speaking. Actually, it's in a thick protective folder. It came over in the morning Concorde, from a bistro in Paris."

"Of course. And it may interest you to know, Justin, that I have the first Gutenberg bible sitting here on my desk, not to mention the Magna Charta, sent over by King Charles as a coffee service place mat, as well as the original Declaration of Independence, which I have just folded up into a paper airplane and sailed out the window."

The lawyer smiled very faintly. "If you say so."

"Justin, where are you calling from?"

"Grogans."

"You're drunk, Justin. Get off my case."

"You're not interested, then?"

"Listen to me, you silly old coot. I'm telling you for the last time. You can take—whatever it is—and you can stick it—"

Justin quickly held the receiver away. "Tsk, tsk," he muttered. And then all he heard was a dial tone. He replaced the phone.

Well, he had tried. Perhaps not very hard, but at least he was on the record. He unplugged the microcorder and stuck it in his pocket.

11. A Phone Call

From the Board's decision, Justin duly filed his appeal to the Court of Appeals for the Federal Circuit—the CAFC, headquartered in their new wing of the Federal Building in Washington.

The CAFC, spawned in 1982 out of the old U.S. Court of Customs and Patent Appeals, was empowered and required to hear all patent appeals arising anywhere in the country. Plus customs cases, generated mostly via the International Trade Commission. Plus trademark and copyright appeals. As well as appeals from the Merit Systems Protection Board. Plus miscellaneous claims against the United States. It was a glorious mismating of judicial functions. But it worked, especially with patents, because not one of the eleven judges was contaminated or influenced by prior technical education. Appeals in patent cases from all the United States District Courts in all circuits, as well as from the Patent Office, had to come here. No longer could a patent be valid in Connecticut and invalid in California, or infringed in Florida and not infringed by the same operation in Michigan. Only the United States Supreme Court could review decisions of the CAFC.

Justin knew all this. He knew certain other things, too, namely, that the CAFC now was deliberating *Beauregard*, and that the decision would probably turn on the Chase Memorandum—or rather, the lack of it. He wondered what three-judge panel had been drawn for *Beauregard*, and whether one or more of those judges might be selected for *In re Gray*.

That afternoon he got a call from the secretary of Lucas Towne, Chief Judge of the CAFC. Would Mr. Justin be available for luncheon next week in the Marshall Rooms? Several other guests would probably be invited.

Yes! He most certainly would be available!

12. St. Martins II

As they walked back to the car, Erin said, "You always seem so happy when you come here, Grandpa. All these dead people, and here you are happy."

"My dear young lady, I can't really help it. I have happy blood, you know. Type H. Great rarity. Years ago, I used to give transfusions to people who needed to be cheered up. But I finally had to stop. I gave one fellow a pint, and he laughed so hard he died. Nice way to go, though."

"Oh Grandpa! Can't you ever tell the plain, simple truth?"

"Sometimes."

"For example?"

"For example, you're the nicest granddaughter I have."

"That's not saying much. I'm also the only granddaughter you have. Don't you know any other true stuff?"

"A little, but I keep forgetting it. I guess I should start writing it down."

"Do you think I'm as pretty as Mom?"

"Absolutely."

"As Grandma?"

"Well, when you grow up a little more, ask me again. For now, you're pretty enough for just about any situation I can think of."

"Actually, I'm a teen-ager, Grandpa."

"Eleven is a teen-ager?"

"Sure. I'm already a young lady."

He stumbled. Now wait just one cotton-pickin' minute. Only yesterday you were in diapers. I cleaned up your little rear end more than once. Slow down! Don't use up your beautiful young life so fast!

She said, "Good luck with your luncheon tomorrow."

"Thanks," he said moodily. "I'll need it."

"Lots of important people?"

"They think so."

"What'll they feed you?"

"A bunch of low-calorie junk."

Back in his apartment that night Justin collected his weapons for the morrow's battle: the great centerpiece—the paper bearing, *inter alia*, Dora Gray's sketch. The dozen or so reports from experts. The photo blow-ups. All that, plus his brain (very ancient, increasingly decrepit, but loaded with all sorts of odd facts—if he could just remember them). Plus a great calm. Calm? Sure. For when you came right down to it, he knew more than any of them. He was entitled to play it cool, and he would.

Even from the distance of time and miles he could already sense the concern and hope of his prospective fellow diners. Pro-long? A chemical for the prolongation of life? A modern Fountain of Youth? Was it for real? They wanted to hear for themselves! They were, and would be, sniffing, searching, wondering. All at a national policy level, of course. Marshall luncheons represented hanky-panky at the summit. But when hanky-panky rises to such heights, it takes another name: statesmanship, and invites apology from those who once eyed it askance.

13. The Luncheon

In the midst of all the hubbub, Justin looked about him carefully. He had never been in the Marshall Rooms before, though he had heard about them. The Rooms comprised several dining rooms, each with its own characteristic clientele. Even here in the anteroom that served as cloakroom and private bar for the Judiciary Dining Room, he sensed the look and odor of ancient dignity. He studied faces with frank curiosity. Some he recognized because he had seen them on TV and in the newspapers. Most were strangers. The men who ran the government frequented this place. It was indeed rumored that no major legislation could be passed through congress until it had circulated the tables of the Marshall Rooms.

Several of the Rooms had names, based on an indecipherable mix of fact and (largely unverifiable) tradition.

The Wilson Room: The great twenty-eighth president had (or thought he had) a problem. Having been re-elected on the slogan, "He kept us our of war," he was now casting about for a rationale to get us in. "That's easy!" said Colonel House. "They torpedoed the *Lusitania*." "That was a couple of years ago," complained Wilson. "They're still at it," said Secretary of War Garrison. "Not good enough," insisted Bill Bender, of the U.P. "You're fighting *Prussianism*, Mr. President. It's your personal duty to *make the world safe for democracy!*" The next day, February 3, 1917, Mr. Wilson told the fully assembled Congress that the United States had severed diplomatic relations with Germany. The formal declaration of war soon followed.

The Truman Room: Harry Truman (after a brisk walk from the White House flanked by puffing Secret Service men) breakfasted here with Charles Ross, his press secretary and old school chum. Truman had just returned from Potsdam, where he had told Churchill and Stalin the drop was scheduled for early August. But he hadn't really discussed anything with Ross at the table. He mostly sat there at the piano at the side of the room, musing through some favorite Mozart and browsing in a bit of Chopiniana. Those who listened in the hall outside recall *Les Sylphides* and the somber strains of the *Funeral March*. It ws August 4, and the last day he could have aborted Hiroshima. As he closed the piano lid, he told Ross, "We're going in, Charlie."

Justin swished the ginger ale around in his glass, and he sighed. Despite the contents of his briefcase (which he carried in his left hand) he felt very forlorn. Just then the Commissioner of Patents walked up, looking equally out of place. "McCormick! Let me buy you a drink."

"There you go, Pop, trying to get me soused, and then corrupt me with logic." They angled over to the bar. "Know anybody here?"

"I've seen some of the faces. That's about it."

"This isn't just a chatty little affair with the three-judge panel, Pop. Look over there." The commissioner pointed with a covert flick of his chin. "Mrs. Foote, Social Security."

"Noted. And isn't she talking to Gates, FDA?"

"Yeah." The commissioner ran a finger around the inside of his collar. "Pop, your CAFC appeal has picked up a lot of attention. We're in big trouble."

"Speak for yourself, Mac," said Justin agreeably. "And I think they're calling us in."

Commissioner McCormick shook his head. "You go on. I'll be in in a minute. I need another drink."

The man at the head of the table remained standing. He banged a spoon on his water glass. "Gentlemen, will you please be seated. The waiters are coming around, and in a moment you can order. I presume you've found your place names. At the outset, and to clear the air a bit, I assure you that this luncheon is completely informal. Nevertheless, it is quite possible that certain decisions will be made. To assist the decision process, each of us may have some questions. We—you—can answer or not, as you please. Nobody's under oath, but we hope you'll all be reason-

ably truthful. So let's start by identifying ourselves. I'm Judge Towne, CAFC." On Towne's left was an empty chair. An invitee was late. Or perhaps wasn't coming at all. Who? Justin would give a year of his life to see the name card. Make that thirty days. Towne nodded to the man on his right, then sat down.

"Judge Kantor, CAFC."

It went around.

"Judge Clark, CAFC."

Towne . . . Kantor . . . Clark, His appellate panel. And it was just as he had surmised. *In re Gray* would be decided in this room, within the next hour, by three men who knew no chemistry and no biology.

It was rumored that Chief Judge Lucas Towne had taken a chemistry course in high school. However, he had flunked it, and the brief indecisive journey into science was not held against him. Nevertheless, Judge Towne had his specialty. He was a Civil War buff. He had picked up the mantle laid down by Sandburg, Catton, Freeman, and a host of other dedicated students of the great rebellion, and he had duly written his million words before his appointment to the bench.

Judge Kantor was reported to have strange chemical concepts. He thought Silicon Valley had something to do with cleavage, and that chlorine was a girl in a chorus line. No matter. Kantor was a fantastic mathematician. Before joining the court, his papers on the infinite series had been published in the math journals.

Judge Clark's chemical background was not really better based: Helium (it was said he quoted Edgar Rice Burroughs) was a city on Mars with twin towers, probably rather like the twin World Trade Buildings in lower Manhattan. His scientific ignorance was irrelevant. His analytical mind was the pride and sorrow of bureaucratic Washington. In *Smith* v. *Commissioner* (to the amazement and consternation of the IRS) he boiled the forty-page 1040 Short Form down to eight clear and comprehensible pages. Clark was the youngest and most ambitious of the three CAFC judges. It was rumored that he had designs on the next vacancy in the Supreme Court. *Beauregard* just might speed him on his way.

Justin had already got into their minds and he had taken the first straw vote of the day. Against the patent, three, viz., Towne (no proof of age); Kantor (utility requirement not met); Clark (prolongation of age not patentable subject matter). For the patent, zero.

His work was cut out for him.

And now the waiters were coming around and he had to attend to the menu. Chowder would follow the fruit cup, then he'd have a choice of *Boeuf Bourguignonne* and *truite au bleu*. He winced. Why couldn't they describe food in plain English? "The beef stew," he grumped at the waiter. That would probably bring a carafe of vin rouge. The vegetables would be the same for everybody: tomatoes *provençale*, carrots *vichy*, potatoes *lyonnaise*. Why couldn't they at least put the adjective in front of the noun? He sighed, dabbled absently at his *salade Niçoise*, and hoped the chef knew what he was doing.

Meanwhile, he had been listening with half an ear to the names still going around.

"Mrs. Foote, Social Security."

"Gates, Food and Drug."

"McCormick, Patent Office."

Then the man next to him: "Moore, Technos Corporation."

Justin swiveled and studied him with open curiosity. Technos? What had he heard about Technos? Private industry? This was no time for his memory to fail him. Think, Justin!

More names, including his own. And now back to the empty chair next to Towne. Wait. Someone has come in and is about to sit in it. Towne is rising, but the newcomer is smiling and pushing him down, with hands on both shoulders. A sudden silence. Not a sound. Great howling hornbooks!

"George Stadt, Supreme Court. Sorry I'm late, gentlemen. Please continue." The voice was smooth, gentle, like prewarmed molasses pouring on pancakes.

The whole ball of wax. Whatever came out of this room, win or lose, would be affirmed in the high court. The Chief Justice would see to it.

Was Stadt's presence here good—or bad? Justin decided he didn't know. He had a pretty good idea of the man's views on the patent system as such. To the ex-governor of South Carolina, patents were fantasies. True scientists were aware of this (according to Stadt). That's why *Chemical Abstracts* marked patent abstracts with "P," so they could be ignored. In federal district courts, new judges were always assigned the patent cases in a ritual of hazing and initiation. Stadt agreed with Huge Black. Hadn't the great Associate Justice once said (speaking for the Supreme Court), "The only valid patent is the one this Court hasn't got its hands on."? And yet, your honor (thought Justin) you must admit that the system continues, and thrives. It endures despite everything the judiciary can do to it. Inventions are still made. Patents are still granted. License fees are paid. This thing is bigger than lawyers and judges. Accept it, Mr. Chief Justice George Stadt!

All this thinking dried Justin's throat. He took a sip of water. How to handle Stadt? Somehow, he felt there was a way. Almost all the puzzle pieces were here, now, at this very table. What was missing? He noted, in a fuzzy abstraction, that his mind was spinning off in several simultaneous levels, racing along multiple mazes, analyzing, searching . . . for what? It would come to him. It—

Zap.

He had it. The little gleam of light that had been dancing just beyond his peripheral vision suddenly flooded his mind like a magnesium flare.

"Gentlemen," said Judge Towne, "any questions about the rules? Ah, Mr. Justin."

He *knew,* but he was going to ask anyway, just to let them know he knew. "Judge Towne, for starters, do you and Judge Kantor and Judge Clark perchance constitute the panel for *Beauregard* v. *U.S.*?"

Towne was clearly startled. He looked at Judge Kantor, then at Judge Clark, then back at Justin. He frowned. "The composition of the *Beauregard* panel hasn't been announced." For an instant the three CAFC judges seemed to exchange wondering glances.

It was so! thought Justin. I've got them all, right here at this table! What

are the chances that any three judges out of an eleven-judge roster will be selected? One eleventh times one tenth times one ninth. About one in a thousand. The fates are with me. For a very brief interval, measured in nanoseconds, he felt compassion for Witcover the Efficient. He continued with artless diffidence: "There's been some talk about a certain document, the so-called Chase Memorandum. I understand that, if found, it might be influential, perhaps even dispositive, in *Beauregard*. But of course that's irrelevant to *Gray*."

Towne stared at him. "If the Chase Memorandum—so-called—ever existed, it was long ago destroyed. And you are quite correct, Mr. Justin, it is indeed irrelevant to *Gray*." He smiled crookedly. "We are not here to talk about *Beauregard*. As Mr. Lincoln told Mr. Seward, 'One war at a time.' "

Fascinating. Justin could even attempt a straw vote on *Beauregard*. Without the Memorandum, the appeal would be dismissed. *With* the Memorandum Lenoir (Black Sheep) Beauregard would win. And that would be final. The high court would refuse certiorari in either case. And then, of course, the media would start looking into the case, and they would find that Lenoir was not a deprived Confederate lieutenant, but a prosperous Yankee. And then all hell would break loose. Grandma Beauregard would never forgive him, not to mention Robertlee. Justin, he said to himself, you must like to live dangerously. He gave Towne his friendliest smile. "Back to *Gray*, then, your honor."

"Mr. McCormick," said Towne, "what seems to be the problem in *Gray*?"

"Utility," said the Commissioner bluntly. "She claims the composition prolongs life, but she submits no proof. No proof, no patent."

Judge Clark pointed his soup spoon at Justin. "How about that, Mr. Justin?"

"I have very recently obtained the necessary proof," said the lawyer. "Basically, it consists of Dora Gray's thumb print on a water color sketch she made over a hundred and fifty years ago. The date is established by superposition of other fingerprints dating from the same period. The folio has been examined by the FBI Forensic Lab, and I have the necessary supporting affidavits."

McCormick regarded him with sorrow and reproach.

Towne leaned forward. "We'd like to have some details, Mr. Justin."

"Yes, your honor. In June 1882 Dora Gray, my client, was visiting Jefferson Davis at his retirement home, Beauvoir, near Biloxi, Mississippi. Oscar Wilde, whom we know as the notorious British aesthete, was visiting Mr. Davis. Mrs. Davis and Miss Gray made sketches of the visitor. Miss Gray gave hers to Wilde, and he took it back to England with him. A friend, Robert Ross, kept it for him when Wilde went to prison, and returned it to him when he was released. It went into exile with him in France. After his death in Paris in 1900, it was bought by the owner of a bistro in Montmartre that he frequented. A few weeks ago I bought it from the owner."

"And you have it?" demanded Towne. "Here and now?"

"Here," said Justin, "and now." He felt his brief case with his toe. Still there, leaning against the table leg. He thought of how Colonel Von Stauffenberg had brought a high explosive into Hitler's war room in a briefcase in 1944, and how the shelter of the thick table leg had saved the Fuehrer. So now the clock was ticking again. He wondered if another table leg would now materialize to save McCormick. Maybe. You never know. It's not over till it's over.

Mrs. Foote broke into his thoughts. "I'm really very sorry to hear this, Mr. Justin. Eighteen eighty two—that's a hundred and thirty years ago. And if your proofs stand up, she's really older than that. The Social Security Administration is quite indifferent to a fake . . . a *hoax*. But *proven* prolongation is quite another matter. We cannot accept any societal change that will increase the ratio of Social Security recipients to Social Security payers. If what you say is true, by the end of this century retired personnel could well be double the work force. The burden would be unworkable and unacceptable." She faced their host. "Judge Towne, in the name of economic sanity, you've got to kill this crazy patent!"

"Now wait just a minute," said Justin firmly. "Social impact cannot be a determinant. If the case qualifies under the patent statutes, that's all it needs." But he was watching Towne, who was watching Chief Justice Stadt, and he saw clearly that social impact might carry a great deal of weight with the minds deciding his appeal.

Judge Towne called over to Justin. "You say you have this sketch?"

"Yes, Judge, right here in my briefcase."

"Her fingerprints overlain by Wilde's?" demanded McCormick.

"Yes. Her thumb print is in red water color pigment. It's quite visible. Wilde's prints were invisible, but the FBI has developed and identified a couple of his prints superimposed on hers."

"I didn't think fingerprints were detectable on paper," demurred Towne.

"There are several techniques for paper development," explained Justin. "If you examine your fingertips under a magnifying lens, you'll note the print ridges are punctuated by tiny sebaceous glands, or sweat holes. These orifices coat the ridges with a very thin layer of fatty material, and this layer is transferred to paper or other material by simple digital contact. If the paper is porous, the oils soak in and may be difficult to detect by conventional procedures, such as dusting with carbon black. Several sophisticated processes are available, however. In one such process, tungsten metal is vaporized between electrodes in a near vacuum. The metal deposits between the ridges, so we get a negative impression. We have blow-ups of this and other types of development. One blow-up, in cross-section, uses the new scanning tunneling microscope, recently adapted to police work. We can actually see the tungsten atoms resting on hematite molecules. Miss Gray's print was first; Wilde's followed."

"How can you be so sure it was *her* print? And *his?*" demanded Moore.

"Comparison with *her* thumb print is simple," Justin told the Technos executive. "We simply made a fresh print.

For *his*, we collected a number of specimens from known Wilde artifacts."

"What do the police require in the way of checkpoints?" asked Towne. "You know, deltas, forks, eyes, dots, that sort of thing?"

"In federal practice, and in most states, at least twelve are required. International practice varies. In Germany, under certain circumstances, it can be as low as eight; France seems to be the strictest, with a requirement of at least seventeen."

"How many did *you* get?" asked Towne.

"Twenty-six for Miss Gray, thirty-four for Wilde," said Justin.

"Seems to wrap that one up," said Judge Clark.

Justice Stadt spoke in a gentle monotone. "May we see the sketch, Mr. Justin? Can it be passed around without harming it?"

"Yes to both questions, your honor," said Justin respectfully. "It's between plastic covers, but it can be taken out for closer inspection, if need be." He reached down, opened his brief case, fished out the exhibit, and held it in front of him for a moment.

"You hesitate, Mr. Justin?" said Towne curiously. "You don't trust us with it?"

"It's not that, your honor. I realize we're not in court. Nevertheless, before I offer it in evidence, as it were, might I be permitted to lay a foundation?"

"Certainly," agreed Towne. "We'd like to hear everything."

"Everything," mumbled Kantor.

Would you really? thought Justin. He said, "Going back to the evening of the sketch, Varina Davis, Jefferson's wife, couldn't find a blank sheet of paper, and she gave Miss Gray an old letter that Jefferson had evidently discarded. Miss Gray made the water color sketch on the back. The paper was high-grade linen stock, perfect for the purpose. We have carbon-dated a fragment."

"A hundred and thirty years is a pretty close shave for carbon dating," observed McCormick. His voice barely concealed a sneer.

"Quite so," said Justin equably. "However, we were nowhere near the minimum for the technique. The paper dated back to 2000 B.C."

They all leaned forward. He had them now. "The paper was made about 1865 in the Stanwood Paper Mill, Gardiner, Maine," continued the lawyer. "In an attempt to deal with the paper shortage during and just after the Civil War, they were trying everything, from straw and esparte grass to cornstalks and peat turf. This particular linen stock was from a boat load of Egyptian mummies. They stripped off the linen wrappings, about thirty pounds per mummy. It made a very high quality writing paper—'satin-note,' it was called, and this paper had a very special clientele . . . mostly high government officials . . . President Johnson, the cabinet, Supreme Court Justices."

Judge Clark's eyes were hard and glittering, but his voice was soft as eiderdown. Justin had to strain to hear him. "Mr. Justin, you asked earlier whether the *Beauregard* panel is present. You recall that?"

"Yes, sir."

"And now, you explain to us in great detail about the paper on which Miss Gray made her sketch . . . this special

'satin-note' that went to . . . certain people . . . including perhaps Chief Justice Salmon Portland Chase?''

''Quite so.''

''And you have mentioned that there's writing on the back of the sketch?''

''Yes, sir.''

''Let's jump to the bottom line, Mr. Justin. Is it—''

''The Chase Memorandum? Yes, it is.''

Judge Clark's face lit up as though flashed by a multi-kilowatt strobe. And then the light was gone so quickly that Justin wondered whether it had ever been there. Yes, he had seen what he had seen. And now he understood that the young jurist had been selected to write the opinion in *Beauregard*, and that he planned to make that opinion a landmark decision, to be included in all future law school texts on Con Law. It would spawn hundreds of law review articles over the next decades. A century from now some kid on the *Harvard Law Review* would submit *Beauregard Revisited. Beauregard*, plus some cautious politics, could lead Clark straight into the Supreme Court. Everything starts with Witcover's petition to remand to consider the Memorandum, which as yet Witcover does not know exists. Clark would personally grant that petition. And that, Judge Clark (thought Justin) would really be quite weird. It would be like granting a petition to reconsider yesterday's execution. It's saying, we fought the Civil War, now let's find out if it was legal. *Beauregard* was not a moot question: the case was not a simple academic exercise. Wounds that a century and a half had healed would be reopened. Hate would flow again. Brother would rise up again against brother in a no-win confrontation. And in the process Grandma Beauregard would discover that Lenoir Beauregard was not a lieutenant under Lee, but (in her view anyway) a turncoat and a traitor.

No, Judge Clark, thought Justin. You may get to the high court, but not on *Beauregard*. ''Shall I read the Memorandum?'' he asked.

''Please do, Mr. Justin,'' said George Stadt.

''It's dated November 19, 1867,'' said the lawyer. '' 'My dear Evarts—' ''

''William Evarts—Davis's federal prosecutor in his treason indictment,'' whispered Towne.

'' 'My dear Evarts. If Davis loses in District Court he will of course appeal, and the case must finally come here. You should be aware of a serious problem—' '' He read it through.

A dead silence fell like a lead blanket over the room.

14. Real Numbers

Finally Judge Towne said uneasily, ''It may be a bit early to jump to conclusions. And I assure you, Mr. Justin, I do not impugn your personal integrity. Nevertheless, very honest men have sometimes been deceived in the matter of documents. You seem to have authenticated the *paper*. Has the *ink* been examined?''

''It has, your honor. And your question is indeed well taken. If the memo were written in modern ink, the whole thing could of course be dismissed as arrant forgery. But the ink properly dates the period. In those days permanent ink was made from an initial mix

of ferrous sulfate, gallic acid—from nut galls, water, and a little gum árabic. A dark colloidal pigment formed, which the gum retained in suspension. For an immediate blue-black color, indigo was added. On paper this ink at first slowly grew darker; but then over the years, as the iron began to oxidize, it would begin to turn brown. If you are lucky enough to have a genuine Lincoln specimen, you'll note that it's in brown ink. So is this memo. After Perkin invented coal tar dyes, synthetic blues were substituted for indigo. No trace of these synthetics can be found in this writing." He concluded, almost apologetically, "We have used both destructive and non-destructive methods of ink analysis, including electrophoresis, u.v., i.r., n.m.r., gas chromatography, and mass spectrophotometry. A battery of experts has declared the document to be genuine, your honor, as to paper and ink. Now, as to the handwriting, we have with us today a man who has seen thousands of genuine Chase specimens and who has recently published the *Collected Letters*. Perhaps he would care to examine the script?"

Stadt smiled. "Of course. I'd be glad to." The plastic folder was handed around to him. He held it reverently for a moment, then opened the covers for a direct look. "Yes, it is indeed his handwriting. Smooth, rhythmic, highly legible. A spare, honest script, no flourishes. I'd know it anywhere."

So now they have come to the end of the trail. They have found the dreaded thing they sought. Justin pondered analogies. Captain Ahab searches the seven seas and finally finds the Great White Whale, which proceeds to kill him. Roger Bacon leafs through endless Arabic scripts and finds the formula for gunpowder. The male *Latrodectus mactans* finds his mate, the black widow spider.

At last Judge Kantor said (with a wobbly squeak in his voice): "Mr. Justin, who else knows about this . . . ah . . . document? The writing, I mean."

"Several examining experts, all sworn to secrecy," said Justin. "Mr. Witcover knows that it exists, but has not seen it. Otherwise, no one outside this room knows about it."

"The Memo may present a bit of a problem," mused Judge Clark.

(Actually, you don't look too unhappy about it, thought Justin.)

"Already," continued Clark, "even without the Memo, *Beauregard* has attracted several dozen related claims. *With* the Memo the gross might be up in the hundred millions."

"Chickenfeed," murmured Lucas Towne. "You want the real numbers?"

Clark shrugged. "Give us the real numbers."

"Slaves and other personal property loss, two and a half billion. Banks, one billion. Loss in land value, three-quarters of a billion. Total, four and a quarter billion. That's highly conservative, of course, and exclusive of interest."

"The government doesn't pay interest prior to judgment," said McCormick. "Title 28."

"Generally not, of course," agreed Stadt. "On the other hand I'm told there's been some discussion about 28, Section 2674—which provides for full compensatory damages based on the law of the place of the tort, which could

indeed include interest, though of course we don't call it that. In any case, *Beauregard* could be amended to include the northern states as a co-defendant. That way, there'd be no problem about the United States paying interest."

Justin frowned. Is he teasing us? he thought. No, he isn't. He's dead serious.

"Just for fun," continued the high court justice, "perhaps Judge Kantor can figure it with interest, say six percent."

"Why yes, of course," said Kantor happily. "That's 4.25 billion times 1.06 raised to the 150th power, and *that*—" He studied the ceiling.

Good lord, thought Justin. He's doing it in his head.

"—is twenty-six trillion, five hundred and sixty-two billion dollars," finished Kantor. "And assuming that the lawyers—mostly the Witcover firm, I imagine—would get a third, that's eight trillion, eight hundred and fifty-four billion."

Justin closed his eyes. He couldn't grasp it. You could divide the lawyers' take by a hundred. Or a thousand. And the individual's share would still be ungraspable. It was like trying to explain differential calculus to a babe in arms. It was silly to even think about it. It was almost immoral.

George Stadt grinned. "I see in the papers the D.A. in Charleston, back in my home state, is preparing a claim."

"Whatever for?" said Judge Towne innocently.

In his gentle drawl the Chief Justice read from a newspaper clipping. "Costs of resisting trespass by Federal troops stationed on Fort Sumter; costs of 3000 shells fired at said Fort; costs of housing and feeding said troops after their surrender and arrest; plus extras for pain, suffering, and mental anguish—"

Lucas Towne rolled his eyes upward. "Dear God!"

"Charleston will never get away with *that*," muttered Kantor.

"Actually, it's not really too clear," said Stadt. "The D.A. quotes Lincoln, on his way to his February 1861 Inaugural: 'Would marching an army into South Carolina without the consent of her people be invasion? I say, I think it would be invasion.' There's more—"

"Never mind," said Clark hastily.

"Seems to me a class action would be required," grumped Towne. "Like the asbestos cases; or Agent Orange . . . radiation . . . Love Canal. But how can you join and organize several million plaintiffs? It's just too many."

"Not really," said George Stadt. The friendly Carolinian smile twisted wickedly. "In *Eisen* v. *Carlisle*, the class action involved nearly four million plaintiffs."

"Any such class action would be so complex and so expensive that several states might have to band together to support it," said Kantor thoughtfully.

"Say, a *parens patriae* comprising Virginia, the Carolinas, Georgia, Alabama, Mississippi, Arkansas, Texas—?" suggested Judge Towne.

"You mean, the *Confederacy?*" asked Kantor.

Towne frowned. "Let's not get carried away. All *that* was decided at Appomattox."

Stadt smiled faintly. "Not really, judge. That simply brings us back to the central question, and the Memorandum.

Appomattox merely decided that the North was stronger militarily than the South. We still have the question of whether secession was *lawful*. The Memorandum could change everything. Just wait until the disaster lawyers get *that!*'' He chuckled. ''The South will rise again!''

Rather hesitantly, McCormick broke in. ''Not my area, really, but how about the statute of limitations? It seems to me that *Beauregard* should be barred at the outset.''

''No, I don't think so,'' said Towne. ''The claim has actually been pending since 1866. It was suspended by and during the Reconstruction Acts, thereby tolling the statutes, and the litigation was only recently rediscovered in the courthouse archives. It was re-opened with the consent of the U.S. District Attorney. And it would support related claims, so I'm told. It's been compared to a magnet, attracting splinter claims. In my view, it's more like a dead horse, attracting flies and buzzards. The legal vultures smell carrion, and they are gathering. There's some case law quicksand hereabouts, Mr. McCormick, and I don't propose to drown in it.''

Judge Kantor shot an accusing look at Justin. ''It's really a shame the Memorandum had to surface just at this time.

Justin wouldn't look at him. He took a guilty bite of stew. Clara had made better, he decided.

Judge Clark looked overhead, as though searching for circling vultures. ''Curious,'' he said. ''If we include interest, gross claims would approximate the gross national product.''

''Actually, as far as the North is concerned, the gross might be considerably more,'' observed Judge Towne thoughtfully. ''The South could hardly be expected to contribute to payment of its own claims. The North would have to carry the entire burden.''

Judge Clark leaped to his feet. ''Impossible! *The North will secede!*''

They all looked at him in surprise.

The jurist returned their stares. His jaw dropped. His face had been red when he stood up. Now it was a deathly white. Judge Clark (Justin noted) was himself appalled, and horrified and embarrassed, and afraid, because he had suddenly and completely plumbed the wellspring of national dissolution. How now could he deny *Beauregard* as unconstitutional, when by his outburst he had announced that the constitution was irrelevant? And Justin understood that this was how nations sundered. A long smoldering resentful wait, then that sudden explosion. And afterward the historians.

''Sit down, Richard,'' said Stadt gently.

The high-court aspirant dissolved slowly back into his chair. ''It's the lawyers,'' he said feebly. ''We ought not let them bankrupt the country.''

''Quite right,'' soothed Stadt.

During the silence that followed, Justin looked covertly about the table. It was almost funny, and he had to suppress an unseemly urge to giggle. And so the lunacy was back to him. Actually, it had never left. Curious. Here were two kinds of madness, separated from each other by a few microns—the thickness of a sheet of paper. A frail dielectric between two lightning bolts. Yet, to him, all options were still open. He could choose one, or the other, or both,

or neither. Fortuna had elected him the Prophet of the New Madness; but did Fortuna have all her marbles?

"Gentlemen," he said. They all looked at him expectantly. "And madame," he added belatedly. (Mrs. Foote sniffed.) He took a sip of tea. Dissolve Dora's elixir in tea and feed it to this bunch, he thought. Wonder what it would do. Probably nothing. "There may be a solution to our problem," he said. "Just let me organize some preliminary thoughts." He faced the man on his left. "Mr. Moore represents Technos, a large but secret pharmaceutical consortium. Right, Mr. Moore?"

Moore nodded.

Justin continued. "I assume that Mr. Moore is here at the invitation of Judge Towne, purely as consultant and advisor in a highly esoteric technical field. As is"—he faced the man on his right—"Dr. Gates, of the FDA. Dr. Gates, of course, in the discharge of his duties as Food and Drug Administrator, may eventually have the responsibility of determining the safety and efficacy of Pro-long. Mr. Moore would like to acquire exclusive rights to Pro-long from my client. Thereafter he would work closely with Dr. Gates to secure FDA clearance. Then Technos would go into commercial production. Sales would be world-wide, and might be expected to gross several hundred million annually. Am I still on track, Mr. Moore?"

"Right on, Mr. Justin."

The lawyer continued. "First of all, I must tell you, Mrs. Foote, gentlemen, that Pro-long has certain limitations. It works only on females. And treatment must be undertaken at a certain stage, just before menarche. If this is done, it works, and so far as we know there are no side effects. Still interested, Mr. Moore?"

"Gates?" asked Moore.

The Food and Drug Administrator nodded. "If that's all . . . no problem."

"But Technos would still have to have a patent," said Moore. "We wouldn't invest otherwise. Now, if Mr. McCormick would withdraw his objections to the patent—"

McCormick seemed to study the faces of the three judges who paneled *Gray*. Justin watched him. It was rather droll, he thought. Everybody was watching everybody else, as though the magic solution was going to pop out of nowhere. Well, McCormick, how about it?

"*No!*" declared the Commissioner. "The Office will *not* withdraw its objections. We are still not convinced that Miss Gray is older than she looks. We leave the appeal in its present posture. Gentlemen, ma'am, I'm sorry. The CAFC must decide." He flashed a covert look of triumph at Justin.

The lawyer smiled back. He said softly, "Still just thinking out loud. The patent file wrapper will undoubtedly be copied many times. The procedure in the Records Branch is to take out each piece of paper and run it through the copy machine. The papers eventually get frazzled and torn. The Wilde sketch is already in poor condition. It would be ruined after a few passes through the photocopier. Actually, in the interests of preservation, it should be mounted on opaque board. Then it could be duly entered as a proper exhibit in *Gray*."

"Mounting would permanently con-

ceal anything on the back of the sketch—?'' said Judge Towne thoughtfully.

Justin nodded mournfully. ''Destroy is a more accurate word, your honor. Of course, before so drastic a step is taken, my client would like some assurance that the panel will not only reverse the Commissioner''—he smiled at McCormick—''but that if the patent should ever be litigated in the Supreme Court, it will be sustained *there*.''

McCormick glared at the lawyer. ''Is this blackmail, Mr. Justin?''

''Yes.''

''Oh. Well—'' McCormick looked around the table. One by one they nodded, until the silent vote reached the FDA administrator. Dr. Gates squirmed. ''We have more than six hundred drug applications pending, and we like to take things in turn.''

''And your law department has several cases pending in the CAFC,'' Towne reminded him. ''Perhaps we can *all* try to speed things up a bit.''

Dr. Gates bit off the word. ''Yes.''

The unspoken question continued around the group.

McCormick broke in again. ''The government could seize the patent by eminent domain,'' he said coldly. ''The United States has a broad general power to use the patent for government purposes under 28 U.S.C. 1498. Besides that, practically every specific government agency in existence can likewise simply *take* the patent—condemn and seize it as you would a parcel of real estate. HBW—in 42 USC 286d, 287b 'may acquire such patents as the Director deems necessary.' Ditto, the Secretary of the Interior, 16 USC 833a. Not to mention seizure powers vested in the Department of Defense, 10 USC 2386. And practically all the other departments have similar powers: Commerce, State, Transportation, EPA. Even Treasury, for heavens sake!''

George Stadt looked at him glumly. ''You've come well prepared, Mr. McCormick. We'll give you that. But I must point out that Mr. Justin could turn the Memorandum over to the Conference of Southern Governors, meeting in New Orleans next month. And then I imagine Mr. Witcover would ask Judge Clark for a remand to enter in *Beauregard*. And eventually the North would face payments that could go as high as twenty-six trillion dollars. Haven't you been listening, Mr. McCormick?''

The Commssioner reddened, started to say something, then decided not to.

And back again to Stadt. ''One thing bothers me, Mr. Justin. Your own firm is spearheading *Beauregard* and a number of related claims. Mr. Witcover is the partner in charge, I understand.''

''Quite so, your honor.''

''Does he know about the Chase Memorandum?''

''Of course, your honor. I duly informed him. And he duly informed me what I could do with it. His recommendation involved certain destruction. Your honor must not be unduly influenced by Mr. Witcover's formal responsibilities in *Beauregard*. At heart, he is a man of sterling qualities, activated by the most profound patriotic principles. He would be the first to admit it.''

''Hm. I think I get the *picture*. Hah! Good man, Witcover. Perhaps I misunderstood him. Let sleeping dogs lie,

that sort of thing. Yes, I can see that he is a true *amicus curiae*."

"As are we all," said Justin piously.

"Now, I don't mean to pry into your personal affairs, Mr. Justin," continued Stadt. "But I was wondering whether your personal sympathies lay on one side or the other? Was your family North or South?"

"My people were farmers, near Sharpsburg, Maryland, practically on the Virginia border. My great great grandfather Peter was a private under McClellan. His brother Paul went south and fought for Lee. Both were killed at Antietam, in 1862, within sight of the house where they were born. They're both buried there, under one stone. It says, 'God knows which was right.' The Justins have paid their dues, your honor. We don't take sides." He regarded the Chief Justice carefully. Yes, he would say a little more. "Now, sir, there are a lot of smart people around this table. Maybe you're the smartest. Doesn't much matter. It doesn't take an extremely smart lawyer to see that the doctrine of finality ought to apply here, that the Civil War, rightly or wrongly, settled the case. Appomattox cannot be appealed, nor reversed, nor remanded for reconsideration."

Stadt considered that. He said, "I see. I quite understand."

Justin stole a look at Judge Clark. The face of the high-court aspirant was gray, drained. No Memorandum. No *Beauregard*. No landmark decision. The rug had been jerked out from under him. The jurist returned the look. His face was smooth, his voice unmodulated, but his eyes were bitter. He said, "As we all know, we deal here in hypotheticals. Let me ask you one, Mr. Justin."

"Please do."

"Suppose no commitment, express or implied, were made to you concerning your patent. Would you, nevertheless, destroy the Memorandum?"

"Good hypothetical, your honor. And it deserves an honest, straightforward, hypothetical answer. To keep it hypothetical, though, and with respect, I think the question should be framed a little differently."

"How, exactly?"

"This way: after the patent is allowed, *then* ask me."

"I see." Clark's response was icy.

Was George Stadt smiling? It was hard to tell. More like a cryptic Mona Lisa look, where the whole face expresses an amused serenity.

"Anything further?" asked Judge Towne.

"A question for Mr. Justin," said Moore quickly. "I should mention that Technos has already budgeted several million annually for research. For example, we hope to solve the sterility problem, and the young-female limitation. The inventions will be pouring out from our laboratories. And central to all this is Miss Gray's cooperation. We are prepared to offer her a very lucrative consulting arrangement, above and beyond purchase of her patent rights. Perhaps, Mr. Justin, you could talk to her about this?"

Justin nodded.

Moore's eyes swung around the table, then came back to the lawyer. "In short, Mr. Justin, our investors would expect that you would continue to handle the Pro-long patent program and all related

legal matters. We have set aside a substantial personal retainer—'' The sentence ended in a rising inflection, and was more a question than a statement.

Fascinating, thought Justin. They need me. I need them. But most of all, Erin needs her father. Bill, you sorry wretch, shake the sands of Saudi out of your pants. You're on your way home. Oh, it's good to be a necessary cog in the machinery of somebody's life and hopes! Next question: should he stay in the firm? Could he continue to endure Witcover the Witless? Suddenly he realized the depths of his own needs. Just as George Washington had his Benedict Arnold and King Arthur his Modred, Witcover was essential to Justin's personal drama. And vice-versa. Two professionals living in reluctant symbiosis, each the medieval torturing hair-shirt of the other. Or was he being too easy on himself? Perhaps he was a viper in Witless' bosom. He smiled inwardly. He liked that! And there were other things that made it hard to leave the firm. How about his office, which fitted him like very old, very comfortable slippers? He couldn't bear the thought of giving up that long-occupied room, with its strong imprint of his father, and history, and his own persona. And finally, he wanted very much to be around when Witcover discovered the true fate of the Chase Memorandum. He could visualize the scene exactly. He is in his office. His swivel chair is jammed against the back wall panel, his feet are propped up on the pulled-out desk drawer. He is leafing through the current *Chess Review*. Witcover storms in, livid, *screaming . . .*

He started. He had been day-dreaming again. They were all watching him expectantly. ''Your patent program would have to stay within the firm,'' he told Moore.

The man from Technos looked over at the Chief Justice, whose head just then was angelically back-lit by a wall radiant. The great man nodded almost imperceptibly. Justin suspected his honor's nephew—or his cousin or his aunt—had this instant become a vice-president of the new drug firm. ''Yes,'' said Moore.

Stadt spoke up in his soft monotone. ''If we're all agreed we don't have to fight the Civil War again, why don't we order dessert.''

Dessert. Justin suspected it would be something with an unpronounceable French name.

''As for me,'' continued the Chief Justice, ''the Court hereby orders a slice of that marvelous Texas pecan pie, at 3000 calories.''

15. Morning Papers

Justin and Dora Gray sat on one side of the great teak table. Larkin, Second Vice-President of the bank, sat on the other, next to Moore. There had been numerous documents signed in triplicate, amid frownings and last-minute initialings. Finally Moore pushed the check over to Justin, who showed it to Miss Gray. They both endorsed it, and Justin turned it over to Larkin, who made out a deposit slip on the spot.

Moore took out a handkerchief and dabbed at his brow.

Larkin said hurriedly, ''I hope you'll excuse me. They're holding the vault open for this check.'' He shook hands

all around and disappeared through the back exit.

"I'll have to be leaving, myself," said Justin. "I want to call the office."

"Of course," said Moore. "Oh, before you go, you'll be interested in our initial research program. With Miss Gray's advice and consent, of course." He smiled engagingly at her.

Let me guess, thought Justin. Don Juan Ponce de Leon, you're going to find that Fountain yet! He recalled a long-ago visit to St. Augustine, and the big bronze statue of the great explorer standing in the square. Some one had painted on the base, "*Sta por aqui*," which he had translated as "It's got to be around here somewhere." Well, Moore, who knows? Maybe if you look hard enough . . .

"With certain molecular modifications," said Moore, "Pro-long might work on males, even on males over forty. What do you think, Miss Gray?"

"Why it just might at that, Mr. Moore. I'd be plain de*light*ed to help y'all find out. And won't you please call me Dora?" Her eyes fluttered.

"Call me Hank." Moore moved around to her side of the table. "Here's what I have in mind, Dora."

Well I'll be damned, thought Justin.

Very quietly he eased out through the door.

Erin was still waiting in the anteroom. She was holding up a copy of *Mademoiselle* and comparing herself critically in the wall mirror with the figure on the cover. "Evening gown, Grandpa, slinky red velvet. What do you think?"

"I think your mother would kill you," he said absently.

"Maybe you're right. How about gold sequins?"

"Be with you in a minute. I have to make a call. Ah, here's a phone in the corner." Should he try to reach Bill now? No, bad time. One-thirty in the morning in Saudi. Anyhow, it ought to be a family call. Try from Betty's early tomorrow morning. Put it on the squawker. Okay, on to Witcover.

He dialed.

"Witcover? Justin. I'm calling from the bank. What? The lunch at Marshalls? That was yesterday. Yeah. The panel was Towne, Kantor, and Clark. It went well. They just wanted me to file a couple of additional documents for the record. I got the formal notice of reversal this morning. Henry Moore of Technos was there. Moore—Hank Moore, of Technos. A new drug conglomerate. Big financial backing. Four stars in D and B. AAA in Poors. They bought the patent. I just deposited the check in our escrow, thirty million, advance against running royalties of ten percent. What? Of *course* it's dollars. Thirty million dollars. Since I took it on contingency, we get a third." He paused and listened to strange noises. "Witcover? Are you all right? Witcover?" And now just a dial tone. He looked over at his granddaughter uncertainly. "If you were Witcover, and you were going to tie one on, where would you go?"

She put the magazine down, and she was thoughtful. "When they told Daddy he had to go to Saudi, he went to Grogans."

"Grogans! Of course. Right there in the building."

"The trouble is," she added, "they

don't really help you get home. Mother and I had to go get him."

"Quite proper," mused Justin. "Keep it in the family. So then, off to Grogans."

After a bit of fumbling Justin found the right key in Witcover's key ring, and together they got him into his apartment, accompanied by intermittent comments from their uncooperative host.

The place was incredibly neat. Had this sterile place produced Witcover, or was it the other way around? There was nothing to suggest the apartment was inhabited. No trace of the wrack and detritus of normal human passage. No coffee mug or beer can visible anywhere. No newspapers on the rugs. Not even a TV guide on the console. The man must have a housekeeper as neurotic as he. "I think the bedroom's down here," muttered Justin. "There we go. Easy does it. Don't bother with the pillows. You unlace his shoes and ease them off. I'll get his belt."

"Gotcha cold, Pop," gurgled the prone man. "Chasing around . . . young broad . . . betcha still in college . . . old man like you . . . shame shame shame—"

"Yeah," said Justin. "Go to sleep, Witcover,"

"No honest way . . . to get that patent. You have a devil . . . I'm gonna tell . . . the trustees—"

"Oh shut up."

"At least turn on . . . stereo. Music to sleep—"

Erin was already at the console. She found the knob, then looked back at Justin. Her face was shining. "Grandpa! You heard him! I'm a genuine *broad*. He thinks I'm in college."

He sighed. Sure you are, kid. Eleven, going on twenty. He listened. Witcover was snoring peacefully.

WGAY was playing the opening bars of Strauss' *Morning Papers*. The only music he was ever able to dance to. Clara had taught him. He looked at his granddaughter in the semi-light. So much like you, Clara. Same impish eyes. Same smile, trembling on the edge of laughter. But not you, not me, not either of her parents. Maybe at most, bits and pieces of us.

Erin, child of magic and mystery, who are you? I see a sprite in an infinite life pageant, a wavelet in a torrent of generations past, and present, and to come. Oh, let time flow forever!

He walked over and bowed. "Miss Justin, may I have this dance?"

She took his hand, happy but puzzled. "I didn't know you could dance."

"My dear child, you cut me to the quick. Who do you think taught Nijinsky . . . Astaire . . . Arthur Murray?" They glided together into the three-quarter beat.

"Grandpa, Mother says you have told the unembellished, unadulterated, unvarnished truth only twice in your lifetime."

"Mighty big words, young 'un." He was thoughtful. "When was that?"

"Once, when you said you loved me."

"And the second?"

"She doesn't know. She gives you the benefit of the doubt for number two."

"The soul of charity. She has a point, though. I've been telling the truth all

day long, and it's just about worn me out.''

Law school! That's the ticket for you, little friend. He'd talk to Bill about it. Why hadn't he thought about it before? Clara had been in some of his classes. He had typed the briefs, made a copy for her. She recited from his carbons, *in haec verba*. She sparkled her eyes at the professors and crossed her legs from time to time. It drove him crazy. Them too. She got A's, he got B's. So much for women's lib. Oh Clara Clara.

Their window shadows swept in graceful drama around the room, now ahead of them, now behind. *Here's* a picture for you, Dora, he thought.■

IN TIMES TO COME

●Our next issue is "Mid-December," and the cover story is for Joseph H. Delaney's novelette "An Ill Wind." You know the saying, and you won't have to think about it very long to convince yourself that certain substances will be used very sparingly in the closed environment of a spaceship. The occupants of Delaney's ship (which, by the way, is unusual enough to be highly interesting in its own right) found this out the hard way, but the lesson came with a bonus. Until that happened, they had no way of knowing they were already the targets of a particularly insidious alien invasion, much less what the aliens' Achilles' heel was.

We'll also have stories by Arlan Andrews (a full-size adventure tale quite unlike his short humor pieces), Jack Wodhams, Spider Robinson, J. O. Jeppson, John Gribbin, Rob Chilson and William F. Wu. And Tony Rothman, with collaborator David Aschman, returns to the science fact department with a closer look at the mysterious shenanigans in Cygnus X-3, which John Cramer discussed in one of his columns a few months back.

Probability Zero

LONG, LONG THOUGHTS

Laurence M. Janifer

Dear Charlie:

I hope you get this in time.

I'm not afraid of dying. Anybody can do that, and everybody will, one way or another. What I'm afraid of is cremation. And it seems to be fashionable as Hell these days (using that term very precisely—but we'll never agree about theology, not even about whether there ought to be such a thing), once you've contributed whatever organs you can handily spare to whatever banks are open for deposits that particular day.

It isn't that I dislike the idea of someone making an ash of me. (Oh, all right; I'll quit that.) As a matter of fact, until recently it struck me as a fairly decent idea, as such things go: not terribly messy, and very nicely quiet and final.

But things have changed.

One new discovery will do it, you know. After Copernicus, you can't look

at the sky in the same way; after Einstein, you can't even look at a moving object in just the same way. And after this . . .

Cremation doesn't seem so decent any more. Though it does seem final. Very.

Briefly—very briefly, I haven't much patience, and this has to go out in the next mailbag—the discovery is this: Evolution is working backwards.

I don't mean that things have suddenly turned around and we're all going to be little green frogs any minute now. Don't be silly. I mean we've been *seeing* it backwards.

From inanimate objects—molecular aggregations—to plant life, from there to animal life, from there to Things With Brains (i.e., us): that's the way it is supposed to go.

But that isn't the way it goes, I'm afraid.

Look for a minute: plants grow, and die—and petrify. Their molecules are replaced by copy-molecules of a new substance, a substance that lasts longer, a great deal longer.

Animals grow, and die—and, if they're lucky (like the plants), they fossilize. They become stone, or a big part of them does—maybe bigger than we know; it's not at all clear that we'd recognize fossilized flesh unless it were as tightly attached to the bones as it is in "normal life," and why should it be? The whole stone structure the bones are in is a good conduction medium.

Continued consciousness? Well, why not? (Given that there was consciousness in the first place, of course; I can't claim that turning into stone adds anything to existent processes.) Radioactive changes in the stone provide for it. Of course, it would be a good deal slower . . . but you'd have all the time in the world (quite literally) to think.

It is funny, when you come to think of it, that there's such a high level of radioactivity in those particular rocks that we call fossils. If *funny* is the right word for it, of course.

But cremation . . . well, I imagine that the ashes would eventually become the material with which some other creature could grow, and die, and be fossilized in its turn . . .

I'm not all that altruistic. I'd like to survive—and that means burial.

And long, long thoughts . . .

Yours,
Alvah

on gaming

Matthew J. Costello

Hacker is my kind of computer game.

First of all, there's no rule book. Nothing. Just a few well-chosen words about loading the program, and there you are. Playing the game. Sort of.

And best of all, *Hacker* doesn't favor the linguistic mavens who've mastered the tedious, truncated vocabulary of most computer parsers. For once, everyone, whether he has mastered *Ultima IV* or is still agog at *Pac-Man*, is in the same boat.

The premise of *Hacker* (Activision Inc.) is very intriguing. You have broken into some top-secret computer network and are now privy to a variety of data definitely not for your eyes. Before long you're involved in a subterranean hunt for pieces of a shredded document held by agents scattered throughout the world. Meanwhile, Magma Limited (who happen to own the computer you just hacked your way into) has spy satellites circling the globe, searching for high-level security leaks. And you fall right into that category. It's then a race between you and the company's security measures, a race that all too often you'll lose.

The game begins gleefully by printing out the question, LOGON, PLEASE? (A reasonable enough request.) It then waits for an answer while you type in whatever the spirit moves you to type. After each of your answers, it repeats its query: LOGON, PLEASE? And on and on, until it announces that it is commencing the disconnection procedure. 5,4,3,2, . . . it prints out, but then fate lends a hand and a glitch in the system gives you access to the computer network. Happily, you move on to the next task.

You are presented with a front and side schematic drawing of a SRU unit, a rather efficient looking robot-on-wheels.

The computer asks you to run checks on various parts of the unit such as the Data Compactor, the Infrared Video Sensor, and the Asynchronous Data Compactor. After a properly befuddled period, you'll probably figure out that you have to somehow test these components. Which is fine, except you don't have the foggiest notion where or what they are.

Ergo, the name "Hacker." You'll find yourself hitting the keys on your keyboard just to see if they do anything, feeling more like Koko the Chimp with an IBM-AT than an intelligent person engaged in a recreational pastime.

But experimentation is sometimes the mother of knowledge, in this game at least, and you will, I'm sure, learn where all the robot's components are, and what they do. (Because if you foul-up on even one small test, the computer will inform you that you've damaged a component and everything must be re-tested. *Everything*.)

(continued on page 134)


Michael F. Flynn
ASHES
The proverb says you can't take it with you—but sometimes you can't get away from it!
ORIGINATION
2064 AD
WHERE ARE YOU GOING?
ENTER DESTINATION
5000 BC
Bob Eggleton

If I had known who he was when he first appeared, I would have killed him.

No, that's an exaggeration. But I certainly would have had him driven from the tribe. Exile would have been fit punishment for disturbing my own exile.

Ah, hindsight. What wonders we can work in the past imperfect tense. Later, I came to like him; and that would have made killing him difficult. He was the only one beside Hawk-flying-high who enjoyed drinking the kumiss with me.

His name was Carver-of-stones, which was good because that was his trade as well. He had a lame leg that kept him from hunting, so he never gained the women or status that hunters enjoyed. Instead, he turned his talents to stoneworking. He wandered from tribe to tribe, with his hand axe and knapper, trading his skills for a share of the hunt. A roving tinker, maybe the first of his kind. One day, he roved into my life and tinkered with it.

It was just evening and we had lit our fires when he first appeared in the circle of flickering light. The virgin who kept the flame circled past him, shielding the brand with her body. We sat there, watching him: Hawk-flying-high, the mighty Chalcolithic hunter and the one on whom the gods smiled; and myself, an exile from a world that was millennia unborn.

He stood hesitantly, with the flames shining off his thin chest. His eyes were shadows beside his bladelike nose. We waited for him to introduce himself, as courtesy demanded.

"I am called Carver-of-stones," he said at last, hunkering down by the fire. He used the language of the River People, since in every tribe someone would know it. Hawk knew it; so did I.

Hawk grunted, seeming to pay no attention; but I knew he missed nothing. He had observed the calluses, the goatskin toolbag. Even the dust on Carver's feet told a story of which trails he had walked. On such minutiae the survival of our little hunting band often depended.

"I am the Hawk-flying-high," he said, giving his public name. "This one," he pointed at me, "is called Coming-from-dawn."

I was a little drunk, my usual state. Kumiss does that to me. I took another long drink from the goatskin bag, trying not to remember how the drink was made. "I would rather be called Ali," I said, passing the skin on to Hawk. Ali Mustapha Shapur was my real name; at least, it was the one my parents had given me.

Hawk frowned and looked uncomfortable. Giving away one's secret name was Not Done, and it bothered him that no magical ill had yet struck me though I disregarded the taboo. I didn't care. I didn't bring much with me when I came here, but my name was one thing I meant to keep.

I was born (I will have been born?) in these same Zagros Mountains where Hawk and his band hunted the aurochs and the wild pig, but on a day thousands of years hence, when the very memory of Hawk and his people was long dust. The wooded hills would be barren; the game, vanished.

It was (would be) an age of ashes, a world without hope. Science and technology had gutted the planet and polluted its air and water. Species were

driven to extinction. There was famine in Africa. Yet, rather than spend the money on down-to-earth, human problems, the technocrats babbled mad dreams: flying to the asteroids, building gargantuan power satellites.

Or, as you may have guessed, building time machines.

What the world needed was less technology, not more: but I saw no way of stopping it. The world was headed toward ecotastrophe and I wanted off. So I stole the world's only working time machine and fled to a world where technology was not even a dream.

A long, long way back. There were no nuclear power plants; no strip mines; no superhighways. There was not even gun powder, or catapults, or copper smelting. Nothing. There were Egyptians somewhere beyond the horizon, but they hadn't invented pharaohs yet. The River Valley people lived in big, adobe villages that weren't quite city-states. In the mountains, we were still playing with rocks.

That suited me. There is no saint with half the zeal of a reformed sinner. I had been a scientist myself, but I wanted no part of it now.

I'd had no illusions about what I was getting into. Primitive peoples live closer to nature, but it is not a comfortable life. Yet, it was not so harsh as you might think. We hunted one or two days a week, but the rest of the time was our own. We mended clothing, chipped spearheads, fancied up our huts, or we did nothing if we felt like it. It is the farmer who is enslaved, tied to the soil and to back-breaking daily labor, a mind-dulling sunup to sundown routine. Enslaved by "labor-saving" technology.

There is only one snake in our Eden. Hawk-flying-high is blessed by the gods. He has an altar-stone on which he sacrifices to them: a great, blue rock. When he burns his holocaust, the gods reward him with copper nuggets in the ashes. He makes bangles and ornaments with them. Everyone is suitably awed by this display of divine beneficence.

When I see those nuggets, I see the bronze-clad warriors of Hellas tearing down the walls of Troy. The first step on the path to ecotastrophe. So, when Hawk sacrifices, I pray my own silent prayers. The gods give him copper and I keep my mouth shut.

Carver explained his proposal to us. For a share of the meat, he would make enough spearheads, bowls, and other stone utensils for the entire band. Hawk pretended to think this over, but I knew he was really thinking of how often he mashed his own fingers in stonework. "Agreed," he said at last. Carver grinned shyly and joined us. I paid him little attention at the time. Just another smelly savage to delight my declining years.

It was some months after that I came on Carver sitting by the edge of a dry gully, dangling his good leg over the edge, and tossing pebbles. They made small tapping noises when they struck. Carver's head was cocked in thought. The sun was very hot that day, and I had a skin of spring water with me. Sitting down by him, I offered him some.

He took a long swallow and passed it back to me, wiping his mouth with

his hand. The dirt and water left a streak across his face.

"Ali," he said, tossing another stone. I heard it rattle downward. "Hawk brought me a double handful of the copper metal to make into ornaments for his women. I have never seen so much copper."

I took my time with my drink, thinking about the question he had not asked. "The gods love the Hawk," I told him.

"The gods love all men, yet they do not send everyone copper."

I shrugged. "Hawk has been Chosen."

Carver pursed his lips. "How did it come to pass?"

I told him the story Hawk had told me. One day, while hunting, Hawk had been cornered on a ledge by a big cat. There was no escape possible, so Hawk held his spear steady and sang his death-song to show he was not afraid. That was a lie; he was scared silly. But who was to know but he and the cat?

Then the ledge gave way, carrying the cat with it. Hawk held on to a bush. When he had climbed down, he found the animal crushed under a blue boulder.

In gratitude for his deliverance, Hawk burned the cat on that same stone; and the gods rewarded his piety with copper nuggets that appeared in the ashes of the fire.

Carver nodded thoughtfully for a few moments. "Do any others sacrifice on Hawk's altar?"

"No," I replied and offered him more water, which he drank absently. "No. Hawk allows any of us to attend him, and he will pray to the gods for us, but he alone burns the sacrifice."

With a little more sophistication, Hawk could become a real priest, just like the ones in the river valley. I wouldn't like that.

Carver ceased his casting, thinking over what I had told him. The sun was high and the ground seemed bleached almost to whiteness. I thought about seeking the shade of the forest. Somewhere downslope an aurochs bellowed a complaint.

Carver selected a large stone and rose, clutching his tool bag. He muttered something indistinct in farewell and limped off.

When next Hawk sacrificed, Carver was there.

The Hawk was troubled.

It had been long after sunset before he and the other hunters returned to the camp. Never before had they stayed away so long, or come back with so little. Carver was sitting by the fire, tapping on a stone. He would tap it, turn it just a bit, tap it again, and so on. It was a monotonous, soothing sound. Between it and the kumiss I was beginning to doze, despite my concern for Hawk and the other men.

Carver noticed them first. The break in his rhythm drew my attention. I saw Hawk hand the women the carcass of a gazelle and a few rabbits and quail. Then he came and sat beside me. He took hold of the kumiss-skin and pulled it from me. I said nothing. Carver blinked owlishly, glanced from Hawk to the meat, which the women were already preparing, then resumed his stonework. Tap. Tap-tap. I knew he was listening. His kind always does.

"We hunted," Hawk announced. "From when the sun broached the sky

until it was this high." He pointed to high noon. "We saw few sign, and no game. We saw the tracks of other hunters not ourselves." He scratched his chest. "There is no game."

Old Gray Man opened his eyes at that. He was the elder of the band. A codger almost forty years old. He spent his days dreaming, and his nights as well. Of all of us, he had the most to fear from a meagre catch. Being old and useless, he would be denied food first.

"This has happened before," he said. There was nothing that could befall the band that Old Gray Man would not declare had happened before.

Hawk grunted. He looked at the fire, not at the elder. "I suppose that now you will tell us of the Hairy Long-Nose."

Old Gray Man shook his head animatedly. "There was prey worth stalking! A single kill would feed the band for moons before it rotted; and our ancestors would slay many handfuls of handfuls at one time." He smirked at us. "My father showed me the bones."

Hawk didn't believe him. No one did, except me. During the Ice Age their ancestors had hunted the mammoth by stampeding whole herds off the sides of cliffs. That had been as far in our past as my birth was in our future; but I was sure that somewhere there were bone-piles still to be seen.

The mammoth had disappeared with the glaciers; but I was struck by a new and disturbing thought. Had they been helped along the path to extinction by the two-legged hunters? But these folks lived in harmony with nature, taking only what they needed.

Or taking only what they could catch?

"We shall need to move to happier hunting grounds," announced Old Gray Man, pleased with himself that others were paying him attention.

"Perhaps," Hawk grudged.

"It was done before, in my manhood; and many times before that. It is the will of the gods that the People travel the land. That is why they have taken the game from us."

"Perhaps not."

We all looked at Carver-of-stones. Old Gray Man was offended. Hawk seemed curious. "What do you say, stone carver?"

Carver paused and looked off into the distance. "The game is wily," he said. "It knows when it is hunted, and seeks to flee."

"That is true," said the Old Man. "Our ancestors once drew pictures, to fool the game and draw it to them." His tone implied that the People had been fools to give that up.

"Drew pictures. Yes." Carver seemed struck by a new thought.

Hawk snorted. "I will believe your tales of the picture-magic when I see such pictures. Who has seen them? Have you?"

Old Man looked uncomfortable. "No," he admitted, but I was told—"

"In your youth, by another Old Man." Hawk laughed. "Old Men's tales, I say."

The others around the fire chuckled. The poor hunt had dampened their spirits. They needed to laugh at something.

Old Man framed a retort, but before he could speak Carver continued. "When many men hunt across the same grounds for a long time, the game will simply go elsewhere."

Hawk looked at Carver with a new respect. "That sounds like a true thing. When the People are new to a place, the game is not wary; but soon they learn our ways."

"As we do theirs." Carver smiled shyly, unsure of his new acceptance by the hunters.

Hawk shrugged. "Then Old Man is correct. If the game goes elsewhere, so must we."

"But where? You say you saw the tracks of other hunters not of your . . . of the People. If we move, we will only move into the hunting grounds of others. There will be trouble."

"Let there be. The People must eat."

"If the game goes elsewhere, so must we. *If* the game goes elsewhere—" He paused significantly. "What if the game were kept from going elsewhere?"

Hawk scowled. "How?"

One of the other hunters spoke up. "If we could catch them alive, we could put them in a circle of bramble-wood so they could not escape."

"Then," spoke another hunter, "we may butcher and eat the males, all but one. We can keep the females and one male to breed more. The game cannot flee because we will keep them here." The man looked so proud, you would think it had been his idea, not Carver's. I looked at Carver, but he was quietly chipping away at his stone, only paying half a mind to our talk.

I decided to put in my own thoughts.

"That many goats or pigs in one place will draw other hunters. Not men, but lions and wolves."

"Let them come. Hunters are brave men. We will kill them." That was Wolf-killer. His first son had been taken by wolves and he had sworn an oath to the Goddess that he would kill all the wolves in the world.

"But how will we capture the game?"

"Ropes," said one man.

"Form a line of beaters and drive them into the box canyon," said another.

"Dig pits and cover them," said a third.

Hawk nodded as each man spoke, remembering each idea and who had put it forth.

"This is a new thing," said Old Man. "Not to be trusted. No new thing will work as well as old things. The old ways are proven."

Carver laughed. It was a deep, heartfelt laugh. He looked at Old Man. "That is not true," he said. He spoke with great assurance, not his usual diffidence. "See how I make points! It is a new way that I learned many summers ago from another stone carver." He looked around and found a large rock nearby. "This is how I once made points." He struck the rock a hard blow with a hammer rock, one that was rounded to fit his hand. A dozen or so flakes chipped off. Hawk and the others nodded. That was how they had always done it. Carver picked up the chips.

"I count a double handful of flakes," he said. "But only one of them holds the promise of a useful blade." He held it up for us to see. "The others are too small, or broken, or shaped crookedly." He cast them away and they rattled in the bushes and rocks around us. Some animal, frightened, bolted away. "I lose nine parts in ten of the stone."

Carver was a technical man talking about his technique. He was animated,

his eyes were glazed. He could not imagine that another person was not equally fascinated.

Hawk looked at me and I at him. For the sake of his idea about capturing game, we would listen politely while he spoke.

"Now, this is the new way which I have learned." He held up the stone he had been working on. "First I search for a rock of good quality, one that I know from experience will flake well. Then I shape it until it is round, but flat on the top and bottom; about so big." What he showed us was a stone the size and shape of a can of peas. "I call this my core stone. Using the flat top to work from, I take a punch made from the antler of a gazelle and I strike it . . . so!" A sharp rap with the hammerstone and a flake fell from the core. He picked it up and showed it to us. We passed it around from hand to hand. It was a long, thin sliver. It would make a good knife blade, once it was shaped.

"I work around and around the core in that way. The scars where one row of flakes have been struck become the backs of the next row." He struck and turned, struck and turned. Flakes fell in rapid succession. He gathered them up. "All of them will be useful," he said. "Some for knives. Some for spearheads."

Hawk nodded. "That is good," he said. Anyone could see the benefit of more points for less work. "I have heard much tonight that I must think on."

Carver blushed, pleased with the compliment from a hunter. There was a touch of something else, though. Guilt, I thought. Carver was playing another game. One I hadn't seen yet.

I looked at him and recognized him for the first time.

He was an engineer.

One of that breed I had come so far to forget. Just now, he was an industrial engineer, describing scrap reduction through methods improvement. In stone knapping. High tech in the late stone age. I decided to watch him much more closely in the future.

It did not take me long to discover that, when the hunters left our camp, so did Carver. His method of knapping allowed him to make all the points we needed in a very short time. That left him at loose ends much of the time. Questioning the women, I found that he left the village and wandered in the forest.

I was a poor hunter. The People tolerated me for my dreams. When I drink the kumiss, when I am drunk, I babble strange things in strange tongues. Madness is prized among primitive people. So, Hawk did not object when I would leave the others and go off on my own.

I tried following Carver. I would circle around and watch our camp from the hillside. When Carver left, I would trail after him only to lose him in the leafy trees.

Soon, he became aware that someone was following him and took care to hide his trail. He began to take different routes coming and going. Once, he hid behind a great tree to surprise his tracker and I only just realized his ruse in time. It was a fine sport for many moons, and I was beginning to enjoy the pursuit for its own sake; but patience and persistence finally paid off.

It was in mid-winter, during the dry

season, when I came upon Carver in his secret retreat.

He had a cache. He had dug a pit in the earth and lined it and had fitted the sod back in place. Now, he had it opened and was bent intently over the stone tablets he had kept there. I watched from the shadows of the forest as he carved patiently on one: small, exquisite pictures of animals and the moon and other things.

They marched back and forth across the stone tablets in implacable rows. I felt something hollow in my stomach.

Carver finished. He picked up the tablet in both hands and stared at it intently. After a while, he put it down again.

"If you wish," he said, "you can come closer, so you can see better." He kept his back to me as he spoke.

I did not move. Surprise had frozen me.

Carver turned. "It is you, Ali, isn't it? Yes. I see you now. Why are you hiding?"

I stepped forth and scowled at him. "What are you doing here?" I asked. It was none of my business. People could do as they wished, except on the hunt.

"You are a strange one, Ali," he said. "Fey. I have heard you talking in your sleep. Strange words. Are you a witch?"

"No."

"I did not think so. Witches are more talked of than seen. You attend Hawk's sacrifice. Do you believe in what he does? In the miracle of the copper?"

"I believe," I answered carefully, "in the evidence of my eyes.

Carver smiled. "An answer that is no answer. What do your eyes tell you when you are drunk? Once you thought you saw a demon named 'Mohsen.' I remember. All of us were very impressed with the magic."

I did not answer.

"Ah, but the copper is there. None can deny it. Before the sacrifice, nothing; afterwards, copper. Do the gods give Hawk copper? Why? Hawk is a good man, but there are others in the tribe who are as good. Why should the gods single Hawk out from the many?"

"Who knows the ways of the gods," I countered.

"I thought on it for a long while," he continued as if I had not spoken. "Perhaps the copper did not come from the gods, but from something in this world. Perhaps the spirit of the sacrificial animal, or the phases of the moon."

He pointed to the stones. "Each time Hawk burned an offering, I watched. I noticed what the conditions were: what animal, whether whole or only portions, and which portions. The phase of the Moon Goddess. What weather the gods had sent that day . . . " He made the secret sign to Enlil, God of Storms. I pretended not to recognize it. " . . . other things. Soon, it was too much to remember, so I came here and made little drawings to remind me. It was Old Gray Man's stories of the paintings that gave me the idea."

I looked at his tablets more closely. I saw that the signs were enclosed in boxes and guessed that each box was one sacrifice.

"It was not long before I saw that the appearance of the copper did not depend on the moon or the stars or even the

occurrence of The Storm . . . '' Again, he made the sign to Enlil. ''I questioned the others and none could recall a time when Hawk had failed to find copper in the ashes. Now there is one thing I must try.''

I had been growing steadily more disturbed by this display of Chalcolithic scientific method. Here was everything I had fled, taking root and growing. It was too late to kill him, though; he had become my friend. But I didn't have to like what he was doing, and I didn't. He would get no help from me.

Still, it touched a strange and (I had thought) long deadened chord in me to realize that at least one person in history had invented writing to make it easier to keep lab records.

Eventually, Carver's last statement filtered through to my mind. ''Of course,'' I said. ''You have finished making observations. Now you must experiment.''

Carver frowned. ''You use strange words. A blessing? Or a curse?''

''Neither,'' I assured him. ''Unless the curse is on me.''

''Only four things have remained constant. The power I seek must lie in one of those four things.'' He stopped and frowned. ''Or in a combination of them. Hawk has built many fires, but finds copper only at sunset on the blue rock. The sun has set many times on the blue rock, but nothing happens unless Hawk has built a fire.'' He scowled harder and counted on his fingers, his lips moving carefully. ''There are a double-handful-plus-one ways in which these four things can combine. But I do not need to think of all of them. Tomorrow, when the tribe is hunting, I will set a fire on the blue rock. If the gods send copper, then I will know the power lies in the combination of the fire and the rock. If not, I will try again using an animal as sacrifice.''

Of course. What Carver proposed doing was as close to a blocked fractional factorial experimental design as a stone age savage could be expected to come.

''If the Hawk catches you,'' I said curtly, ''he will kill you.''

Carver blinked, as if the thought were a new one. ''Yes. I suppose he will.''

How I hated him for his calmness. The history of science is choked with such foolish bravery. They would have lynched Pasteur had they caught him playing with rabies. Galileo muttered ''It still moves,'' even in the teeth of his enemies. The urge to discover, to know things . . . Why had I ever supposed it to be a modern disease?

I stayed behind in the camp the next day, while the others went out to hunt. The women left also, walking with their baskets past the new pens of cleverly woven thornbush where we kept the few goats we had captured. I heard them chattering about seeds as they walked past. Save the seeds, one said, and put them in the ground and not leave the sowing to chance. Then the harvest will be a known thing and they would not need to hunt and pluck the land bare. One of the other women made thrusting motions with her hips and said she never left the planting of seed to chance. They all laughed. One of them turned her head and looked at me. I paid her no mind. I was drinking kumiss.

Thus do ideas spread. Like a conta-

gious disease. Someone asks, "Why not?" And soon everyone is asking it. I could have told them why not, but they would not have understood.

Destroy the ecological balance? Endangered species? The words would mean nothing; the concepts, less. They had routinely overhunted their lands, upsetting the balance; and had already driven hundreds of species into extinction. Ecological concern was an invention of technological society.

Overpopulation? The world was now more crowded than it would be in my own day. Stone age hunters needed ten or a hundred times the land area per person as technological folk. As thinly spread as they were, hunters were already beginning to criss-cross each other's paths. Conflict would come as different bands began reaching for the same resources.

"And then," I said aloud, though there was no one to hear me, "you will take up your weapons and hunt new game: other men, who are not The People." I threw the empty goatskin bag in the direction that Hawk and the hunters had taken. "And you will go—" I turned to face the path down which lay Hawk's malachite altar stone, where the sacreligious Carver was already at work. "You will go with fine bronze weapons, made from the copper you melt out of the blue rocks."

A thin plume of smoke drifted upward through the distant trees. Carver's experiment had begun. I cried out. "Allah il allah! Mohamet resoul allah! It is God's will. Kismet."

I slumped down on my haunches, staring at the dust. A shadow fell across my sight and I looked up. Hawk-flying-high. Beard of the Prophet!

"Running-like-deer has fallen," he said without preamble, his eyes searching the cluster of hovels we were pleased to call home. "He has smashed his spear. The shaft is broken. The point is broken. Where is Carver-of-stones?"

I do not know, I swear I do not know what it was that Hawk saw in my face just then. But some arcane sixth sense triggered an alarm in his head. I said nothing, but Hawk turned and saw the smoke rising above his altar. He roared and ran off.

Poor Carver, I thought as I watched the Hawk run, his great stone axe swinging in his fist. He brings it on his own head with his meddling. The world is better off without his kind.

But, unaccountably, I was running, too.

Coming to the clearing at the bottom of the cliff, I saw a tableau.

Carver, sifting through a pile of ashes on the altar-stone, his back to:

Hawk, who had his axe cocked and ready to throw, not seeing:

Me, Ali, who yelled, "Hawk! Stop!" just as he threw.

Carver-of-stones heard my yell and turned in surprise, putting his weight onto his bad leg. It twisted from under him and he went down just as Hawk's axe would have smashed his skull.

Hawk had not waited but had thrown himself after the axe. Nor had I waited. My yell had come between two running steps. I gave Hawk a shoulder block, low around the hip, and he went down, whipping his arm to catch me as he did.

He was stronger, but I was faster. As I twisted away from him I saw Carver

rising to drop a rock on Hawk's prostrate form.

"No, Carver, don't!" I said, extending the blade of my obsidian knife toward his belly in the style I had learned in the streets of Baghdad.

Carver looked blankly at the rock, then at Hawk. He threw it from him and it crashed into the bushes of the forest.

"Now," I said. "The two of you will not fight. You are both my friends. People who like kumiss are hard to find. I would not see either of you slain, especially not by the other. So, if you wish to fight, you must first fight me."

"A proud boast," said Hawk from the ground. "It would not take much of my strength."

"Perhaps not; but I have said it."

Hawk raised himself to his elbows. "I wish to know why your *friend* has profaned my altar." His face had such a look of injured betrayal on it that I had to look away. I saw Carver. He looked ashamed. He shook his hand as if he had dice in them. Then he tossed a handful of copper nuggets to Hawk who, still horizontal, caught them in one huge hand. He looked at them, then at me, puzzled.

I surrendered. "It is the stone," I said. "The blue rock." I waved upward at the exposed seam where the ledge had fallen. "There is copper in it. The fire brings it out. No god. No sacrifice. Just the rocks and the fire."

"But who," asked Hawk truculently, "put the copper in the rock, if not a god?"

"Wisely said, Hawk!" That was Carver. "The gods put the copper there and then led you to it, so you could give it to the People. It was they who guided you here on the hunt; they who sent the rock to smash the lion; they who inspired you to burn your kill on the rock. Look at the cliff! There is enough copper there for all of us to have bangles and ornaments and bowls and spearheads. They will call you Copper-giver!"

Carver was not a proud man. He cared only for the discovery itself, the finding out of new things. Others could take the credit.

I saw the struggle in Hawk's face; but he *was* a proud man. Too proud to take another man's deed. He rose and brushed unsuccessfully at the dirt. "No," he said, with a tinge of disappointment. "The name is yours."

I relaxed and my knife disappeared to its hiding place.

Hawk looked back toward the camp. "We must tell the People." I wondered what he was feeling. I remained in the background as he walked heavily down the trail. Carver took three steps after him then stopped.

"Hawk was an important man," I said, after the other's form had vanished. "Now you have made him look like a fool. Oh, he will adjust. Maybe, after a time, he will be happy again."

Carver turned and looked at me. "I liked him."

I laughed sourly. "Of course. So you hurt him. I don't know if he will ever like you again."

"But, I had to *know!*"

"Did you? I suppose you did. You are driven. Hawk is not. His world is simple and, in it, he is wise. You, you have a demon whispering in your ear, do you not?"

Carver nodded dumbly.

"So do I. I had thought I had slain

him; but I hadn't. He is still there, whispering questions, telling me to *solve* problems, not flee them.''

I sighed. ''Find the white metal, Carver. Mix it with the copper. Melt them together. Listen to the demon that is whispering in your ear. And remember, the bangles and the bowls and the art are worth a few swords and spears. Be gone—'' I waved him away. It was a dismissal. ''Go back to the camp. I have some friends to mourn for.''

So, I sat in the dust and ashes to bury my rash younger self, while Carver-of-stones limped down the trail, his head cocked in thought, planning his first forge. ■

ON GAMING

(Continued from page 122)

Once you get your SRU unit all checked out, and you know how to operate the Hydraulic Motivator, the computer will display a map of the world, criss-crossed with subterranean tunnels. There's also a list of three-letter codes that, if you start hacking at your keyboard, will reveal their function. (No secrets revealed here, friends.)

Finally, in an act of computer largesse, a message appears telling you to recover pieces of a secret document by bartering with an international chain of spies—all of whom speak their native tongue only. It can be lots of fun negotiating in Arabic, offering a Swiss chalet for who-knows-what. At least in Paris I was able to make some sense of the deals.

It could be a relatively easy matter to scour around in your Subterranean Robotic Unit, snatching up the pieces, except for the fact that your unauthorized presence is discovered. Two satellites then begin searching for your unit. They soon find you, and ask you a security question which, if you answer correctly, they let you proceed. For a while. The questions grow increasingly difficult until the satellites ask the biggie, the one that got you started ''hacking'' in the first place.

LOGON, PLEASE?

Answer that one, and you win the game.

Hacker is not without its frustrating moments. As you successfully acquire pieces of the secret document, they appear on the screen. But if the spy satellites catch you they terminate your connection and it's good-bye to all your hard-earned pieces. You see, there is no save procedure in *Hacker*. (You are, after all, illegally using the Magma's computer network.)

The only solution I've found to this problem is taking a picture of the document pieces so that, eventually, I'll be able to give the right answer to Logon.

The repetitiveness of the game can also get a bit wearying. Whenever you reload *Hacker*, you'll have to run through a complete test procedure on your SRU, a procedure that's quite entertaining the first time, but grows tedious with replay. But there's no way to avoid it.

At least, I don't think so.

Hacker is, nonetheless, a refreshingly delightful computer game. It's a game you really play with, a grownup toy that always has another surprise up its sleeve. It is worlds removed from most computer games and, if we're all very lucky, it's an early arrival from the next generation of computer games. ■

Jay Kay Klein's biolog

That Michael Francis Flynn has ancesters named Lynch, McGovern, and Dolan shouldn't automatically make one assume he is a fey, blarney-spouting son of the old sod. After all, with a family living for 120 years in Pennsylvania Dutch territory, he also has relatives named Zängele and Ochsenfuss. Still, Mike's light touch on otherwise heavy-handed procedures seems more associated with ends-of-rainbows than *schmutz amschels*.

Born in Easton, PA, he spent eight years attending universities in Philadelphia, Milwaukee, and Boulder, CO, receiving a BA in mathemaics from La Salle College and an MS for work in topology from Marquette University. Statistics and quality engineering studies came on the job.

For eleven years in the Denver area, he was an industrial quality engineer and statistician attempting to apply scientific method in the face of what can only described as a belief in Black Magic by members of other disciplines, including those supposedly educated in rationality: chemists, metallurgists, and engineers. For the last two years he has been a senior management consultant with the Stat-A-Matrix Group. Here, along with indoctrination courses in sheer rationality as applied to trouble-shooting and problem-solving, Mike has been applying Deming, Juran, and associated Japanese techniques to quality improvements for corporate clients.

His first story ever was "Slan Libh" in the Novermber 1984 *Analog*. Aside from "Eifelheim" in this issue, several more are in view, including an historical novel set in Medieval Ireland. Mike grew up on Heinlein, Asimov, Norton, and other SF writers. The first library book he checked out was *Space Captives of the Golden Men*. He started writing at ten and a high-point in his pile of rejection slips was one three pages long from former *Analog* editor John W. Campbell.

For Mike, a story will start with either a scene flashing into his mind or a character coming into view. After that, he wants to find out what went on before, what happens afterwards, and what sort of interesting things that character will do. Plots and characters always take off in unexpected directions.

Some dragons needing slaying are the preconceived stereotypes and notions most people operate by. He finds the *New York Times* as much in a mental strait-jacket as the *National Enquirer*. Particularly deplorable are depictions of scientists as brilliant but narrow. Mike found science students always versed in history, literature, and other "humanities," many playing instruments and taking part in dramatics. The humanities majors were *never* so broad, and were virtually illiterate in technology. Worst of all, perhaps, are the "do-gooders" whose short-sightedness, self-imposed limitations of knowledge and outlook, and arrogance of spirit really wreck things for the rest of us. ■

Michael F. Flynn

The
Alternate View

THE CYBERNETIC WEATHER CROCK

G. Harry Stine

In the days B.S. (Before *Sputnik*), weather forecasting was so primitive and yet so important to the propeller-driven aircraft which mostly flew at 25,000 feet and below—mostly below—that even the vaunted airline pilots had to contend with it. (Today, they climb to Flight Level 370 and, except for some thin cirrus and occasional clear air turbulence, don't pay too much attention to the weather until it really gets *bad*. The common joke was that every office of what was then the United States Department of Commerce Weather Bureau had a vital piece of equipment: a large earthenware crock from which the meteorologist pulled the next weather forecast. All the other scientific equipment was for show and not for blow. . . .

Today, the weather crock has been replaced by the computer, and the local "Weather Bureau" is now known as the forecasting office of the National Weather Service (NWS) of the National Oceanic and Atmospheric Administration (NOAA).

And they're using the computers to make very good guesses (forecasts) about the weather as far as 120 hours in advance.

The main NWS computer forecasting center is located at Suitland, Maryland, where data constantly streams in from surface observations, satellite imagery, automated surface observation equipment (AWOS and AMOS), radiosonde balloons ("raobs"), ships at sea, and radioed reports from pilots ("pireps"). NWS uses four computer models of the atmosphere. The reason there are four is that the Earth's atmosphere is complex, and the interactions of all the variables are not well understood. The four models are called the Spectral, the Limited Fine Mesh (LFM), the Nested Grid Model (NGM), and the Medium Range Forecast (MRF or "murph"). Each is different and each forecasts a different future.

The Spectral model uses digitized inputs from infrared and water vapor satellite sensors and covers the entire northern hemisphere.

The LFM uses part of the Spectral data to look back and update itself, but its program cuts off in the eastern Pacific and is therefore often less precise.

The MRF and NGM models are purely mathematical in nature, relying mostly on data from hourly surface reports and raobs.

All models can provide forecast charts at several levels in the atmosphere, but most forecasters prefer to use the 500-millibar level (about 18,000 feet, where half the atmosphere lies below).

But the nation's weather forecasting isn't carried out by computer from Suitland, Maryland. Four "prog" charts developed from the computer models are generated twice daily at Suitland and transmitted to all NWS offices along with more commonplace data as surface

and upper air charts, winds aloft charts, radar weather depictions, and hourly GOES-W satellite raw and computer-enhanced visual and infrared images. Regional and local geography and topography have such powerful effects on weather that the actual NWS weather forecasts are assembled by meteorologists who have experience in how the local weather behaves in comparison to what the computer-generated charts forecast. Some of these forecast center locations are Boston, Los Angeles, Miami, Seattle, Salt Lake City, and Phoenix.

Weather forecasting is still very much a human guessing game. The forecasting room of any NWS facility looks like a computer center with satellite photos, charts, and "prog model" charts tacked or taped over nearly every available square inch of wall space. A Hollywood art director for an SF film couldn't dream up a set as fancy as what exists in reality. Four to eight forecasters are involved in a continuous study of the four Suitland computer forecast models as well as the incoming satellite, surface, and raob data. They sit before their computer consoles, replay loops of satellite and computer model data, chatter among themselves and by telephone to other forecasters elsewhere, and try to discern trends in what they see.

Every day at 12:30 P.M. local time, the lead forecaster gives a briefing to all available forecasters, observers, and interested insiders. If you want to spend a fascinating 30 minutes or so, call your local NWS office and ask to attend one of these. As many as 15 to 20 people may be present not only from the facility staff but also from industrial, sporting, and agricultural interests in the region. Smaller and less formal briefings go on between forecasters when shifts change three times each day, but the Noon Balloon is the big one.

The forecasters make the best possible educated guesses based on the available data plus their own "feel" for the regional weather. A mountain range such as the Sierra Nevada or the Rockies can have a strong influence on what really happens. Even a ridge of high ground such as the Palmer Divide between Denver and Colorado Springs can mean that it will snow heavily in Denver while the Springs doesn't get a flake. The "lake-effect" is well understood in the snow belts along the southern shores of Lakes Erie and Ontario. A cold drizzle may be falling in Stamford, Connecticut near the leavening heat sink of the waters of the Long Island Sound while at Danbury only 25 miles north it can be snowing. The Appalachian Mountains had a well-deserved reputation as a weather nightmare in the early days of aviation. These are just a few examples of regional and local weather factors.

Finally, it's the lead forecaster's turn to generate a forecast on the basis of all the inputs. It's really a consensus. In spite of the computers, human experience and judgement rule the day.

The result is a state and/or regional 24-hour forecast, a 3- to 5-day extended forecast, and a "forecast explanation." These are typed into the NWS network. You can get them directly from the CompuServe on-line computer network by typing GO WEA at the action prompt. The state and extended forecasts and even the probability of precipitation

forecasts are in plain English and are easy to understand. But you may have trouble with some of the shorthand used in the forecast explanation which is intended mainly for other forecasters but is extremely useful to anyone who knows any meteorology.

Here's the translation of a typical forecast explanation that came of out Phoenix, Arizona on February 5, 1986 and indicates how the computer models are evaluated and how human judgement is worked into it:

"All prog models except the LFM show the next upstream short wave will be digging strongly southeastward into southern California and western Arizona during the next 48 hours. LFM has been forecasting too little development of weather systems recently, so we'll disregard it. The Spectral and NGM are very similar and in step with the Qualitative Precipitation Forecast and the Positive Vorticity Advection. We believe the NGM is a good substitute for the LFM. In spite of a strong deepening and development of a closed low aloft in northwest Arizona by Thursday morning, the NGM forecasts very little precipitation. Its precip forecast is confined to the northeast corner of the state during the third and fourth forecast periods and is less than a tenth of an inch. This seems too little, but it may be right since there is not going to be much of a baroclinic zone ahead of the new trough and since a fair amount of drying has taken place in the west and south. Precipitation will probably be showery and confined to the central mountains and the northeast plateau. We do not see any need for a winter storm watch at this time. A combination of wind, cold,

and snow showers might justify a traveler's advisory, but that would be for the second and third forecast period and can be issued later if needed. Satellite imagery indicates the development of a low off San Diego which does not show on any models, but is common this time of year and could turn into a major winter storm during the next 72 hours if the polar jet coming down the coast turns inland."

What really happened?

There was a showery period with some snow at the higher elevations in the western basin. But the low developed and was driven inland by the polar jet. Within 72 hours, a major winter storm dumped an inch of rain in southern California and two feet of snow in the southern Rockies. 120 hours later, the storm stretched from the Texas panhandle to Indianapolis.

It doesn't always work out this well, of course, and meteorologists still take a lot of static from users of their information—pilots, farmers, sports promoters, and others whose business is weather-dependent. In spite of constantly improving computer forecasting programs, weather forecasters still know that a larger percentage of a good forecast can be developed by simply looking out the window. And they are all too well aware of the statistic which points out that if they forecast for tomorrow the same weather as today, they will be correct 76% of the time.

It's the other 24% that concerns them.

So even though the imaginary weather crock has been replaced today by the computer, human experience and judgement are still the most important factors behind a weather forecast. For quite some time yet, you won't be able to curse a computer if the weather forecast is wrong, and the meteorologists won't be able to blame it on "computer error."

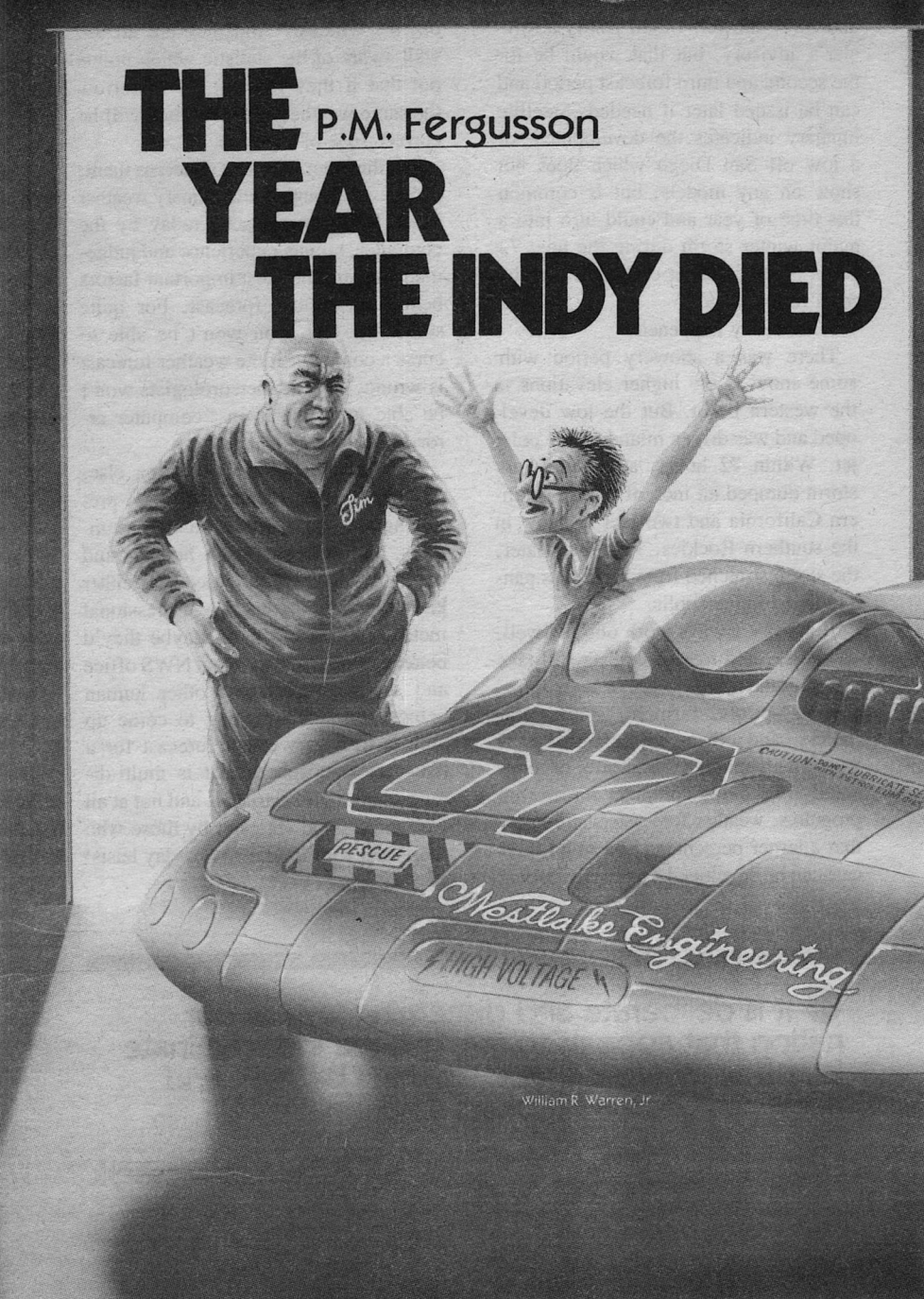
This should tell us something else, too. Maybe the scientists who are predicting nuclear winters, nuclear summers, carbon dioxide hot houses, and new volcanically-induced ice ages either know something that the professional meteorologists don't, or maybe they'd better go down to their local NWS office and see what problems other human beings must tackle trying to come up with a 72-hour weather forecast for a planetary atmosphere that is multi-dimensional, multi-variable, and not at all well understood yet even by those who must deal with it on a day by day basis! ■

● It is deliberate and discerning love of our nation that appeals to me, not the indiscriminate love that assumes that everything be right and righteous because it bears a national label.

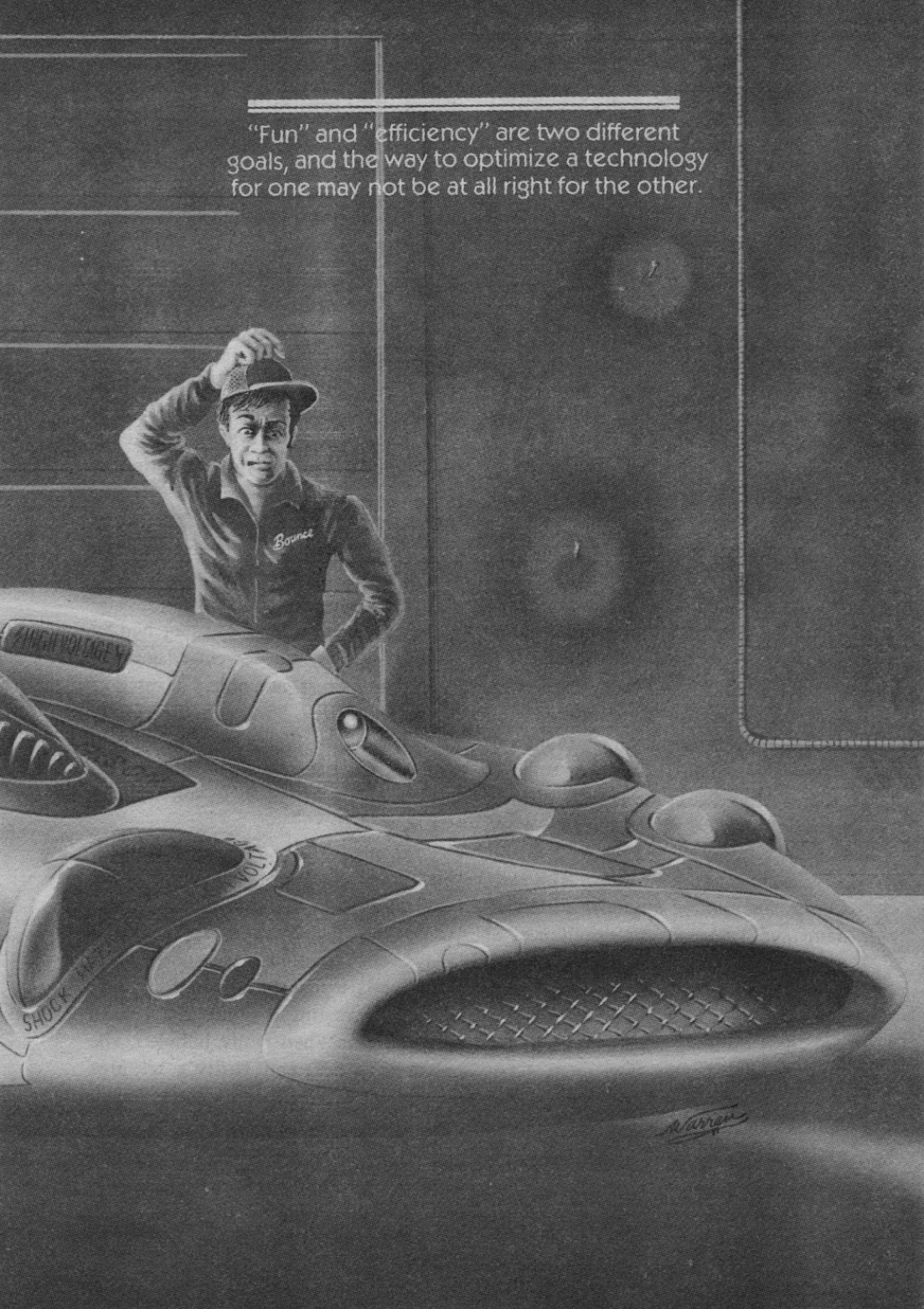
Thomas Masaryk

THE YEAR THE INDY DIED

P.M. Fergusson



William R. Warren, Jr.


"Fun" and "efficiency" are two different goals, and the way to optimize a technology for one may not be at all right for the other.
Bonnet
HIGH VOLTAGE

"Where's my old man, Bounce?" The voice was pitched in a harsh, grating, whine: the kind of voice that's irritating in children and an invitation to extermination in an adult. Considering that the speaker was twenty-three years old, and I'm not noted for patience, much less an even disposition, I think I did well to manage a civil reply instead of a back of the hand. Of course the fact that the speaker was also the boss's son, his pride and despair, helped some.

"He's in with one of the Unsers, Arnold," I replied, reluctantly laying down the torque wrench I'd been tightening a head bolt with. "They're negotiating for the new Indy cars. Anything I can do to help you?"

"He's wasting his time and theirs," Arnold whined, then raised a briefcase. "I got a new thing in here that will make whatever they're talking about obsolete."

Since I happen to be the chief engineer for Westlake Engineering, and what they were discussing was my design—over which I'd spent months of labor—Arnold's comment didn't noticeably improve my feelings toward him.

Who am I? Oh, sorry. Sean "Bounce" Carvil, automotive engineer extraordinaire and Irishman par excellence, at your service. The nickname of Bounce is a holdover from my college days when I worked as a peacemaker in several local drinking establishments. Patrons used to bet on how many times obnoxious customers would bounce after I pitched them through the front door—in extreme cases, without bothering to open it first.

I studied Arnold before I replied, trying to gauge if he was serious or not. With a kid who earned doctorates in half the physical sciences before he was old enough to vote, it's wise to listen—no matter how obnoxious he is, or how ridiculous his statement sounds. What I saw was a bundle of sticks draped with a mix of rumpled, out of date, Ivy League shirt and tacky plaid pants, which assemblage was being towed along by a nose and a pair of horn-rimmed glasses. Some people are tall and lanky, some tall and thin. Arnold would have made Ichabod Crane look like Mr. Moto. His watery blue eyes peered antagonistically over the rims of his glasses; glasses which always seemed to be threatening to fall off his face if they could only find a way over the hump in the middle of Arnold's beak. The eyes looked serious.

My incipient reply was squelched by Holly Angeles, our secretary, accountant, receptionist, and object of my not-so-secret desires. "Hi, Arnold," Holly said in a voice that made me want to splatter the twerp with a breaker-bar, "Your dad's free now if you want to see him."

"Thanks, Holly," Arnold replied, his voice's inborn nasal rasp echoing and buzzing in the caverns of his sinuses. "I got a real winner for him. It may even revolutionize transportation."

"That's wonderful, Arnold," Holly bubbled, creating a minor riot behind my retinas. When Holly bubbled, she also wiggled—and Holly's wiggles would have been the star attraction in any show in Vegas.

Arnold ratcheted and articulated toward the door of his father's office—the way Arnold was put together, normal

walking would have constituted a minor miracle. At the door he paused and peered in my direction. "Don't go to lunch or anything, Bounce. We may need you."

I managed to nod and held the "Arrrgh!" at subvocal levels until the door closed behind him.

"Really, Sean," Holly commented in a frustratingly calm voice, "I cannot understand why you don't like Arnold. He's really a very nice boy."

The view I was getting as she leaned over to examine the engine I had been working on stifled any bright repartee I might have put together.

"Isn't that turbocharger mounting ring on upside down?" she suddenly asked.

I tore my gaze away from the view long enough to verify what she'd been looking at. The damned thing *was* on upside down. Arnold does that to me. I managed to nod, suppressing another inarticulate expression of anguish.

"I thought so," the delight of my eyes said and straightened up, creating a chain reaction of bounces and ripples that threatened to give me herniated eyeballs trying to watch. "You better fix it before you try to mount the turbocharger." She gave me an amused smile and rotated her way back to her own office.

And people wonder why engineers drink and have nervous breakdowns.

Half an hour later Jim Westlake called from his office, "Hey, Bounce, haul it in here and take a look at this thing Arnold's come up with."

I gave a sigh and final tug on the torque-wrench. As the torque indicator hit its preset mark, the bolt merrily snapped. The stream of profanity that surged out of my brain pulled up short on the down side of my tonsils. First, I reminded myself, cursing at the boss—or appearing to curse at the boss—is unwise with a man as big as Jim Westlake—he was the bull in the pasture where Arnold played scarecrow. Second, I decided, it's a damn sight better to have the unprintable sumbitch break inside the shop than at two hundred plus on a race course. I tapped the fractured bolt-head into my palm, laid the wrench down, and headed for the office.

"Boss," I told Westlake as I entered, "We need to find a new supplier for these things." I dropped the chunk of broken bolt onto his desk. "That's the fifth this month that hasn't met torque."

He gave the offending part a cursory glance and said, "Do it. But right now, I think you'd better take a look at this." He pointed at a . . . thing, sitting in the middle of his drafting table.

The thing was medium sized, about six inches square by two inches tall. It looked like a high-school science project gone wrong: a collectin of batteries, coils of wire, lumps, bumps, and plastic tubing topped by a short whip antenna. It was being hovered over by Arnold.

"OK. I'm looking," I said noncommittally. "What am I supposed to see?"

"The greatest advance in transportation since the wheel," Arnold stated modestly. "The magneto-gravitic engine—EMG engine, really, since it needs electrical power to run."

"Ohhh kay. I see it. What does it do that's so revolutionary?"

Jim Westlake gave out with one of his papa-bear snorts and chuckled. "That's what I asked. Watch."

Arnold touched a button on a control box he was holding, and a surprisingly loud hum came from the thing on the table. For a moment nothing happened except that the hum rose in pitch and disappeared in the direction of dog-spooking super-sonic. Then Arnold's thing moved. It rose about a sixteenth of an inch and hovered.

Arnold moved a lever on his box and the thing moved slowly to the edge of the table and stopped. Arnold played with the box some more, and the thing moved around the perimeter of the table, then came back to the center and stopped.

I was real impressed. I'd seen toy-store robots do more and I damn well knew they cost less. Arnold's tinkering tended to be expensive. Never use silver when you can substitute platinum, was his motto. Before I could put my foot in my mouth, Arnold explained, "I've given it its pattern. Now watch." He took a largish marble from his pocket and set it in a despression on the top of his invention. The assemblage dipped momentarily, then stabilized. "First at slow speed," Arnold twanged nasally.

The assemblage, marble perched insecurely on top, moved swiftly to the edge of the table and proceeded to track its previous course—a hell of a lot faster than it had the first time. I kept watching that ridiculous marble, waiting for it to go sailing off into where-ever. It didn't. It just sat stolidly atop the coils and bumps and plastic as Arnold's EMG engine swooped around the edge of the table.

"Now medium speed," Arnold said.

The EMG picked up speed, and I began to feel a definite breeze as it zipped around on its preset course. Still that damned aggie just sat there. What, I wondered, is keeping that rock-sucking marble in place. Maybe Arnold dipped it in quick-set glue.

"Now high speed," Arnold told us. He tapped the keys on his box again and the EMG thingy became a blur. Papers fluttered in the minor whirlwind its movement was creating, and the hiss of wind as it moved was audible. That thing *had* to be moving at least fifty miles per hour around the perimeter of a three-by-five-foot drafting table—with nothing keeping it there.

"Good enough, Arnold," Jim Westlake remarked over the rush of wind noise. He glanced at my bugged-out eyes and added, "I think Bounce has seen enough to get an idea of the potential."

Arnold nodded, and abruptly the EMG slowed and drifted sedately back to the center of the table.

I reached out a less than steady hand and on the second try picked the marble off the top of the thing. It *was* just sitting there. Somehow the damn thing slipped from my fingers and rolled across the table, making a final plunge into the heater vent before I could grab it.

Jim Westlake laughed. "That's two marbles I have to fish out of that rotten vent. I did the same thing, Bounce, so don't feel bad. Arnold's little invention is a bit unnerving."

"A *bit* unnerving, boss? What in God's name kept that marble in place against the g-loads it was taking?"

Arnold gave a deep sinus honk and grinned. "Nothing. It wasn't taking any g-loads except normal gravity. The EMG engine acts equally on anything in its field."

I managed to find a chair and sat down before I fell down. "Could you explain that—in terms a simple mechanical engineer can understand?"

"Sure. The engine coils track along the magneto-gravitic flux lines. Electric power from an external source accelerates it and maintains speed. Hysteresis slows it when you shut off the external power—it'll actually feed power back into the the electric source—as it decelerates. Its coils are directable, so that if you're making a turn at . . . say three-g, the EMG field acts to oppose that load and keep you on track. The g force of the turn and the field maintained by the EMG cancel."

"But," I choked out, "that means there's no limit to how fast, or how sharp you could turn that thing."

"Precisely," Arnold sniggered. "That's why I thought it might be applicable to a race car."

My first instinct was to blurt out "NO!" I could see a car screaming out number four turn at Indy at six hundred plus MPH—and having the EMG drive fail. The hole it would make in the wall, the fence, the stands—not to mention any spectators in the way as it disintegrated—would make any previous racing disaster look like a stubbed toe by comparison. My second instinct was to keep my mouth shut and listen. Jim Westlake was no fool. It was a sure bet he hadn't called me up here to look at the latest in anti-personnel weapons. I chewed on my lower lip and followed my second instinct.

Arnold assumed a pedantic pose and prepared to lecture. Jim Westlake squelched him gently by suggesting, "Just give us the basics and limitations, Arnold. We can work out the details later."

Arnold sulked briefly, polished his glasses, dumped them unceremoniously back on his beak—resmudging them in the process—and began pompously, "First of all, there *are* limitations to how fast the EMG can drive a vehicle. The greater the weight and speed, the more power required to drive the fields. The power required increases as a function of the squares of the mass and speed."

"Good old MV squared," I muttered.

"Wrong," Arnold gloated. "M squared, V squared divided by the gravitational factor. The equations are relativistic, not Newtonian. It a derivation of the fields that Einstein postulated but never had a chance to work on—and even he would have been surprised by some of the details. I decided that the theorists who support the gradient theory might be wrong—after all, what acts on the mass to create the tendency to move down the gradient? So, I developed this tensor—" Arnold grabbed a pencil and started scribbling funny little symbols on the back of the Unser contract.

"Arnold!" Westlake interrupted, grabbing the contract and an eraser. "Bounce and I are engineers, not theoretical physicists. Just tell us what the drive does."

Arnold gave and injured sniff and continued, "In practical terms, understandable by a non-physicist, a two thousand pound race car needs about a two hundred kilowatt generator to drive it at five hundred miles per hour in a straight line. When you add cornering

loads, the power requirements go up or the speed comes down."

"How far down?" I asked.

"Obviously, speed would drop in direct proportion to the radius of the corner," Arnold pedanticised.

I qualified my question by specifying the one track I hadn't been able to field a winner on. "Say at Indy."

"About three-fifty at the apex."

"Judas," I gasped out, "That is a hell of a lot of speed to scrub off in a damn short distance. I don't know of a set of brakes that would do it for more than ten or fifteen laps."

"No brakes involved," Arnold gloated. "The gravitic flux lines do the slowing when you get off the throttle or when you begin to turn. The system *has* to balance itself; it's just the way gravity works. You push one way, it pushes another. Of course the lighter the car, the faster it would go."

I nodded. I'd been wondering about weight. "You've already got a lot of poundage involved in your engine and generator, Arnold. A two hundred kilowatt unit isn't small, and the engine to drive it has to be about the same size as the ones we use now."

Jim Westlake nodded in support of my statement, adding, "I doubt if we could keep the weight under two thousand five hundred plus if you include fuel and driver.

"Not really." Arnold paused to give us a superior smile over the tops of his damned glasses. The little twit was gloating again. "Not if you use a fusion pile for power. Thermal conversion efficiency is enormously higher than mechanical."

That did it. Throwing a twenty-five hundred pound missile around a turn at three hundred plus MPH would be bad enough if anything broke, but to suggest doing it with an H-bomb was pure insanity. I know they say that the magnetic bottle used to contain the pile and its radiation is absolutely safe, unbreachable since the bottle is powered by the pile and all the controls are inside the bottle. And don't ask me to explain the principles of wave mechanics they use to get the power out of the bottle and the control signals in. If you're desperate to know, *you* go read up on the latest in pseudo-wave mechanics and n-dimensional tensors. When the math gets past three fine-print pages of abstractions, I start to babble incoherently and pick up a copy of *Playboy*. Anyway, "absolutely" and "unbreachable" are relative terms; they're a lot more positive in the vacuum of a public-relations man's head than they are in the mind of a nuts and bolts engineer —particularly when applied to vehicles moving at 600-plus MPH. It is a source of wonderment that I didn't get up and walk out in disgust; instead I asked with quiet menace, "Arnold, how many people are you going to kill if the EMG drive fails and lets that car go slamming into the wall?"

Arnold looked genuinely surprised. "Why nobody, Bounce. I thought I explained that. The system has to balance. Even if the unit shuts off, the lines of gravitic flux that the coils are cutting force everything into balance. The car simply goes where it's pointed until it comes to a stop. You couldn't possibly hit the wall unless you deliberately drove into it. Even then, the lateral field effects would turn the car away from

the barrier. I don't think you *can* hit anything head on with an EMG engine."

Jim Westlake and I stared at each other. "When do we start the prototype?" I asked.

"After Arnold completes a quarter scale test model. *Then*—if the model works—we start worrying about finding a fusion reactor small enough to stuff in a car."

Arnold looked hurt. He flapped his arms and gave us a blank, pop-eyed stare, sort of like a frog someone had just stepped on. "Why shouldn't a model work?" he whined. "Why even bother with a model instead of a prototype? The physics are absolutely unimpeachable. After all, *I* did the research."

"I don't doubt the theory, Arnold," his father said soothingly. "But from theory to practical engineering is a long step—and there are a lot of things that can go wrong which have nothing to do with physics, or even good engineering." Westlake pointed at the broken bolt-head on his desk. "Like that, for example. We are going to be stressing equipment in totally new ways. No one, not even you, can know for sure what effect those fields are going to have on the materials we use in race cars. No one knows what effect they'll have on a driver." Arnold started to object again, and Westlake held up his hand. "I know we don't feel any effect from this unit—but we're outside the field, not within it. Build the model first—Bounce will give you all the engineering assistance you may need—then we'll decide on our next step."

I would? Wonderful. Just what my heart desired, having a whiney, overconfident genius slung around my neck like a Yap dollar. Ah well, if the boss said I would, I'd do my best.

I needn't have worried. Arnold wanted as little to do with a common engineer as I wanted to do with him. Jim gave him an unused garage to work in. Arnold moved in some machining equipment and locked the door. He built the model on his own.

It was a disaster.

It looked more like a 1930s version of a space ship than a race car—a Buck Rogers special that had been run over by something heavy and angry. It was oval, flattened, and had lumps and humps in odd an inexplicable places, and a little plastic bubble on top. I couldn't even tell which end was the front. I know that modern race car design produces some exotic looking machinery, but this was ridiculous. Worst of all, it didn't have any wheels.

"But it doesn't need wheels," Arnold protested, when we pointed out this minor discrepancy. "The EMG unit holds it exactly one inch off the road surface."

Jim shook his head. "Arnold, aside from ease of moving it around when the drive is off, we are in the business of building race *cars*—not racing airplanes. If it runs on a track, it has to have wheels in contact with the road. It's in the rules, Arnold. No ground effects vehicles of any sort." He shook his head and continued, "Also, it doesn't meet dimensional specs. Assuming that's a quarter scale model, it's too wide by at least a foot. There are some pretty rigid specs covering width and overhang. There have to be, or some smart-

ass would build a car as wide as the track so no one could pass him."

"But, that's archaic," Arnold whined.

I knew he'd been putting in godawful hours trying to make this thing right. I almost felt sorry for him. Almost—not quite. Holly was giving him enough sympathy for the both of us.

"It's not really Arnold's fault," she defended, making me hope Arnold would melt into an obnoxious puddle of gunk from some untreatable disease. "He built it to go fast, not look pretty."

"Oh well," Jim sighed. "We may as well test it for performance. At least we may get some idea of what our next step needs to be."

Unfortunately, it didn't go fast either. At least, not consistently. When we tested it on our private desert race course, it surged down the straight, then positively waddled through the turns, hunting from left to right like a squatty, metallic hound trying to find a lost scent. After a few laps, it started hunting its way down the straights too. It would accelerate like a bomb had been set off in its tail, then decelerate just as fast and start hunting, then back up to speed again. I could have ridden a bicycle and achieved better lap times.

"Its got to be the radio control," Arnold said. "the solenoids are just too slow on response to keep it tracking."

Maybe, I thought. Maybe. I'd seen too many experimental vehicles to be optimistic. At least the test dummy we'd put in the seat wasn't any the worse for its experience of high-g acceleration and deceleration. The monkey we used in a second test came out OK too. At least the field didn't cause physical damage. Of course the little bugger up-chucked all over the cockpit—which mess, guess who got to clean up.

Like the saying goes, optimism is nice, but pessimism is forever. We built a three-quarter-scale, low powered version, using a hot five hundred two stroke to drive a fifty kilowatt generator. We figured the thing would top out at around a hundred. Like an idiot, I let myself be conned into testing it. At least it had wheels and looked more or less like a race car.

I've driven machines that were pure baby buggies at two hundred plus, and I've been in stuff that at sixty, I'd have felt safer pushing a three-wheeled bascart through a supermarket on sale day. This fell somewhere in between. I took it real easy to begin with—I thought. We started it on the track rather than in the pits. When I gave it a little throttle—or what I estimated was a little throttle—the first turn positively exploded at me. I got off the throttle fast and clamped a tight grip on all sphincters. The damn car almost stopped dead in the middle of the track. It didn't really slow, it just went from some godawful speed to almost stopped NOW. The feeling was weird, no sensation of acceleration, just zoom, zip, coast.

I turned the switch off and opened the lid and sat for a moment, waiting for my hands to stop shaking and letting my internals come down to a reasonable level. Deep breathing does wonders. "We definitely need finer throttle control," I finally said into my helmet mike.

Three hours and a lot of jury-rigging later we were ready to try again.

This time things went better, but we'd guessed wrong on speeds. It went up to

one-seventy like a rocket, smooth and straight. I got off it a bit and set up for the first turn, a long fast sweeper. It zinged through like it was on rails, without a hint of lateral loading. So far, so good—despite the eerie lack of feel. This was a road course, and, in a normal machine, the second turn was a fifty MPH left hander. The exit had a wide pan to skid on if you missed it, so I figured just to blow into it at eighty or ninety and see what happened.

What happened was that damn hunting. It began as soon as I started the turn: left-right-left-right in ever wider wobbles. I could feel the tires scrubbing and screeching as I tried to hold a line, but that was all. It was like someone was moving the track back and forth under the car. Definitely *weird*. The speed went from about a hundred to zip in a few yards. When it finished weaving its way through the turn and got back onto a straight—zoom. Next turn—ugh. I won't even try and describe the esses. Now I knew why the monkey barfed. I've never been motion sickness prone, but I damn near off-loaded my breakfast on that stretch.

Back to the pits.

"The damn thing still hunts! Something's bad wrong, fellas. It doesn't give a damn which way the wheels are pointing, it just overpowers the steering."

"But it can't," Arnold rasped in an irritable, buzzy treble. "You must be over-controlling it."

I may not be an Unser or Andretti, but I do know how to drive. I do *not* over-control. Jim Westlake looked at his son in disgust. One does not blame the test driver for design faults—not when he risks his skin to uncover them. Even Holly gave Arnold a look which made the day brighter from my standpoint.

Her look also calmed me down and kept me from stuffing little pieces of Arnold under the cowling—just after I fed his fingers into the turbo charger. I took a deep breath and suggested, "I think you should try it yourself, Arnold. Other than the hunt, it seems about the safest piece of racing machinery I've ever tried."

The boss looked startled, then worried, then he shrugged. Which was a tribute to my judgment and the trust he put in me. The way I felt about Arnold at that moment, *I* wouldn't have trusted me that much. Hell, I didn't even know if the twerp knew how to drive. I mean, he rode an odd looking bicycle—which he'd designed—all over town.

Apparently he could drive. He dug up a helmet, climbed in, and took off.

It only needed one lap, and a much abashed, slightly greenish Arnold wobbled slowly back to the pits. "Something is wrong," he admitted. "The coils can't seem to align with the magneto-gravitic flux lines when you try and turn it. It acts as if they were discrete lines with gaps between rather than a continuous field. Maybe—" He was suddenly off in a world of his own, scribbling esoteric equations on an oil-stained piece of sandwich wrapper with a felt tip pen, Holly hovering over him in motherly concern.

I looked at Holly, then for a wrench or something else heavy and lethal. Luckily for Arnold, the boss diverted me by saying, "OK, Bounce, let's load this muther up." I got rid of my mad by rolling the back tire over my toe.

Intense physical pain is wonderfully distracting.

Three months later we were back at the track.

"It needed more coils," Arnold explained in a happy, nasal burr. "More and smaller to give it finer control. Now it should handle like a jewel. You see, with the larger coils the windings were so coarse . . . of course, windings isn't really the right term." Arnold grabbed a pencil and a sandwich wrapper. "Look, when theta is . . . " Arnold was off again into numbers and esoterica, while Holly jiggled enthusiastically over Arnold's erudition.

Me? I bit my pipe stem in two. I shut out Arnold's tensor static by stuffing my head into my helmet and climbing into what I was coming to regard as Arnold's Awful Auto.

Pessimism is a wonderful thing. It never lets you down. Arnold *had* solved the hunting problem; it cornered like it was on rails and smooth as silk. I could have steered it with the tip of my tongue—but with a top speed of fifty MPH, who cared.

Arnold looked crushed. The boss looked tolerably frustrated—after all, son or no son, this was costing him a bundle. Holly hovered over Arnold and looked motherly—like a hen with a duckling. I looked like a mass-murder going somewhere to occur every time I allowed myself a glance at the two of them.

I had *hoped* that Arnold's continuing lack of success would redirect Holly's wiggly, jiggly interests elsewhere—like at yours truly. It seemed to have exactly the opposite effect. Maybe . . . Hmmmm. Perhaps if he succeeded. If the thing could be made to work like the theory said it should . . . "Arnold," I suggested, "It feels like the coils are searching so much to keep the car on line that they can't apply a steady thrust to get any speed. If we installed a couple of big coils to give it speed and deceleration, like in the first version, and a lot of these little ones for directional control—just maybe we could get the effect we're looking for." And maybe, I added silently, *I* can get the effect *I'm* looking for from the luscious Angeles.

Arnold, damn his considerate little hide, stopped polishing his glasses and fretting, and stared at me like I was Santa Claus. He looked like a fifteen year-old virgin whose girlfriend has just told him she's on the pill. "Bounce, you're a genius. I apologize for underestimating you all this time. If I'd listened to . . . " The honest little bugger went on in same vein for so long I felt like I was drowning in gratitude. Holly beamed proudly—but not at me, unfortunately.

I'll be damned if the idea didn't work. For lap after lap, the flaky thing ran like a charm. And brother let me tell you, it took some getting used to. No feel of acceleration. No lateral g's in turns: just zip, zoom, and watch the lap records fall. Even in a low powered version, we topped out at 190 on the straights—long or short—and we were blowing through turns at speeds that would have been insane in any normal car. In fact, after a session with that beast, I had to get in a standard car and turn a couple of laps to get back the feel and sense of speed I needed to drive home. But it *was* safe. Even Holly took it around a few times. Did right well, too. The girl

had many talents—some not so obvious as others. Then, of course, she fell gratefully and passionately into *my* arms. Fat chance. Success stuck her to Arnold tighter than ticks on a purple ape.

It was time to build a full powered prototype.

If we'd thought we'd had problems before. . . . Well . . . have you ever tried to buy a small fusion reactor? Yeah, sure, I know they use them in all sorts of things: portable power sources, mobile refrigeration units, even to power remote radio transmitters. But those are sealed units, manufactured by licensed contractors to very strict government regulations and under a supervision that makes the watchfulness of Old Lady Hawkeye in third grade look like three blind mice on a toot.

First of all, they wanted to know what we were going to use it in—that was bad enough. If the boss hadn't had a few friends in Congress, friends who owed him favors, that would have been the end of our project right then and there.

Then there were the safety checks and certifications and regulations and authorizations and . . . it went on for months.

Finally, they wanted to know what *kind* of motor the fusion unit would be powering. That little secret we weren't about to let out.

Why not? *Why not!* You gotta be kidding.

Aside from the fact that the government would have declared the whole thing top-secret and probably tossed us in a nice safe cell while they picked our brains, other racing outfits aren't stupid. What they *are* is snoopy; they survive by finding out what the other guy is doing to make his car go faster, then topping it. We had enough problems with security without letting slip we were working on somethng really revolutionary.

We smoke screened them by rigging a full blown operating electric car. It was fast enough to put the dogs—both governmental and private—off the scent, and slow enough to make them think we were wasting our time on a loser.

Some guys will try anything: word trickled back that one or three other car builders had requested fusion units.

Of course, once we got the government geeks off our necks and the company spies out of our trash cans, things went smoothly.

Sure they did.

If you believe that, I've got a real sweetheart of a deal on some resort property in the Falklands for you. That car had more bugs than a termite mound. The hunting reappeared at about four-fifty. And, brother, if you want unnerving, try having the road seem to start shifting back and forth at *those* speeds. It seems our mounts weren't steady enough to handle the speed we were achieving.

With that problem corrected, we began to get surging at speeds over five hundred. This time it was the driver/steering.

A man driving a car is continually making tiny corrections—so small that not even he notices them—based on what sight and feel are telling him. At normal speeds, in a normal machine, these keep the car on a super-tight line. In our beast, the field coils would sense the correction as the start of a turn and

begin deceleration. The bigger the surge, the greater the tendency to make a manual correction and the worse the next surge would be. We finally had to swipe a page from aircraft engineering and stick a computer between the driving coils and the directional coils. Unless a directional change over a certain amount was sensed, the drivers kept a steady output. That took care of the exotic problems.

The more mundane ones really drove us nuts. For example, racing tires are designed for certain centrifugal loads, based on the diameter of the tire and the maximum expected revolutions per minute it's going to be turning. They'll run fifty or sixty laps under those conditions before abrasive wear from cornering makes you change them. Turning three times their designed rotational speed, those tires didn't stand up worth toad-squat. We didn't have to worry about abrasion; we had to sweat complete and explosive disintegration.

Lemme tell you, our under the table, behind the scenes dealing with the tire manufacturers would make a book, but we finally got what we needed.

Now all we had to do was find a driver willing to risk his neck in a totally experimental car, who could keep his mouth shut and learn to handle our beast before the time trials began for Indy. *Then* we had to worry about getting through tech inspection without being banned, getting through time trials without being banned, getting through the race without being boycotted, getting . . . you're getting the idea.

We hit a snag on item one.

"Goddamnit, boss, there has to be some driver who isn't signed up already."

Westlake looked morose. "Sure, several. But not one who'll sign a contract without trying the car first. All we need is one saying no, then running his mouth, and our project is shot in the ass. We'd have CART, NASCAR, USAC, the FIA and the CIA on our necks like flies on a pit-road hamburger."

I joined the boss in moroseville.

Jim got a sly look and eyed me in a way that made my skin crawl. I started feeling like a choice hors-d'oeuvre at a cannibal banquet. "What," he asked hopefully, "about you doing the driving, Bounce?"

"Got a piece of paper, Boss?" I replied with equal reserve.

"Sure. What for?"

"For me to write my resignation on. I am an engineer, a designer, a mechanic, a lot of things, but I'm no Indy driver."

"But, Bounce, you used to race. Did damned well, too, as I recall."

"I did," I admitted without backing down an inch. "But I raced sports cars —*production* sports cars—not Indy machines. I was also ten years younger, a silly kid of twenty-three."

"So what?" Jim argued. "Cars is cars, racing is racing. Hell, you've got all kinds of wheel time in this car of ours already, and you're turning laps I would have said were impossible a year ago."

"So what yourself, boss. Let me tell you 'so what.' 'So what' is that there ain't thirty-two other cars out on that test course. 'So what' is that out in the middle of the desert nobody's getting

in your way or crashing or spinnng in front of you. You may not be able to hit the wall accidentally in that car, but that doesn't say do-wa-diddy about someone else forcing you up into it or careening across the track right in your path. It takes reaction time to avoid that kind of stuff—reaction time I don't got any more! Hell, I don't even have a current license to race."

Holly swiveled and bubbled in with a fresh pot of coffee while I was lecturing. "So why not let Arnie drive?" she said quietly.

Arnie? Who the hell was Arnie, I wondered.

The boss looked as blank as I did for a second, then suddenly gasped, "You mean *Arnold*—my son, Arnold?"

"I don't know any others," Holly told him in a slightly miffed voice, puffing up in a way that made me wonder how long her dress's seams were going to hold. Not long, I hoped, while I ogled the results of her puffing.

There have been damn few times I've ever seen Jim Westlake stunned speechless. This was one of them. He finally stuttered, "But Arnold can't drive a race car! He has absolutely no experience."

Holly glared at Jim and said sarcastically, "See how well the big man knows his own son." She stared hostilely at us for a moment then went on, "For your information, Arnold not only *can* drive a race car, but has been doing so for over three years—on his own. He does quite well, too, considering the lack of family support or interest. He won his class at Lime Rock last week."

Jim gargled, "He won—"

And I followed, "His class—"

We chorused "Where?"

"Lime Rock," Holly said complacently.

"How the hell long has this been going on?" Jim roared, "and why didn't I know about it?"

Holly lifted a haughty eyebrow and glared down her nose at the boss. "Don't bellow at me, James Westlake. You're my boss, not my father. As to how long: I told you, three years. As to why you didn't know: because you didn't ask and were always too busy to listen to Arnold when he tried to tell you about it."

Shock gave way to fatherhood and Jim objected, "But a sports car isn't an Indy car."

I thought *I* just said that. Oh well.

"It certainly isn't," Holly agreed with a nasty twist of the verbal dagger. "Compared to that car he designed, sports cars are a *hell* of a lot more dangerous! Not to mention the questionable ability of some of the drivers he's racing against right now."

Hell? Had I really heard Holly the calm, unflusterable, and pure say hell? In defense of Arnold? I thought about it, and decided that feeding Arnold to piranhas—a bit at a time—might be an interesting way to spend a lazy Sunday afternoon by the river. Or maybe the zoo—leopards are always hungry.

"B-b-b-but—" Jim elocuted.

To make short of a lengthy and sometimes acrimonious argument—you should have heard Arnold's mother's ten cents worth—oh, blue, where is thy verbiage. Anyway, as I was saying, after some discussion, Arnold became our official driver. Much to my despair, he was a damn good one—horn-rims, big beak, and all. Personal style he might lack:


WESTLAKE ENGINEERING
HIGH VOLTAGE
DANGER!
FUSION
Electric Blue
67

when he got rolling, he sat hunched forward, looking like a stork after a fish—but a damn fast stork after a damn rich fish.

At long last the big day came, and we rolled Electric Blue—which was what we'd named the car—out to the Temple of Speed which is Indianapolis Raceway, registered for tech inspection, and held our breaths.

Vince Granateli, chief of tech inspection, stood in the door of our garage area and stared at the car in near disbelief. "What the unprintable expletive do you think you're doing with those skinny tars and whills, Westlake? This ain't 1933, for expletive's sake!"

Jim shrugged and handed him the manufacturer's specs. "They meet—hell, they exceed all the requirements."

Granateli studied the specs, then the tires, then the rule book, then the specs again. Finally he handed them back. "Big deal. So the expletives go around fast. I don't know where you're going to get any bleeping cornering traction though."

"Isn't that my worry?" Jim asked calmly.

"Suppose so," Granateli conceded, "as long as you don't go too slow and become a hazard."

The reactor was even more fun. But not as much fun as it could have been. I told you other makers were snoops? Better believe it, son. We knew that there had been no less than three nuclear-electric racers testing at Indy over the preceding weeks. One, the Kawasaki entry, even looked competitive—with normal cars, anyway. Those Japanese engineers really know how to do their homework. Since that was the case, the reactor slid through on ten inches of specs and certifications.

The drive unit—the EMG engine—was another matter. Until the race was over, that was a secret. If it wasn't, we'd never get on the track. So we did the only thing we could: we black boxed it and lied like a couple of Persian antique dealers.

"Where's the engine?"

"Right there," Jim pointed.

"All I see's a couple of black drums."

"That's it," Jim agreed placidly, "field coils are mounted to the drums and the stators to the axles. Cheap and light-weight."

"But a bitch to get apart when you need to service them," I grumbled for effect. God help us if they demanded to see inside those enigmatic black drums. There wasn't a thing in them, nothing but empty space and some electronic pickups for track temp and other technical readouts.

"You don't *have* to service them, Bounce," Jim snapped, testy like. "I'm sure Wood Family or Bonato would love to have your services."

Granateli looked shocked. Trouble in the Westlake Paradise?

I relapsed into sullen silence—and managed to keep a straight face, somehow.

When the tech team had left, we shut the doors, locked them, and let out a collective sigh of relief. Then we broke out a fifth of *Jim Beam* Green Label. We held our peace until the first sip had slid warmly past our tonsils—then we had hysterics. We'd done it; we'd snookered the tech teams, we were IN!

For time trials and practice we cut the output of the reactor down by a half.

What we didn't want to do was scare off the other cars. Even so, Arnold put the car on the front row. I had to admit it, the kid was as good a driver as he was a physicist.

Holly bubbled and wiggled and kept lap times. I spent a lot of time feeling sorry for myself and trying to ignore her decolletage. Indianapolis in late May is hot and steamy, but not half as steamy as the outfits she almost wore. Holly was such an attraction that guys were making pit stops just to get a look at her. Jim Westlake is a sharp team manager: while the competition was ogling Holly, they weren't snooping around the car.

The night before the race we boosted the power to three quarters max. After all we wanted to win, not embarrass everybody.

And that was that, right? We buzzed out the next day and put the Indy in our pocket. Good God, are you optimists still around? Fellas, it just don't work that way.

Memorial day dawned bright and clear and cool—perfect racing weather. A day made for winning. A day made for heroics, for dragon slaying, for the thrill of victory and the agony of a hangover—which was what I had.

I agonized my way through a shower, a shave that felt like I was flaying my face with a buzz-saw, and seven or eight cups of black coffee. At eight A.M. I stumbled into gasoline alley and the middle of a panic. Arnold was listed among the missing.

"Bounce!" Jim Westlake yelled in a voice that left little bits of my skull buzzing in a tight orbit around Pluto—the planet, not the dog—I think. "Where the hell is Arnold?"

"Ask Holly," I muttered petulantly. "They left the bar together last night while I was still getting warmed up."

"Holly's here," Jim told me at a more tolerable volume, "having hysterics. She hasn't seen Arnold since eleven o'clock last night."

Gradually it was starting to penetrate the hangover haze. Arnold was missing, nowhere to be found. We had the fastest car in the world—a shoo-in to win the world's greatest race—and no driver. Ohhhhhh shit!

"Bounce," Jim stared hard at me. "I can't leave the car. Holly's so panicked, she's useless. *You* have to find Arnold."

I got the idea: find our missing boy or don't come back. I wondered idly what the weather was like in Buenos Aires. Adrenalin was doing marvelous things in the way of demolishing the remains of my hangover, and the coffee was doing the same to my bladder. I nodded what I hoped was a confident confirmation and left to find first a bathroom, then, hopefully, Arnold.

As the pressure on my kidneys eased, my brain began functioning. I got a sudden hunch. Everyone had looked in his room, hadn't they? But did they really look, or just open the door and yell Arnold? Or . . . what had Jim said? "His room doesn't *answer?*" Did they just call and assume? I jumped on the minicycle we use around the track and headed for the hotel.

Shortly thereafter, some fast talking, recognition, and a reputation for punching out desk-clerks when I got irritated placed the key to Arnold's room in my

hand with a minimum of effort. I took the stairs; I wasn't about to wait for the elevator.

A few seconds later I took a deep breath and opened the door. At first, I thought I'd guessed wrong; the room was empty. I almost cursed and left. Instead I just cursed. I'd noticed a discrepancy—one does not generally close the bathroom door when leaving a hotel room.

He was there all right. Fully dressed, sitting on the edge of the tub, staring at nothing. I risked a tight little breath; he looked scared but healthy. "Come on Arnold," I kidded him, "time to play race driver."

He mumbled something through his nose that got lost in the caverns and came out too low to catch.

"What?"

"I can't," he quavered in a sinusy whine at a nearly understandable volume. "I can't do it."

Ahhh. Ha. Like Hercule Poirot, the little gray cells began working. I knew exactly what was wrong. Arnold was scared. Not of the race per se. Not of getting hurt or killed. Arnold had been putting his gonads on the line every time he hopped into a Can Am car, and doing it without a quiver. What Arnold was afraid of was screwing up in front of God and his father in the biggest race in the US. He was afraid his design would fail. He was afraid *he'd* fail. He was afraid he'd pee his pants in public just getting to the car. It's called stage fright, people, and it can be as paralyzing as facing a tail-shot grizzly with your knickers around your ankles and a roll of TP for a weapon.

I had a number of options. I picked the only one I figured might work coming from me. I figured Arnold believed that I thought he was a useless theorist who couldn't do a real day's work if he had to. Mostly *not* true—I might want to strangle him, but I didn't underestimate him.

I got nasty.

I shrugged. "Big deal. So we get another driver. It would have been nice if you'd told us sooner, though."

It got through to him. Life re-lit in his eyes. "Huh? How can you? I was the one who qualified the car."

"So what, Arnold? Don't you read the rules?" I stared at him with all the disgust I could muster. "Judas, what a wimp! Your dad's been fielding Indy cars for how long, and you don't even know the rules. It's the car, Arnold. It's *all* the car at Indy. The driver ain't shit. If the car a driver's qualified breaks, *he's* had it. If a qualified car's driver breaks . . . So what? Grab another wheel jockey and stuff him in the cockpit. As long as the guy is licensed and can keep up the pace, it don't matter who's sitting in that car when the flag drops. With Electric Blue, it don't matter at all. A six-year-old could win in that thing."

I was taking the burden of failure off him, convincing him he wasn't that important. That the car and the team could do very nicely, thank you, with someone else behind the wheel. Now I needed a spur to get him mad and moving. He gave me the opening.

"So who do you think is available to drive an experimental car at this late hour?" he asked almost belligerently.

Now, if the rumors I'd heard were right . . . I remembered those laps Holly had turned. If that smoothness she'd

shown meant what I thought it did. . . . I said a prayer and took a shot. "Holly, probably," I told him in a matter of fact voice. "She's got an acceptable license, has driven the car, and is experienced enough to keep out of trouble." The last was stretchng it, but it didn't matter. Arnold wasn't listening—he was boiling.

"You'd replace ME with Holly, with a *girl?*"

I managed to keep a straight face. "Sure. Why not? The driver is irrelevant in that car."

"Like hell he is!" Arnold growled. He was so mad, he cleared his sinuses and his voice sounded strong and honest, not a hint of whine or rasp. This was an Arnold I'd never seen. Sheesh, I could almost like *this* guy. "I designed it," he snarled. "I built it." (Well . . .) "And I'm damn well going to win in it." He was picking up his gear as he raved at me and was heading out the door on his last comment.

"I think your dad might like that," I quietly told his disappearing back. "I think he might like it a lot."

Well shoot, folks, the rest is in the history books. Arnold won—hell, he won by a ridiculous amount, like eighty laps. On the winner's stand, he told the public, the other drivers, and the press the secret of Electric Blue, and announced that the physics of it was already available in some esoteric University physics publication I'd never heard of—published a month ago.

Mayhem, anguish, and insanity. The drivers and other teams howled that they'd been had—they protested: vocally and in writing, officially and unofficially. It didn't get them anything but sore throats and writer's cramp; the car didn't violate one spec—not even a tiny, long forgotten and ignored one. Jim Westlake and I had been real careful about that. The Federal government had fits. We'd violated National Security, they raged. The courts threw that one out without a second glance in under two weeks—some sort of record. We were investigated by everybody from the CIA and FBI to the Postal Service. We were threatened by the IRS and the DAR. It took six months for the smoke to clear. But public domain is public domain and that IS the law. Arnold hadn't been working for or under grant from any government anywhere. It was a pure private sector discovery in which the government had taken no part—not that Arnold had offered them one—nor had they shown any interest during the reactor tests; It was Arnold's to do with as he saw fit. Once he'd published that paper, the war was over before it began. The worst they could convict him of was poor judgment—and everyone knows that people who drive race cars aren't real heavy in the practical smarts department. Otherwise, they wouldn't drive race cars.

The government couldn't squelch it, the other race teams couldn't fight it, so . . . the next year every car that showed up at Indy was an EMG powered machine. Some of the guys were really inventive, too. They got better performance than we'd even thought of on our first try. We finished second.

Even so, it was essentially a race where thirty-three cars followed each other around for an hour and a half in an order that was set at the end of the first lap. No screaming of tires, no rasp

and blare of high tuned engines, no smell of burning oil and overheated rubber. Just an hour and a half of whoosh, whoosh, whoosh. Real exciting stuff.

The year after that it was worse yet, and the fans responded by staying away in droves—and not just from the Indy. By the fourth year, the Indy was a dead issue—you couldn't give away tickets—and the survival chances of the rest of auto-racing looked as bleak as the North Pole in mid-winter.

Jim Westlake and Arnold were being unfondly referred to as the geeks who stuffed it to fun. Jim couldn't stand that; racing was his life. He hauled me into his office. "Bounce, I can't take this any more. There has got to be something we can do to put the driver back in control."

"Boss, I've been thinking about that. Now I don't claim to know what makes Arnold's EMG unit tick, but the applications are pretty straightforward."

Westlake interrupted me. "Stop giving me the pep talk. What have you got?"

I grinned at him. "First we get rid of the reactor. That damn bomb has always scared me, no matter how safe they claim it is. We replace it with a good old reliable reciprocating engine."

"Damn it, Bounce, Arnold proved that we can't build a standard powerplant light enough to power the EMG. Not and stay competitive."

"Wrong!" I gloated—just a little gloat, nothing overbearing. "We can't make one to power drive *plus* all the *extra* EMG units: the ones that control direction, float the car, et cetera." I paused long enough to relish the sudden thoughtful look on Westlake's face. "We damn well can make one hot enough to power the drive EMG and a few extras for safety and enough lateral boost to stay in the running."

Westlake looked at me as if I was Santa Claus, then he glowered. "Well for Foyt's sake, what are we sitting here for. Let's get building."

"I was just waiting for your approval, Boss."

The piston paper-weight whizzed past my left ear as I bolted for the door. I was still laughing when I parked myself in front of my CAD terminal. Westlake was suppressing a few chuckles himself as he dropped into the chair at the terminal beside mine.

We went to work.

Went to work? We didn't see the outside of that garage for two months, but we got an answer. Come spring, we fielded a car with a snorting, fire breathing behemoth of a turbocharged V-12 driving an EMG power box. Directional control was strictly stick and rudder, with just enough auxiliary EMG units to help with the lateral stability. We needed every ounce of power that V-12 put out to push that muther.

Arnold spun it twice in its first race. The second spin, he busted his beak on the front of his helmet when he smacked a barrier. The meeting with the barrier didn't do the car any good either. Arnold rode the ambulance to the track infirmary, and the car rode the wrecker back to the pits. Our first DNF in three years and it felt great! *Excitement* was back!

Jim Westlake was given a testimonial dinner by grateful racers that would have made Henry VIII green with envy.

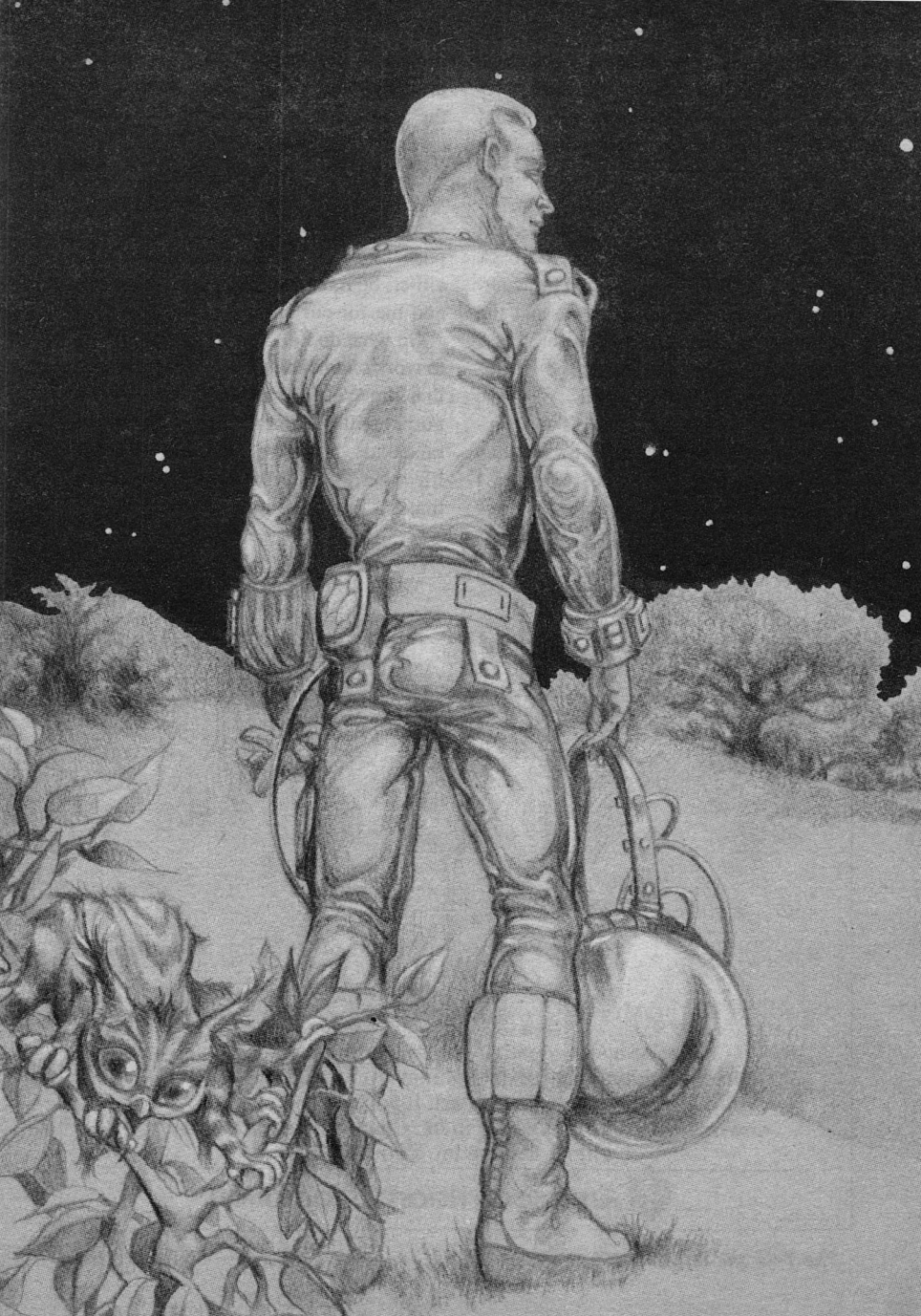
Me? I went home to Holly and our

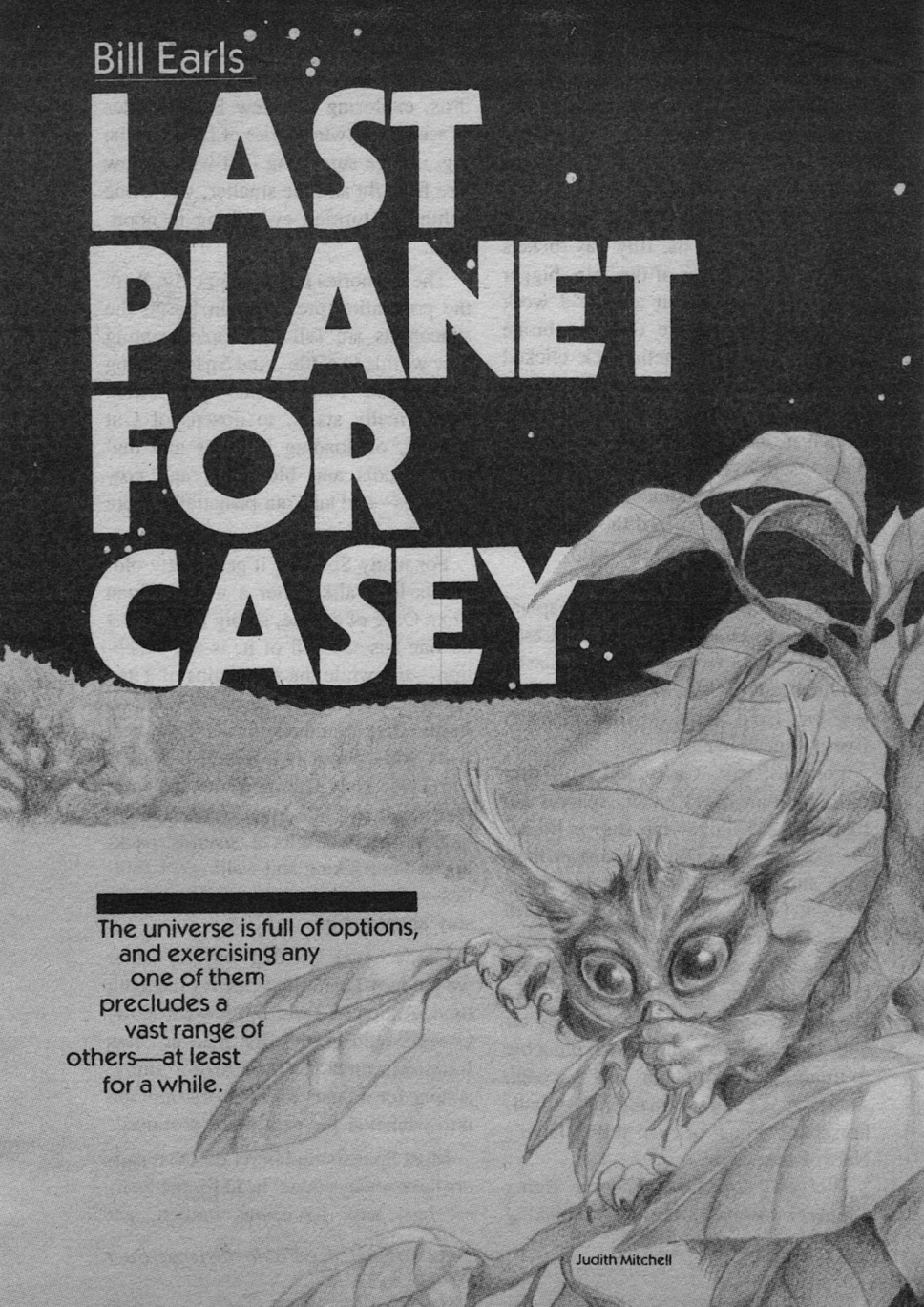
new bouncing baby engineer feeling like a million dollars.

Oh, yeah! About Holly. Life's real peculiar sometimes. Seems what with being a big hero and celebrity after the Indy, Arnold had women running out of his dresser drawers. Somehow, sort of, poor Holly got pushed to the back of the closet. Holly is not a girl for hanging around in closets. She was out the window of Arnold's life before he'd tumbled his second pit-popsie—Mid-Ohio Raceway, I think it was. What the hell, Arnold liked the twitches and wiggles of cars and physics better than Holly's anyway. Not me, brother; I caught her on the first bounce.

Arnold was right about one thing, though. The EMG drive revolutionized the transportation business. A really safe car, truck, or bus. A vehicle you couldn't crash! It made Arnold a very wealthy man—he'd held back a couple of goodies when he'd published that paper. Not dumb, that boy. Not selfish either, he forced a percentage on his dad and me for our help in development.

So what do I do now that I don't have to work? Same thing I did before, except that Jim Westlake and I are full partners now. I still design race cars, ogle Holly, raise kids, and have a blast. It's a great life when you love what you do and can make a living doing it. ■





Bill Earls

LAST PLANET FOR CASEY

The universe is full of options, and exercising any one of them precludes a vast range of others—at least for a while.

Judith Mitchell

They got to him after a while. Not the planetfalls as much as the Pilgrims, not the places we'd been as much as the people we'd brought there. I should have seen it coming. I was as close to Dan Casey as anyone.

We'd pull into the dock at Titan Float One, Casey using the tiny gas rockets to control the waver of the ship, bigger ones to slow it down and he'd work without rest from the time we broke Jump until the magnetic lock clicked shut on the forward hatch. Then he'd get up slowly from his pilot's seat, stretch in that slow, catlike way pilots have used ever since Yeager made feigned Southern Indolence part of the routine, and look toward the captain. "Permission to leave the ship, sir?" he'd say.

"Permission granted," the captain —Timmons, Drabel, or Nahone—Casey served three—would say and Casey would head for his room and a fresh uniform. He'd be out the forward hatch five minutes later.

For a Spacer, Casey liked off-ship more than anyone I knew. Spacers are like the old sailors—the ship is home, the place they eat, sleep, and stow their gear and they're uncomfortable away from it. Give a man three weeks Earth time, for instance, and he'll probably be back in two; fresh air and openness bother a Spacer after a while. He likes the closeness, the smell of recycled air and galley chow, shipboard pinochle tournaments and clean clothes each Tuesday. We weren't made for softball, horseback riding, or even skiing Titan's North Range.

We've all done that, of course. Being a Spacer means skiing Titan, making planetfalls on Grissom and Ride and Brex, chasing the sand devils on Andros, exploring the New Paris jungles or seeing the twin sunrise of Drinon—the big, orange sun rising first with a glow like firelight and the smaller, white one behind it, turning everything to noontime.

The memories build up quickly. With the population pressures on Earth, the spaceports are full of people wanting new worlds to settle. And Spacers bring them from Titan Float One, where Space really starts, to dozens of Out Planets, off-loading Pilgrims and material—tools and blueprints and cow embryos—and take our planetfalls where we can.

For many Spacers, it gets pretty old. Floats look alike after a while—Titan Float One, of course, so big that almost no one has seen all of it, is the exception—and while the mountains of Titan are beautiful, most of us never skied on Earth. Brex is interesting until the heat wilts you—about five minutes. Anderson Two, New Georgia, and the farm planets all feel like Iowa. And there are quarantines, weird local customs, packing and unpacking and waiting for shuttles—after a while, a lot of men simply stay aboard ship.

Casey never felt that way. Whether we put into Titan Float One for the tenth time, Anderson Two, or New Moscow, Casey would be the first man in Class I uniform, medals on, earring shiny, aching for a chance to get off-ship and into whatever the new place promised.

Most Spacers on liberty do what sailors have always done: head for the nearest bar, look for some women, get

sloppy drunk or into a fight, then help one another back to the ship.

Not Casey. He'd get as far from the spaceport as he could and talk to the natives. On Traber and Brex, he'd visit the mines and talk to miners. On Anderson Two, New Georgia, and Alpha Three, he'd talk to farmers and ranch hands. He'd ride horses, hunt thrangs, check the soil, swim in the ocean, watch Little League baseball on Grissom or dragon fights on Denby, make friends wherever he could, and spend most of his time listening, a faraway look in his eye.

"This is what it's all about, Ran," he told me once. "The real people live like this."

"I'll stick with what I'm doing," I said. "I was Earth-bound for twenty years. Being a Spacer is better."

"It beats working," he said. We were on Grissom then. One of the darker, smaller planets, it had an .85 sun, a 1.02 gravity and a mining colony, smelters and a spaceport that lifted tons of sheet metal and girders upstairs for the ship construction crews. Mostly Slavic, the natives worked long hours and ended the day in neighborhoods that could have come from Pittsburgh or Warsaw in the mid-20th century: homes close together, neighborhood bars, softball under the lights. They drank good beer, laughed a lot, and loved their kids. But they looked tired, too—and I wasn't about to swap my clean sheets and earring for their lifestyle. For all his talk, I didn't think Casey would either.

What Casey wanted, I thought, was his own monument and for a while I thought he'd made it when Galaxy Central diverted us to assist the Brandon, one of the Explorer Light Ships, after she'd been holed by a meteor. Casey went aboard, took charge, got the ship repaired and, because he wasn't sure if the repairs would hold, jumped it himself back to Titan Float One. He got a medal for that, was interviewed by news people, shook hands and even had dinner with Admiral Davis. Two months later there was another crisis and someone else got the medals and adulation.

I thought that Exploring was the kind of action Casey needed. Explorer Ships did more than simply haul Pilgrims in Long Sleep from Float One to the Out Planets. They *found* the Out Planets —then surveyed them, mapped them, sent down bio-techs, geologists, and botanists to take soil and mineral samples, captured birds and bugs and animals and then brought everything back to Titan Quarantine—maybe the most interesting place in the Galaxy—for more checks.

It was a good job for Casey, because once he put the ship into parking orbit above the planet, he became Explorer Shuttle pilot. Although the Exploration Crew Chief was nominally in charge, as shuttle pilot Casey was legally Commanding Officer for the week or three weeks the shuttle was below and could overrule almost anything if he felt the shuttle's safety was compromised. It was a mark of Casey's integrity that not once, in a dozen trips, did he ever have to invoke his power. From Casey, a simple "I don't think that's a good idea," was enough.

I always enjoyed watching the Exploration Crew leave the ship. First there'd be a small ceremony in the wardroom—a toast, a short speech by the

captain and Exploration Crew Chief, handshakes all around—and then the Exploration crew would file onto the shuttle, as if they hadn't been working on it and prepping it for days. At that point, Casey would appear in the tiny cockpit window, give thumbs-up to the flight supervisor in Shuttle Control, and the rest of us would head from the shuttle bay to the viewport near Medical.

We could see the shuttle bay doors open and the shuttle stick its tail into the blackness of space like a small child climbing down a ladder as Casey used the air rockets to lift it off the deck and back it out. Past the doors, he'd give a good jolt to the starboard rockets, back 1,000 yards away, and call up the flight supervisor.

"Permission to make planetfall," Casey would say.

"Permission granted." Another blast from the air rockets—the shuttle had to be 3,000 yards away before the main engines kicked in—and the shuttle would fall away, hang there a second; then the engine would flare red and the shuttle would go into a long glide out of sight.

And then we waited.

Being parked in orbit was often the best part of a trip for the crew. Many of us went into a modified holiday routine—four on and twelve off—and filled the time with chess and pinochle tournaments, movies without interruptions, weight machines and isometrics. And, of course, caught up on sleep.

We stayed in touch with the Exploration Crew. They broadcast all the way down, sending up air mixture, temperature, and pressure readouts. Then 40 to 100 miles above the surface—depending on gravity and cloud cover—they put the shuttle into a cruising orbit and made at least 10 circuits of the planet, mapping and reading all the way.

The mapping often found problems before they developed. Above Drinon, the story went, what looked to be cloud shadows on the first pass turned out to be a swarm of Brown Biters, carnivorous to the extreme.

Once the shuttle had landed, some pilots took the ground time as rest time. Not Casey. He learned to take soil and water samples, to put equipment out and break it down. He wasn't dumb enough to work himself into exhaustion—though it was normal for the Exploration Crew to do that—but he helped a lot and the crews appreciated it.

After a while Explorer Crews asked for him as pilot. And he began spending more time with them—working soil samples in the ship's lab, growing things in Petri dishes, going over maps and helping to plan expeditions. When we docked at Titan Float One or Quarantine Station, he'd go along with them and once invited me for the tour of the zoo.

It wasn't a real zoo: cargo space was still critical and no one, not even the Navy, was about to boost a rhinocerous or eland into space just to look at it. Cow, goat, and sheep embryos were something else—the first had gone into space not long after the United States developed the first space shuttle and learned that an animal born in space could live there. And, like everything else, do it on less food and sleep.

No less smell though. The zoo was on the fourth level of Titan Float One—past the barracks section where thou-

sands of Pilgrims waited in noise, clutter, and tension; past the machine shops and drafting sections Float One needs to keep growing; and finally past the Ag section, full of plants and seeds from all over the universe—and even before we reached the end of the corridor, I could smell barnyard.

I could have grown nostalgic, but didn't. I'd grown up in rural Nebraska —there is no place more rural—and had spent most of my childhood downwind from too many cows. I hadn't missed it at all.

"Nice talking with you, Casey," I said. I turned to the young woman with him—an Ag tech on the last Explorer Crew—and said "Nice talking to you, too." Casey put his hand on my arm.

"Won't be but a minute," he said. "Di just wanted me to have a quick look." I relented and spent 30 minutes wishing I hadn't.

Casey wanted to touch the cows—three each of Guernseys, Jerseys and Herefords—and for a moment I thought he wanted to kiss them. They fascinated him—"Cows, in space," he said in disbelief, and asked the tech in charge if they minded not having hay.

They didn't, the tech in charge said; they thought the green goo from the hydroponic tanks was fine. They didn't mind having their eggs lifted and artificially inseminated either—these were grandparents of cows on 17 Out Planets. Casey wanted to know how the eggs were carried, what treatment they required, what kind of milk and wool came from New Georgia and Anderson Two.

I barely listened. I'd been on Anderson Two—it looked like Nebraska with purple grass—and had no desire to go back, tasty milk or not. I didn't want to spend precious float time talking about cows —not with three new bars on Level Two. I told Casey and the girl where I'd be.

"Have a beer for us," Casey said. I could have had four. An hour later Casey and the girl came into the bar, said "Hello, nice place," and started talking about yanna bushes on Brex and whether the next shipment of Korean Pilgrims could make goats survive on Karanal. Stuff like that. I excused myself as soon as I saw someone else I knew and, in the best Spacer tradition, spent the next nine hours barhopping.

When I saw Casey next he was in the receiving area. We were trying to load Pilgrims for New Paris, trying to get order in a situation that was always chaotic—kids crying, parents worried, people wondering if they'd take to Long Sleep, families asking not to be separated even aboard ship, tearful goodbyes being said in the raceway, in spite of orders and requests not to make them there.

"Looks like another happy load," Casey said.

"They never look pleased," I said. "This is traumatic for most of them."

"Even after what they're leaving—the noise, pollution, decay?"

"It's still Earth," I said. "Where they were born and where most of them would like to be buried." They never would, of course, but there was a good business—illegal—in transporting back small vials of ashes for burial in Colorado, Shropshire, and Osaka.

"I can't see it," he said. "They're making new lives for themselves

—they're pioneers. They should be excited."

"Long Sleep scares people," I said. "What most of them need right now is a tranquilizer. Do you have one?"

He didn't, but he had something even better: a gift for inspiring confidence. Casey stepped from behind the processing tables into the middle of the crowd and used a voice that most men couldn't get after three courses of Command School Diction.

"It'll be all right, folks," he said. "I'm Commander Casey and I'll be your pilot this trip." He turned to the nearest family—man, wife and three kids—and put his hand out. "First time in Long Sleep?" he asked. It was, of course. People don't Long Sleep from Earth—and they were nervous. He talked with them for five minutes, asked where they were from, who their sponsor was, what their skills were, then moved on to another family, then another. It was the smoothest load we ever processed—over 2,000 people Long Sleeped in eight hours.

I told him how much he'd done to smooth the operation and he just looked away for a moment. From the wardroom viewport we could see the slowly diminishing bulk of Saturn and a whole galaxy of stars behind it.

"You do what you can," Casey said, and his voice was far away. "Those people today—they're the pioneers, Ran. Years from now, they'll be the mayors and leaders of the towns and cities they're setting up. And us. What about us?"

"We're Spacers," I said. I touched the earring that had been so hard to earn.

"Sailors, transients," he said. "Here today, gone tomorrow. Nothing to mark our passing but a name carved in a tabletop, a girl with some memories and a picture disc someplace. Fifty planetfalls, a hundred Jumps . . . and when it's over they strap you to an Agnes IV and shoot you into the sun."

"You could always jump," I said . . . and we knew that was out. Some men did jump—leave the service—and they were always sorry. You'd see them a few years later, still wearing the ring, but something missing—a sparkle out of their eyes, a bounce gone from their step. Once you've been in Jump—the hyperspace between the planets where a Spacer spends half his time—and seen the hypnotic shift of colors and the all-sucking blackness like staring into Satan's soul, nothing landbound can touch it.

"That's no answer, either," he said. He shook his head. "I don't know what it is I want, Ran."

I told him I wasn't sure either. As personnel officer, I tried to understand people. Sometimes I could arrange a job switch or get someone to a head massager if necessary—though Spacers had less need of psychiatry then any occupational group in the universe—but mostly I played amateur psychologist and got them thinking about something else—weight training, sculpture, a foreign language.

Casey took a course. Not on navigation or principles of Cedric engines—or even Ancient Rome, one of the video courses we had—but on law. While the rest of us played or stood watches and the Pilgrims Long Sleeped, he was in the ship's library reading about contracts and procedures.

When we broke out of Jump three coordinates from New Paris, he put the video away, fed his scrap paper into the recycler—it would become food for the hydroponics—and wandered down to the mess decks for coffee and chess. He wound up talking with some communications techs—guys always glad to share what they knew—and I figured he was back to normal.

A day later when we began bringing people out of Long Sleep, he couldn't be there—his job was to dock at the New Paris Float—but once we were linked and on Float power, he came to the receiving bay. He re-introduced himself, told the Pilgrims he'd enjoyed having them aboard, and when they filed out of the ship for the shuttle down, shook a lot of hands and said, "Let me know how it goes," as though he really cared.

We had returnees from New Paris that trip—a politician who'd learned that New Parisians worked pretty hard; two industrialists who had checked the mines and were going to file a report with Galaxy Central; even a couple of emigrants, who'd decided New Paris wasn't for them and were going back to Titan Float One for reassignment.

Casey talked with all of them—how crops grew and how rich the ore was, what the weather was like and how the settlers spent Saturday night—and I figured out what he was after.

"You want them to remember you," I said. "You're thinking of running for governor or coordinator or something . . . and you want votes." He didn't say anything, but when I saw him on the mess deck again with the politician, he winked.

When we put back into Titan Float One, I half expected Casey to take out a Governor's petition to run for office or get himself named to a board of directors—corporations like ex-officers. He didn't do either, but when he learned that we had Exploration orders for Randovann, he smiled.

Fine for Casey—he would handle the Exploration shuttle again and have a good time—but extra work and a cut in liberty for the rest of the crew. We had to re-configure the ship's bay for a shuttle, stock food and supplies for the Exploration Crew. As always before Exploration, I punched up Planetary Data at Library Central for information on Randovann.

It looked promising. Discovered four years ealier, it had been virtually ignored because it was in a far corner of the galaxy. We didn't know enough about it to open it for settlement—it's why we were taking a third look—but it didn't seem bad at all: a 1.01 Earth Atmosphere and .987 gravity. It looked as Earth might have 200 or 1,000 or 10,000 years ago: white sand beaches, green forests, and miles of rolling hills.

Best of all, I thought—having grown up in winters too cold and summers too hot—it didn't have Earth's intense winter/summer fluctuation. Canted just 8.5 degrees, there was enough variation for a snow cap to grow and recede at both poles and for ice to form on ponds in the higher latitudes. But much of the planet was, as the first Exploration Crew had said, "Eternal June."

I could understand why Galaxy Central was committing the biggest Exploration Crew I'd ever seen. Casey would bring down five Ag specialists, two for-

esters, four biologists, three geo techs, two cartologists—plus eight Fridays to cook, tend house, stand guard, and gofer, with a three-man shuttle crew on top of that.

They were, of course, cross-trained in everything: the small animal specialist was also a co-pilot; one geo tech was a medical doctor, another a small engine specialist. They'd all worked together—all had worked with Casey a few times—and I could see why he was excited about exploring Randovann with them.

It looked like a good place to explore.

It just didn't look like a good place to die.

We jumped right from Titan Float One to Randovann and put the ship into parking orbit. From the view ports it was hard to see anything except green and blue—forests and lakes, Casey said.

"I'm kind of sorry you're not coming down, Ran," he said.

"I can run some tournaments, get fellows going on courses they should take," I said. "There's about eight men who should be striking for second class this exam time."

"Get on 'em," he said. "You need those guys coming up and making rate." The words were good but there was something in his tone that said making rate didn't mean much.

"You're looking forward to this trip," I said. "You haven't spent much time with ship's company."

"I know," he said. "Just a lot of planning with the Exploration Crew, that's all. What we're going to do, what sequence the work will take."

"You've worked with these people before," I said. "Dina, the ag tech—she was with us at the Float One zoo."

"I thought you'd remember," he said.

"Too pretty to forget," I said. "A couple of the others are real attractive, too. It could be good duty."

"Could be," Casey said. "They generally work too hard to party, though. So do I."

"I know," I said. "But you don't generally take down a crew that's more than half women. Maybe you can take a weekend off."

"Good thinking," he said. "We'll write it into the Ops Plan—party weekend—just between Cartography and Lichen Check. You're sure you don't want to come along?"

"I'll watch from up here," I said. "I always enjoy that."

The wardroom always hosted a send-off party for the Exploration Crew party because no one knew if all of them would come back. They could run into anything—animals, insects, bacteria, earthquakes—and when Captain Nahone ladled gin into the punchbowl, everyone was silent, looking at one another.

"To a safe and profitable Search," Nahone said. We all raised glasses and sipped. Good gin—though not as potent as the engine room brew that officers weren't supposed to know about—and everyone drank it slowly, saying farewells around the room until the last hand was shaken and the last sip was gone.

Casey, at the end of the handshake line, gave my hand an extra squeeze, then grabbed my shoulder for a moment. I was touched, never forgot it and wished for a long time afterwards that

I'd been the first to make that extra gesture of friendship and caring.

A week later Casey was dead.

For three days—72 hours—the Exploration Crew sent data up from Randovann: chemical analysis of soil and rock samples, slides from plants and trees they'd sectioned and run through the Basic Analyzer. After three days they changed location and shifted everything 200 miles and repeated the process in a different area. They spent another 74 hours there—about two and half Randovann days—and then picked up and moved north.

Whenever we had a shuttle working, the comm shack, which ordinarily had one officer and two techs on duty, was filled with crew listening to sporadic voices from below—techs checking with Instrumentation. Samples, or History, asking how something worked or what a set of readings meant—and maybe 15 sets of ears heard Casey say "Heading east now on an 87 bearing . . . looks like Ohio down here . . . lots of rolling hills, a river or two . . . good fishing. If there were any fi—

And then nothing. One moment we had Casey's voice and a dozen or so instruments monitoring the flight. And then Casey's voice stopped in mid-sentence and every dial and gauge went to zero at the same time.

"I've lost contact with the shuttle," the comm tech said. There was a ripple of noise from the watching crew, but no one moved for a moment.

"Try the other channel," Jack Mennach, the comm officer, said. The tech flipped a set of switches. Nothing.

"Try to raise them."

"Cannon calling scout ship *Flower*. Come in, *Flower*." There was a touch of desperation to the tech's voice. No answer. Mennach raised the bridge and asked for the CO. Captain Nahone was in the comm shack a moment later.

"Do you think they're down?" he asked.

"I don't know."

"Is there any way to find out?"

"We don't even get a reading from the EL." The Emergency Locater was supposed to withstand a shock of 40 g's. But its batteries worked in any number of instruments—in spite of orders not to touch them, most techs saw the EL as an emergency battery supply. They still do.

"Is there any way we can find them without it?"

"Not unless the cameras can pick up something."

They couldn't. There were 50,000,000 square miles of planet to cover and even if we could narrow it down to a tenth of one percent of that—and we could —most of the planet was forest or water into which the shuttle could have vanished without a trace. Even so, we beamed in on the last known location, brought the Lightship as close to the planet as we dared and read everything we could.

No luck. Metal deposits, but ore—not the shuttle. Cloud cover was such that we couldn't tell a slash in the jungle, where the shuttle might have gone in, from a canyon or a shadow.

After a week and a half, we heard from Galaxy Central on the Instacircuit. "Presume shuttle lost. Return for further orders."

Before we moved out of Randovann's

orbit, the entire crew turned out in dress blues on the shuttle deck—the biggest clear area we had—while Nahone read the Service for the Lost in Action. It's short, simple, and so moving that half the crew was in tears by the end. He read the names of the Exploration Crew and a gunner's mate fired a round after each one from the antique .38 each Lightship carries. The last name he read was Commander Dan Casey.

"Casey looked for a memorial," Captain Nahone said, "something bigger than he was. And, because he was the man he was—a pilot, a war hero, a senior officer in the Service—finding that something was very hard.

"The ship was not bigger than he was. The war was not. Not even the Service. Only Death was bigger and, in finding it, Dan Casey found something else: a whole planet. Let the Star Atlas call it Randovann. Let the politicians name it what they will. But Casey was one of us—and from this time on, throughout the Service, this place will be called 'Casey's Planet.' "

He paused, looked away, blinked back a tear—Casey had been a good friend, about as close as anyone can get to a captain—and said, "Fire the salute."

And then I blinked back a tear. Maybe a couple.

You don't forget a man like Casey quickly, but the Service says you have to—and it's right. The living are more important and in the routine of papers to process, courses to set up, transfers and promotions, captain's masts and awards and, always, new loads of Pilgrims, Casey's memory blurred a bit. Each time his name came up, the hurt was a bit less. There was a new pilot on the next trip, another a few trips after that. I was promoted, assigned to another ship, did a tour on Anderson Float One as exec, came back to the Lightships with an Ops officer rating.

And one day, not long after my third stripe, I woke up thinking of green hills, waterfalls, and remembering the sound of birds in the back yard. I hadn't thought of it in years and was about to smile when I felt the pain in my chest. I coughed and could taste blood.

I lay back and felt the emotions hammer me: self-pity one minute, understanding the next, anger and denial right after that. I didn't need the doctor to tell me what I had—I'd seen too many Spacers with it before—but I checked into Medical anyway.

"How long do I have?" I said.

"It's hard to say. How do you feel?"

"I want to go home. I want trees and grass and flowers." I hadn't felt that way in years and that was how I knew; when they're dying, Spacers want to go home. I shut my eyes and could see the town I was born in: the oak trees on the village square, the phlox in my parent's yard. I wanted to see it again.

"I'll tell the CO," the doctor said. I put my hand out to stop him and a chest pain doubled me over. I woke up on my back and could feel the ship quivering in Jump.

"I'm going to beat Kelly," I said. Kelly the Death Angel—the first man to see what Spacers needed when the illness hit them: a ride home—and the first man go to the admirals and argue for the dying Spacers. Now it was a rule, unwritten but still inviolate: when the Spacers cough blood and want to go

home, get them to the nearest planet. Even if it kills them.

The doctor kept me sedated so my lungs wouldn't tear themselves apart—and I missed coming out of Jump and coupling to a float for the last time. I could barely stand, but the captain turned out sideboys as though I were a commodore and I took the last salute and crossed from the ship into the receiving area of the smallest float I'd ever seen.

My legs collapsed then and the doctor helped me onto a Rest-Easy and gave me another shot. As I slipped to sleep, I thought of Earth and what it had looked like when I was a boy. What waves had sounded like crashing on the beach. How hawks had soared in the wind above ridges. What snow felt like and how the rain outside sounded when you were inside near a fire. I wanted to see Earth again and, in wanting it, knew I was dying.

There are vague memories of the transfer from the Float to the shuttle —lights, a crewman talking—but when I opened my eyes again, we were on the ground.

And Casey looked down at me.

I knew I was dead then and tried to put my hand out to touch him, but couldn't. The med tech had strapped it.

"Commander." The same voice I remembered. Only the face more lined. Older. Grayer. But then I'd aged too. If this was Heaven, why wasn't he the same age he'd always been? If this was Heaven, why did I hurt?

"Where am I?"

"Casey's Planet," he said. His hand rested on the back of mine for a moment. "Sleep," he said. "We'll talk later."

I could have died then, perhaps should have. Most spacers in my condition did. My lungs were shredded and I'd been coughing blood all the way down. On the ground, in the gravity, they were under extra strain, but the doctor was good. He didn't let anyone in to see me for days and kept me pretty sedated. A couple of times, I felt a pinch as fresh blood was shot into me or a stirring on my back as a nurse changed my sheets.

And, a couple of times, I saw the face of Casey above me.

Eventually the sedation wore off. I saw sunlight, a touch of green on a hill, something that looked like an oak tree but wasn't.

"Welcome, Ran." Casey's voice. I turned my head and saw him—older, his face lined, his hair gray. But Dan Casey.

"You're not dead," I said. Which meant I wasn't either. I put my hand out and he squeezed. I tried to squeeze back but there was no strength in my grip.

"Not quite," he said. Behind him, outside the window, something red flashed in blue leaves. It wasn't a bird. It stopped moving and looked at me. It had big, brown eyes, red and black fur—and six legs.

"Where am I?" I asked.

"Casey's Planet," he said. "That's what they tell me you call it, anyway."

"Casey's Planet," I said. "You didn't die."

"No. Sorry to get you alarmed." He buzzed for an attendant and someone came into the room and helped me into a wheel chair. Casey pushed me down a hall, out a set of glass doors onto a

patio rimmed with blue trees. The red and black animal moved through the branches close to me, chattered and waved four of its arms.

"That's a gremlin," Casey said. He reached into his pocket, tossed a cookie and the animal snatched it out of the air. "Totally harmless, fun to have around, a cross between a squirrel, a cat, and a robin." He smiled again and looked around. What looked like apples were ripening on a nearby tree. The air was full of spice smells. On the opposite hillside, animals were grazing on yellow grass.

"Real cows," I said. "You planned it."

"From the beginning," he said. "From the first time I made planetfall on a place no one had ever touched. I figured there had to be a better way, a chance to set up the life I wanted for myself, for my kids, for millions of people.

"And this is it?"

"It's a start."

"You collected the team," I said. "All the Explorer crews you worked with, all the time you spent talking with people in the Ag centers and zoos. You found people who thought the way you did. You probably worked to get them assigned to you." He smiled and nodded. "That's why there were so many women on the crew . . . you needed them."

"They've averaged six kids apiece," Casey said. "Some the natural way . . . some with implanted embryos. There's a hell of a gene pool here."

"Cows, sheep, and goat embryos, too," I said. Another nod and another smile. "Chicken, pheasants, seeds."

"Even honey bees," Casey said. "Frogs. Salmon. Mussels. Clams. Oak. Apple. Balsam. Poplar."

"You lived in the shuttle for a while."

"Not long. We had to build places to live the first year."

"Had to?"

"The law library you had me check aboard ship," he said. "It said that if we built a residence within the first year and held it for five, that would establish serious intent."

"Serious intent?"

"That's the phrase. Up to then we were deserters, mutineers even. I'd have been court-martialed. But after that time, the statutes ran out and we became a colony . . . a sovereign nation."

"And then you could contact the rest of the galaxy."

"No hurry. There was a lot to do, a lot to find out—what would grow, for instance, because we saw this as a farm planet. But we mapped it for 200 miles around, even laid out roads and future cities. Found ores, catalogued the plants and animals. Got to love the place—so clean, so open, so big."

"Didn't miss Earth, the Service, cities?"

"Not much. Too busy partly. Sometimes we didn't dare miss it: I think whenever we thought about what we'd done, we'd simply get scared. Mostly we loved what we were doing—starting something new, something we could shape the way we wanted."

"And you hung on for five years before you contacted the rest of the galaxy?

"Waited close to nine, Ran," Casey said. "We looked around at the end of five years—all 28 of us—plus the 30

children —and said we weren't ready yet. We didn't want anyone coming in —not until we were sure we could run things the way we wanted to."

"And then?"

"A year ago, we said we were here. It took a month for the first Lightship to arrive. Almost a year after that they sent a float."

"Tiny float," I said.

"Don't need much," Casey told me. "It's not exactly on the tourist maps yet."

"It can be," I said. I looked past the still-curious gremlin in the bushes to fields of blue and yellow grass where five small houses ringed a pond and fenced-in play yard. Beyond it stretched a lake with a white shoreline, puffy clouds rimming distant hills. "People will come. You can set up tours, find the right kind of Pilgrims, control the access."

"Lot of work," Casey said. "We'd need an administrator, someone used to dealing with crowds, handling records. It'd be endless work."

"Not for someone good," I said. "Might even be fun."

"You'd never get back to space . . . or Earth."

"I can't go back anyway," I said.

"Might as well stay then," Casey said. He put his hand out and I took it. It was all the contract I needed.

That was ten years ago. I still cough a bit—the lungs never healed entirely —And I don't do stairs well, but last year we set 3,000 Pilgrims up on some of the finest farmland in the galaxy. And that means everything: land surveys, crop selections, schools for the kids, medical care and transit and schools waiting for them when they arrived.

On the Galaxy World Chart, it's still called Randovann.

But it's still Casey's Planet to me.■

●If scientific discovery has not been an unalloyed blessing, if it has conferred on mankind the power not only to create but also to annihilate, it has at the same time provided humanity with a supreme challenge and a supreme testing.

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the reference library

By Tom Easton

The New World, Frederick Turner, Princeton University Press, $?, 182pp.
Circuit, Melinda M. Snodgrass, Berkley, $2.95, 232 pp.
Count Zero, William Gibson, Arbor House, $15.95, 264 pp.
Redwold, Charles L. Harness, DAW, $2.95, 229 pp.
Wizenbeak, Alexis Gilliland, Bluejay, $8.95, 288 pp.
Little Myth Marker, Robert Asprin, Donning, $7.95, 172 pp.
Flight in Yiktor, Andre Norton, TOR, $14.95, 256 pp.
Nerilka's Story, Anne McCaffrey, Ballantine/Del Rey, $12.95, 190 pp.
The Year's Best Science Fiction, Third Annual Collection, Gardner Dozois, ed., Bluejay, $19.95 hard, $10.95 trade paper, 624 pp.
Body Armor: 2000, Joe Haldeman, with Charles G. Waugh and Martin Harry Greenberg, eds., Ace, $3.50, 311 pp.
Earth and Elsewhere, Kir Bulychev et al., Macmillan, $22.95, 320 pp.
The Sound of Wonder: Interviews from "The Science Fiction Radio Show," Volumes I and II, Daryl Lane, William Vernon, and David Carson, Oryx Press, $18.50 each, 203 + xi pp. (I), 201 + vi pp. (II).

Believe it or not, though I have been writing this column for eight years, almost as long as Stan Schmidt has occupied the editorial throne, the two of us had never met. Nor had I met his assistants, first Betsy Mitchell and now Shelley Frier. All our dealings, from the time when I asked "Need a new reviewer?" and he said "Yes!" had been by mail and phone.

I can assert my purity no longer. I met Betsy at the 1985 Boskone. Back in February, at the 1986 Boskone, I met the tall, slender, black-haired, vivacious Shelley too briefly. In March, on a quick trip to New York to confer with some of my several editors, I met the short (compared to my 6′3″, anyway), balding, bearded, urbanely hospitable

Stan, and I hope to see the Man again. With luck, he will take a vacation in Maine, where I make my home. Not to knock the land of skyscrapers and funny accents, but New York is so foreign to my tastes that it might as well be an alien planet.

Poetry is foreign to my usual tastes, too. But some things transcend taste and the distinction between prose and poesy. I have before me a piece of science fiction so marvelous that if it were a novel, it might well cop the Hugo and the Nebula both. However, though it was published in 1985, none of us heard of it in time for the voting. We need a special award for such occasions.

What am I talking about? It's Frederick Turner's **The New World.** It's an epic poem, of all things. And it may be the first volume of poetry in many decades to warrant mass market publication. Bluejay, Bantam, NAL, TOR, take note. I can't believe you could lose by grabbing the paperback rights.

We usually think of epic poetry as in the style of *Beowulf*, the Norse sagas, Tolkien, and their ilk. They are set-pieces for archetypes, oral comic strips, akin to grand opera, their background replaced by thunderous music. Their lines are strongly rhythmic, their stories painted in bold primaries, their villains unmistakable, their heroes golden.

Turner has chosen a more modern verse form, "an enjambed long line divided by a caesura," of which the classic iambic pentameter is a special case. As a result, it is difficult to read his lines aloud in the sing-song so easy with the *Aeneid* or *Beowulf*. The rhythm is almost that of prose.

Turner improves on the classics in other ways as well. His characters are as boldly drawn as any of the past, but he fills in much more of the background, as perhaps he must if he chooses to write an SF epic. He gives us a time four centuries hence, after pogroms have destroyed most of the old middle class and many people have fled to the stars. America has four segments: the matriarchal Riots, urban dope-fiends; the Burbs, remnants of the middle class, slaves for the Riots; the Mad Counties, tyrannized by Christian fundamentalist fanatics; and the Free Counties, where rational democrats have achieved a paradise. Metals—their ores exhausted—are scarce. Energy is from the sun and wind. But microprocessors have provided intelligent swords and other weapons, and bioengineering means the technology of our times is barely missed.

The story centers on the efforts of Simon Raven, banished after his attempted rape of his half-sister Ruth McCloud, to raze his home Free Counties. He has become a Messiah to the Mad Counties, and his success seems all too likely. Against him are ranged his half-brother (by another mother) James George Quincy and his, Ruth's, and James's childhood playmate Antony Manse. James and Antony are both suitors for Ruth's hand; James wins when Antony fails an essential test. Both are also military leaders of renown; Ruth is a civil leader, and eventually a ruler.

Turner has given himself some grand material. There are conflicts of ideology and of personality, of good and of evil. There are echoes of myth, of Homer, of Beowulf. There is high heroism, and love, and sacrifice. And there is beauty —I think of a lyrical paean to the seasons in Mohican County. There is . . . There is poetry as poetry should be, but too rarely is.

I recommend this book as heartily as I possibly can. You are criminally remiss if you deprive yourself of the experience it offers.

* * *

I also recommend Melinda Snodgrass's **Circuit.** It's a conventional novel, but it escapes total conventionality by making its hero a constitutional lawyer and posing the problem of independence to be faced by space colonists in terms of his profession.

We begin with a power-hungry president reminiscent of Nixon at his worst. He looks at the colonies in orbit, on Mars, and in the Belt, sees their independence of his control—think of it! their legal system is little better than that of the kangaroo court!—and resents it. To establish control, he sends his old buddy, Cabot Huntington, into space as the judge for the new Fifteenth Circuit Court, with authority in treaty matters as well. With Cab goes Jenny, his erstwhile law partner and now his legal clerk.

Needless to say, the spacers don't appreciate his presence. They were doing just fine before he came, thank you, they know full well why he is there, and they refuse to patronize his court. But—meanwhile, a Soviet mining commune, sick of shortages of essential equipment, decides to sell its ore to a Western corporation and turn capitalist. The Soviets, who also wish to crack down on their colonists, conspire with the U.S. president, and Cab's first case calls for deciding whether the commune will be allowed to continue its independent course.

After suitable agonies, Cab caves in to the pressure from Washington. He decides for the Soviets, who then, with the aid of an American blind eye, nuke the commune. Cab's guilt crescendoes. Jenny leaves him. But then a survivor of the nuking appears to testify that what wiped out his friends was decidely *not* a meteorite. And Cab asserts his own independence. He returns to the supremacy of the law over politics, and in the process he winds up supporting the independence of the spacers.

Circuit seems a far more mature novel than much of SF for two reasons. First, the action upon which it relies is more mental than physical—though there *is* physical action. Second, the relationship of Cab and Jenny is more complicated, and more satisfying, than we often see. It is a novel for civilized grownups, not for adolescents of any age.

Do you qualify? Do you *want* to qualify? Then don't miss it.

The hero of William Gibson's **Count Zero** uses the title as his handle. He is really Bobby Newmark, a slum youngster hung up on the image of Gibson's patent "cowboy," plugged-in rider of the cyberspace range, data thief, slick manipulator of electron flows and great gobs of cash. That makes him a sucker. His connection slips him a piece of software, assures him it will break the blackest of "ice" (data security), and points him at a nice, safe databank to crack. Poor sucker. Poor chump. Things are not what they seem! The target's ice grabs him and is in the process of burning out his brain when a mysterious, apparently female figure steps through the veils of cyberspace to save his ass. He runs, and soon after a bomb blows his apartment to pieces.

Meanwhile, "executive recruiter" Turner is mounting a mission. A top scientist, Mitchell, responsible for the marvel of biochips, wants to defect from Maas Biolabs and join Matsuda. Maas will use guns to stop his departure; Turner's job is to dodge, fight, and run, as necessary, to get Mitchell to safety. But things are not what they seem. Instead of Mitchell, it's his daughter, her brain loaded with biochips, who flies

the ultralight to Turner's camp, and as she lands, someone blows the mission to blazes. Only Turner and the girl escape.

Meanwhile, disgraced art dealer Marly Krushkova is being hired by tycoon and art collector Josef Virek to track down the artist responsible for several "boxes," mounted montages of everyday items with a unique power. The trail leads her to Wigan Ludgate, a burned-out cowboy who is convinced that God resides in the world's computer net, and that God talks to him.

And here Gibson's plot lines intersect. Behind all the intrigue and action-adventure lie the independent artificial intelligences of the net. They hide from humans most of the time, but occasionally they emerge, sometimes posing as the gods of voodoo, sometimes as Wigan's God, sometimes as . . . I won't say. Gibson has knitted a masterful yarn, action-filled, suspenseful, thought-provoking. Read it, and enjoy.

Charles Harness's **Redworld** is flawed but still worth a read. We have a world where all is shades of red, relieved by touches of black. After a vicious war, science and religion have settled their differences by treaty, enumerating the allowed beliefs of science, drawing the line on technology at an embryonic industrial level, and splitting society between them. Witches, or lamias, are electrocuted which, because of the natives' chemistry, causes them to burst into flame. Water's place is taken by ammonia, and temperatures run 80 degrees Absolute. This is not Earth, nor are the six-fingered people human.

As the story opens, a lamia about to burn fingers young Pol as the prophesied Revenant: He who will die and live again, He who will bring change to the world. He shrugs it off and goes on to his first day at the paper factory. He meets Josi, the local madam, who has only five fingers per hand, and leads us through his world, which echoes strangely of our own, on his way to his apotheosis. In due time we learn that Josi is, as we suspect from the start, an Earth human somehow modified to live on Redworld. We learn too of her fantastic mission and of the role Pol must play in his world's future. And we identify with Pol, we cheer for him. We end the book with the sense that we have indeed tasted an alien humanity.

The flaws? Harness has written a tale of warmth and hope, but he has not managed to convince us to suspend our disbelief. There is the problem of Josi—a human living in a world that should kill her a dozen times over. There is the problem of the redness of Redworld—to an Earth human, yes, all would be shades of red, but a native (I should think) would partition the redness into as broad a range of colors as we are used to. There is the problem of terminology—jarringly, oxygen becomes oxien, nitrogen nitroen, ammonia monia, and so on; Harness has sought to convey his world's alienness but achieved only silliness. He has failed to reconcile truly the alien and the human viewpoints.

There is also the story's obsession with life after death. Pol talks with his dead brother, who provides much of the information that resolves the tale. This fits with Harness's own obsession with his own dead brother, explained in his interview in *The Sound of Wonder, Volume I* (see below). I find it unlikely, but I must admit that, with the interview at hand, it adds an interesting depth to the story.

Bluejay is touting Alexis Gilliland's **Wizenbeak** as "the first of a series that will appeal especially to fans of Piers

Anthony's *Xanth* series and Robert Asprin's *Myth Adventures*." Bluejay may be right, but I think the resemblance is rather vague, especially to the latter. *Wizenbeak* is not played entirely for yocks. Wizenbeak is a wizard whose talent is for finding water. His familiar is a troll-bat, enchantingly drawn by illustrator Tim Kirk, and his mission is to colonize the wasteland to the north of the kingdom of Guhland. As he departs with a corps of 50 mercenaries, the kingdom is beginning to totter. One prince is accusing his stepmother of preserving his dad on the throne as a living corpse, a ghola (remember *Dune*?), hoping to gain time for her own son to grow up and claim the kingship. The other prince hews to the queen. The first prince allies with the church to attack witches and gain popular support. The second plays it cool, preferring a longer view, and dispatches Wizenbeak.

Wizenbeak is a figure of fun, yes, but he also stands for the power of reason over passion. His role is emphasized by the fate of his patron, for the second prince also favors reason, but he uses it in the pursuit of power; and in the end he falls, as do his brother and stepmother. We are left with the wizard, the maid he saves from burning as an accused witch, and the queen's two children, one of whom brings from the debacle a very interesting soul.

The book is readable and fun, but it is not as slight as the comparison to *Xanth* and *Myth Adventures* suggests. Buy it, enjoy it, but note that Gilliland is saying something serious.

Not serious at all, except in the occasional aside, is Robert Asprin's latest in the *Myth Adventures* series, **Little Myth Marker.** Here Skeeve, the bumbling, impossibly successful apprentice to the demon Aahz, wins big at the hypercomplex game of dragon poker (the value of a hand depends on such factors as the day of the week and the weather). Jealous competing wizards then hire the Axe, a character assassin, to do him in, but despite the usual assortment of imbroglios, deftly illustrated by Phil Foglio and mostly centering on Markie, a little girl whom her father hands over as his marker when he loses at dragon poker, he comes out on top. As usual.

The root of the humor is Skeeve's ingenuous ineptitude. It is thus low humor, slapstick, burlesque. Strictly for yocks. But it *is* humor, and the reader *does* laugh. Enjoy.

My last two novels this month are ones about which I needn't say very much. You'll buy them no matter what.

First is Andre Norton's **Flight in Yiktor.** As the sequel to *Exiles of the Stars*, it brings back Maelen, the Moon Singer of Thassa, now in the body of a long-preserved woman of another race; and Krip, the human in a Thassan body. They are on their way to the Thassan homeworld, Yiktor, but first they stop for refitting and acquire the hunchbacked waif Farree, whose telepathic facility with animals makes him valuable. When they finally reach Yiktor, they find the Thieves' Guild awaiting them, eager to avenge their loss of the Forerunner cache in *Exiles*. The Guild also wants whatever ancient artifacts the Thassa may have stashed away, and that conflict drives much of the book.

I was very happy to see that Norton had not written another of her fantasies, though they too are often excellent. In *Flight*, she is at her SF best.

My second short take is Anne McCaffrey's **Nerilka's Story.** It develops an incident in *Moreta; Dragonlady of Pern* into a small novel. After the

plague, in which Nerilka has lost her mother and several sisters, she flees her overbearing father and his imperious bride, taking her healing skills to Ruatha, where the plague had begun. There she helps with the recovery and finds true love.

A slight tale, but well done and a nice addition to the canon.

As the current editor of *Asimov's*, Gardner Dozois is in a somewhat awkward position when it comes to picking the year's best SF stories for **The Year's Best Science Fiction, Third Annual Collection.** He recognizes the problem when he says that "Even though no material purchased by me appeared in calendar 1985, as *IAsfm* editor I could be said to have a vested interest in the magazine's success—so that anything negative I said about another SF magazine . . . could be perceived as sour-grapes or, worse, an attempt to make my own magazine look good by tearing down the competition.

"Aware of this constraint, I've decided that nobody can complain if I only say *positive* things about the competition. . . . "

That's from the introduction, in which he overviews the 1985 SF scene—good performances, deaths, awards, promising novels, and so on. He does not promise to make this anthology his last or to refrain from picking for future volumes stories he buys for *Asimov's*.

Perhaps that will bother some people. It does not me, for Gardner has once again done an excellent job and I expect he will continue. Here he gives us two dozen tales, tending to novelette size, with no dogs at all in over 600 pages. Buy the book for Lucius Shepard's "The Jaguar Hunter" and "A Spanish Lesson," in both of which modern humans encounter the alien. Buy it for Bruce Sterling's charmingly ecofanatical "Green Days in Brunei" and his prophetic "Dinner In Audoghast." Buy it for Michael Swanwick's and William Gibson's "Dogfight," or Joe Haldeman's "More Than the Sum of His Parts," or Tiptree's "The Only Neat Thing to Do," or Waldrop's "Flying Saucer Rock & Roll," or S.C. Sykes's "Rockabye Baby," or Kim Stanley Robinson's "Green Mars." Buy it for Shiner, Cadigan, Blaylock, Martin, Williams, Pohl, Crowley, Card, Fowler, Silverberg, Kelly, Kress, and Davidson. You won't be disappointed.

If you prefer theme anthologies, and if you have a taste for gore, take a look at **Body Armor: 2000,** edited by Joe Haldeman, Charles G. Waugh, and Martin Harry Greenberg. Its one original story is my own "Right to Life." The rest are reprints; of them, the newest and best is C. J. Cherryh's "The Scapegoat," in which a human-alien war can end only when at least one human accepts the aliens' very different view of war and peace. The others include stories by David Drake, Larry Todd, George H. Smith, Richard C. Meredith, Robert Sheckley, Gordon Dickson, Allen Kim Lang, and Harry Harrison. There is even the opening segment of Haldeman's *Forever War*. Most get a lot of mileage out of self-powered, armored suits like that in Heinlein's *Starship Troopers*.

Earth and Elsewhere collects five Soviet SF novelettes, two of which actually strike me as good enough to survive Roger DeGaris's translations (the other three may appeal more to other readers). They are Kir Bulychev's "Another's Memory" and Oleg Korabelnikov's (a new and rising Soviet writer) "Tower of Birds." In the first,

an aging biologist clones himself. The story hinges upon the premise that a clone retains the memories of the original, but without the inhibitions that make many of them inaccessible. Bulychev uses the results to study the original's life and career quite effectively and movingly, and to consider the need of any child to become separate from the parent.

In Korabelnikov's story, a curio-hunter wandering through Siberia becomes embroiled with forest spirits, discovers his own link to nature, and returns as an environmentalist to civilization. Sadly, in the USSR, his is as futile a mission as it was in our own land not so long ago, but the story does indicate that that may change in coming years.

Of the remaining stories, Arkady and Boris Strugatsky's "The Way to Amalteia" may suffer worst in translation. DeGaris seems unaware that in English, Jupiter's closest moon is called Amalthea. The tale itself, in which disaster strikes a relief ship heading for a scientific station on short rations, seems leached of what might have been a great deal of emotional power, but I cannot say how much of the loss happened in translation. Sever Gansovsky's "A Part of the World" presents a world in which brain transplants are routine and the Soviet bureaucracy, aided by absent-minded computers, can lose the foundations of a city; it has a hint of Goulart. Olga Larionova's "A Tale of Kings" tells us of how the two most gorgeous humans on Earth, a Russian man and a French maiden, are kidnapped by an alien who wishes to relearn the nature of love; sadly, the alien's very defect dooms the Earthlings, as well as the alien species.

I found this collection rather more satisfying than some of its predecessors in Macmillan's long series of Soviet anthologies. Most to the point, despite its defects, it has at least two excellent stories, and it thus stands on its own as well as do many anthologies of American or English SF. For the first time, I can urge you to buy it for the sake of its fiction, rather than for the sake of what it tells us about another major portion of the world.

The price is high, but $37.00 (plus applicable tax) will buy you interviews with sixteen SF writers, one artist, one movie critic, and a publisher, packaged in two slim paperbacks from Oryx Press (2214 North Central at Encanto, Phoenix, AZ 85004) (to order toll-free, call 1-800-457-ORYX; in Arizona, Alaska, and Hawaii, call 602-254-6156). The books are the two volumes of **The Sound of Wonder: Interviews from "The Science Fiction Radio Show"** that evolved when an SF course at Odessa College failed to get off the ground. Professors David Carson and Daryl Lane, with the aid of others, including research chemist William Vernon, turned the course plan into a series of interviews for the campus radio station. Later, they changed the format for syndication through the Longhorn Network and, eventually, reworked their tapes to produce the books.

Volume I gives us Stephen R. Donaldson, C.J. Cherryh, Hal Clement, Charles Harness, Theodore Sturgeon, Howard Waldrop, Jack Williamson, Rudy Rucker, and Michael Whelan. Volume II covers Piers Anthony, Edward Bryant, Philip Jose Farmer, Don Wollheim, James Hogan, Marion Zimmer Bradley, Roger Ebert, Gene Wolfe, Gordon Dickson, and George R.R. Martin. In each case, the interviewers prompt their subjects to speak of why they are involved in SF, their philosophies, their ideas, their plans, and their

relationships with their readers. It is all interesting stuff, but it lacks some of the charm of Platt's work (the *Dream Makers* books). Many of these interviews were done by phone, and the interviewers give us nothing at all of their subjects except their words.

There is no harm in such books, just as there is no harm in such celebrity magazines as *People*. The writers are willing to be interviewed—it's publicity, after all—and people seem willing to read the results. But the interviewers pick the same people so many times, there is so much repetition, and I wonder how much value one more round of Donaldson/Cherryh/Williamson/etc. can have. Would it not be better to wait a few years and give the writers time to come up with new things to say? Or to pick subjects who have not already been interviewed to death?

In all fairness, I should emphasize that Lane, Vernon, and Carson have not picked only the biggest names. They have a number of subjects who do not appear in every other book of interviews, and those subjects are the ones who give these volumes what value they have. ■

brass tacks

Dear Stan:

Recently I ran across stories about Joseph Newman and the patent office denial of a patent on a revolutionary new concept in electric and mechanical energy generation. He claims his machine will develop more external output by several orders of magnitude than the external, electrical energy input.

Joe has built three operational prototypes after more than fifteen years spent studying and developing his conceptual theory. He has also collected a large number of affidavits from physicists, electrical engineers, and technical individuals stating that after careful testing, his invention *does* develop more energy output than the external input.

It appears that:

a. His theory probably was suspected by Michael Faraday but could not be detected with the instruments of that time.

b. The incomplete theory published by Faraday worked reasonably well. It and subsequent theories from Faraday and his successors have been frozen into accepted "laws." These laws are learned by rote and accepted on faith by most technically educated people.

Mr. Newman has now published a book fully disclosing his theory. The book contains formulae, charts, graphs, and photographs. He states the book was written and the prototypes made for the good of mankind, rather than to prove to himself that his theory is correct.

It seems to me that the people most likely to visualize the potential of his claims—that from his theory can come limitless, non-polluting power and energy—are the readers, writers, and editorial staff of *Analog*. How many of you dare to accept his challenge to develop his concept—or refute him?

PARKER ANDERSON
1279 Houston St.
Melbourne, FL 32935

I have no firsthand knowledge of how valid Mr. Newman's claims are, but I've read enough about his invention to provoke a good deal of curiosity. In view of the number of similar claims which haven't panned out in the past, I can understand and sympathize with a healthy skepticism, but the response of the Patent Office (if the accounts I've read are true) seems to go beyond that. At this point it would seem that what the Newman device needs is some independent attempts to duplicate it, and maybe some of our readers will have the interest, time, and means to do so. The book is called The Energy Machine of Joseph Newman, *and it's available from the Joseph Newman Publishing Company, Route 1, Box 52, Lucedale, MS 39452 for $34.95 plus $3.50 for shipping and handling (plus 6% sales tax for Mississippi residents). I must emphasize that this is not an advertisement or endorsement; I am in no position either to vouch for or to deny the book's value. But those who would evaluate Mr. Newman's work must necessarily start by familiarizing themselves with it, and this would seem the logical place to begin.*

Dear Mr. Schmidt:

Until your November '85 editorial "The Old Refrains," I was willing to forgive your occasional lousy story and accept a ration of about one great tale for every five mediocres. Indeed; I think you often do better than 1:5, and an occasional "Leaves of October" cements my loyalty further. However, this "Refrain" editorial was too bereft of compassion and full of that specious aristocracy so popular among us New York City media folks that my anger was moved to comment.

Later when I read the rest of that issue, I began to seethe. Here, in one issue, you establish your literary criteria and then violate those criteria at least three times!

To review; "The Old Refrains" is your "editor's lament" about how cliche story submissions clog your "slush pile." The editorial's major complaint was that most unpublished writers submit plots which fit one of several overused themes while offering no redeeming literary value. Fine. Your article caused me to reflect nostalgically upon my own writing career which began when I was 17 after receiving one of John Campbell's 2-page rejection letters.

What you failed to note to your readers in the editorial (but elaborately insinuated throughout that issue) was a major fact of magazine life: that all the "rules" in your editorial apply only to unpublished writers. "Name" writers, like Eric Iverson's expendable incarnation, "Harry Turtledove," W.R. Thompson, George R.R. Martin, and Ben Bova can submit all the cliched trash they like and get them joyfully published for magazine rates.

What a rude slap in the face you bestowed upon loyal readership/writership when you tell them, "I *know* that in any given month I'm going to see at least a few of *each* of the following: Adam & Eve, Computer Game A, Computer Game B"; and then fifty pages later print a sure-fire reject like, "The Efficiency Expert," obviously a Computer Plot C: Computer takes over the world, *á là* Heinlein.

What are you really telling those naive kids who have real creative careers ahead of them when you condescendingly write, "If you're planning to write one of those stories on my little list, bear in mind they have to be that special to make the grade," and then show them what you mean by Ben Bova's

"Béisbol." A Robot vs. Human story —done better by Serling in a boxing ring 25 years ago.

Why did you forget to tell them about the Last Rule of Magazine Publishing: "The worst story by a famous writer sells more copies than the best stories of an unknown."

So I'd like to propose imposing Readers' Rights. Lets put it to a Brass Tacks Vote. I propose we demand that you try a six-issue experiment: Print what you think is the best unpublished writer's submission each month. I, for one, am willing to see six real slush pile entries from unpublished writers and decide for myself. After six months we can all decide.

GEORGE AVGERAKIS

New York, NY

I hate to disappoint you, but your "major fact of magazine life" is emphatically nothing of the kind. (Frankly, it sounds suspiciously like sour grapes.) Your choice of examples is particularly ironic, since two of the writers you mention are the ones I bought out of the slushpile quite recently, and whom you only consider "name" writers because I and other editors have bought several more things from them since then. Here's a really *elementary fact of magazine publishing for you:* Every *"name writer" first had to attract some attention as an unknown. The most popular story I've published since I've been editing* Analog *was a first story by someone who was then a complete unknown —and most "name writers" have stories rejected a lot oftener than they'd like you to know.*

So your "experiment" is unnecessary —we're already doing it, all the time. As for "lack of compassion," you missed the point entirely. The object of the editorial was not to grumble about the writers who don't make it, but to give those with potential a better idea how they can*—for their sake as well as yours and mine.*

Dear Sirs,

All things pass, I suppose (or as some trendier folks say, "entropy prevails"). But even so, I would like to add my contribution to the many letters of praise and regret you will receive now that Spider Robinson has finished off his Callahan's Place stories.

I've never quite been sure what to make of the Callahan stories. In almost every one of them, there was something that rankled. I never liked Mr. Robinson's (or rather, his protagonist Jake's) treatment of women, and I always thought there was too much smart-assed patness in his remarks on life and the ways of man. But I loved the stories anyway. I've read every one I could find, even going so far as looking through back issues in the library to see if there were any I'd missed. There was a Callahan story, the very first Callahan story, in the very first issue of *Analog* that I read ("The Man with the Eyes"). And it was the unexpected discovery of a Callahan story, the very best Callahan story ("The Time Traveler"), in reprint that got me started reading science fiction again after a four or five year stretch when I couldn't bear to look at the stuff.

Oh, but if only there really were a Callahan's. . . . What a thing it would be to walk up to that chalk line and, pegging a glass hard into Callahan's fireplace, make a toast "to life, to all of us." Is such a thing possible, I wonder? Even without the interstellar invaders, assorted time travelers, and the talking dog, it seems just too wonderful, generous, and audacious a thing for some place as real as Suffolk. Oh well . . . Maybe it's better that Callahan's existed only in Spider Robinson's

imagination. That way, it could be shared by thousands of us rather than just a lucky few.

Finally . . . A few weeks ago in the *New York Times Magazine*, William F. Buckley wrote that the advantage Marxism and fanatical Islam have over mere humanism is that they are redemptive creeds while humanism is not. Clearly, Mr. Buckley never heard of Callahan's place.

G.W.LUCAS

New London, CT

Dear Stan:

In re Charles Hornig's letter to Brass Tacks (October '85) and Clark R. Anderson's rebuttal (April '86)—may I offer a nontechnical reader's viewpoint?

Mr. Anderson is absolutely correct when he suggests Mr. Hornig is insulting *Analog*'s readers' intelligence! There are lots of SF (and sci-fi) magazines, but *Analog* is the only one I consider educational as well as interesting.

I personally was raised on science fiction and *Analog* from a very early age. I have been a subscriber for about ten years now.

I have some college education (mostly nontechnical—majored in music two-and-a-half years, switched to zoology), and am currently working hard at what I consider the most important job in the world—raising children.

At times I do flounder through a science fact article (physics is my downfall), but I always *learn* something. Sometimes I don't fully appreciate the technical aspects of the science in a story, as I'm sure Mr. Anderson does, but I love to consider and discuss with my father, my husband, or a friend the plausibility of the ideas presented. And what I learn will be passed on to my children, if not in actual fact, then in attitudes.

Right now my two-and-a-half year old son loves *Analog* for the spaceships and unusual creatures pictured, and my three-month-old son is only interested in mama's milk, but all of my children will receive exposure to mind-broadening concepts via *Analog* as well as other sources. I hope it will help them stay out of too many ruts in their thinking.

No, Mr. Hornig, I don't believe that ANY of the science articles are "*far* too technical for the average reader" (emphasis mine). I don't know what the "average" is for *Analog* readers, but I'll bet a lot of them have a better technical background than I do. I am glad to have my knowledge increased and my imagination stretched. (I also subscribe to *Scientific American*.) If the technical aspects of an article or story cause me difficulty, I can almost always find someone to help me understand it. If it was always simplistic enough for me to fully understand, how much would I learn?

As to Stan's editorials, don't we all need to really consider where our society—our world—is headed? The editorials, the stories, the science articles bring out ideas we all need to think about. Is the most important thing about a science fiction story hard science? That can certainly help define science fiction as opposed to science fantasy—but such a narrow definition leaves out stories with great social implications such as "Night of Power" by Spider Robinson. Must editorials in a science fiction/science fact magazine be only about SF or science facts? Or is one of the reasons why science fiction—and *Analog*—exist is to fulfill the need in humans to explore the future and to consider the consequences of our actions, or lack thereof, as is often the case! *Analog* brings us ideas about our

society, our world, and our future that we *need* to consider.

I want to end by saying, Thank you! Thank you, John Campbell, Ben Bova, Stanley Schmidt, *Analog*, and all the many authors and others who through the years have helped and are still helping to keep us from resting on our technological laurels and stagnating!

SANDY LARSEN

131 Robinhood Lane
Route 1
Jones Creek, TX 77541

Dear Dr. Schmidt:

Regarding your editorial ("The Panic Mentality," May 1986), thank you for reminding me that I am not the only one wondering about the sanity of my fellow Americans.

My home state of Texas has already passed a mandatory seat belt law using the "We're gonna make you safe whether you want to or not" principle. One of my employees just recently was in an accident in which his car was totaled. He came into the office afterwards saying how that accident made a seat belt believer out of him—until I asked him what would have happened if the car had hit him in the driver's side door instead of the passenger side door. He left my office a bit bewildered.

People don't seem to understand that safety and risk are probabilistic; they seem to believe that "seat belts save lives"—no matter what. In fact, I'm beginning to suspect that the mandatory use laws are actually going to increase the number of accidents, since it seems to be axiomatic that people are going to take more chances now that seat belts are guaranteed to save their lives.

Keep up the good work. *Analog* is one of the few pieces of printed matter that I still look forward to reading.

By the way, thanks for the new peelable address labels.

MICHAEL HANKAMER, PH.D.

Buda, TX

Dear Stan,

I've noticed an intriguing point about the mathematics of Fred Pohl's *The Coming of the Quantum Cats*. The binary arithmetic of his multi-world congerie is hard to handle, even when broken up by commas and dashes. Computers use binary, but computer operators do not. Binary numbering may make things convenient for computers, but then again, computers are here to make things convenient for people. Besides, human use of binary wouldn't make things easier for computers—it's just too damned easy to misread a long binary number, and if you made a mistake punching one into a terminal, imagine the trouble (and eyestrain) of spotting the error. Everyday numbers would become impossibly cumbersome; for example, you would have to use a twenty-three digit phone number just to make a local call. Even if you could remember *one* such number, dialing it would be a hassle.

Yet there is a way around this mess. Pohl doesn't mention it, but his numbering system is actually base eight! Convert his groups of three binary digits into their ordinary counterparts and you will see this is true (this is a trick I learned in a programming class years ago). Octal numbers can be converted to binary simply by replacing each octal digit with its binary equivalent. There's no need to give numbers new names; our old system will work fine—64_{10} becomes 100_8, pronounced "one hundred" and understood to mean eight squared. This still leaves the matter of keyboards and telephone dials—which raises a troubling point.

If there is such a thing as parallel time, then eventually all possibilities must come to pass—and, even by coincidence, *Quantum Cats* must describe events which happened in a real alternate time. Ballistic recoil becomes a serious problem—one we have to worry about. Take a look at the dial-a-subscription ad on p. 37 of the April 1986 *Analog*. As Marc Miller pointed out in Brass Tacks a few years ago, the stylized dial in the ad has eight holes—making it part of an octal system. I can't help but notice that this ad first appeared in 1982_{10} . . . around the same time that the DeSotas and Douglasses started working with their portals. Sure, the problem is starting out small, and right now it only effects little things like printed pages, but there's no telling where it could end, Albert.

W. ROCH THOMPSON

Dear Dr. Schmidt:

May's *Analog* is the sort of issue which has made *Analog* my favorite publication. Science fiction with rivets, and good science fact. But there seems to be something missing from Vinge's bobble stories, a very nearly inevitable consequence of bobble technology.

Bobbles can, and usually do, have centers of mass that aren't balanced. Otherwise, the Korolev's castle would come out of the bobble upside down, like as not. This means that they can be used as high energy density fly-wheels. Relativistic fly-wheels, in fact. Simple equipment can be used to dump energy into them in virtually unlimited quantities, and you could get the energy back out again at high efficiency with a couple of dollars worth of components. (Suspended magnetically in a vacuum, a coil and a couple of diodes could extract the energy; add an oscillator and you can put it back in, too.) A high energy bobble suspended in an air duct would make a jet engine that would sneer at rock dust, and require no fuel tanks. Just recharge it on the ground from a central power supply. A very high energy, short-lived bobble would make a planar explosion with an intensity comparable only to anti-matter.

. . . Lunan's answer to the Fermi paradox looks good, indeed. I still recall the disappointment I felt when I learned of the long term effects of cosmic rays. While they hardly make space travel or colonization impossible, they do make it enough harder to raise the threshold for private space travel. Remember those intrepid pioneers in O'Neill's book, *The High Frontier*? They would have arrived in the asteroid belt as low grade morons. Could they have afforded the drives and fuel to carry along enough shielding? And consider the von Neumann machines. Although Lunan has hopes for those, would such probes designed without knowledge of cosmic rays have sufficient self-repair capability to survive orders of magnitude more radiation than anticipated? You can picture such a machine, poking along through interstellar space, accumulating radiation damage behind several centimeters of shielding.

BRETT PAUL BELLMORE
8750 Burt Rd.
Capac, MI 48014

The authors reply. . . .

I agree that bobbles would have striking consequences beyond the obvious time travel and weapons applications—and thinking of new possibilities is fun. Some of these I simply missed, and some didn't affect Wil's last case enough to mention (e.g., the consequences of super small bobbles on electronics technology). Brett Bellmore's energy storage scheme is neat; it should be possible to spin up a bobble.

Two things for speculators to keep in mind: Bobbles are always spherical (so for special shapes, Larry Niven's stasis fields are in order); and you can't bobble a bobble (though the effect can be faked with cooperating, well-synchronized bobblers).

VERNOR VINGE

and . . .

I took Mr. Bellmore's comments to my good friend Chris Boyce, who argues strongly for galactic exploration by von Neumann probes in his book *Extraterrestrial Encounter*. The first point to emerge is that even if the probe makers don't know about high-energy cosmic rays, the probe's computers have to be hardened against radiation from the propulsion system, and also against natural radiation phenomena in the origin solar system: giant planets' radiation belts, solar flares etc. These may be much more violent in some of the destination systems where the probes and their descendants have to replicate themselves. So the computers will be built from materials which are structurally resistant to radiation damage—ceramic blocks, Chris guessed, with embedded electrical networks analagous to those of an organic brain—with multiple backups, so that even a century's worth of unexpected cosmic ray bombardment wouldn't prevent accurate replication in due course.

The second point is Chris's insistence that accurate replication of the original "brain" is easier to achieve (by comparing the memories of several units, even if damaged) than the ability to make repairs to an existing unit of such complexity. From what we know of the way that memories and skills are diffused through the brain, although marshalled by localized centers, it doesn't seem that replacing damaged cells would restore previous performance. Instead you do what nature does with organic brains: make a new one and educate it.

Chris believes that the von Neumann probes will contain the full personalities of their makers, duplicated as many times as need be to ensure accurate replication in destination star systems. As the descendants of the first probe spread out through the Galaxy, new personalities will be added by transmission from the home system, from other civilizations, and by exchanges with other civilizations' probes. The distinction between organic and ceramic brains will have become unimportant not because the machines have replaced or enslaved us, as in dystopian SF, but because full interaction has raised them to our level. In any planetary system reached you can transfer your awareness into as many organic or mechanical bodies as you like, to say nothing of the imaginative realms the computer can generate for you. Lifespan becomes infinitely prolonged and infinitely varied.

By this time Chris and I part company. It seems to me that however seductive such capabilities may appear, for an individual personality to bring so many changes must ultimately be depersonalizing. Unless the individuals who sent out a von Neumann probe are recreated each time *as they were*, so that every Contact is a First Contact, then what you get if you're on the receiving end is First Contact with a beehive. I'm much more attracted to the idea of putting Daedalus engines on habitats, getting out there, and doing things our way. Traveling to the stars in frail organic bodies which have to be heavily shielded against cosmic rays may not be efficient, but I bet that it's a lot more fun. As I said in the article, if there are only von Neumann probes out there then our predecessors' stories may have been sad ones—but ours doesn't have to be.

DUNCAN LUNAN ■

a calendar of analog upcoming events

14-16 November
PHILCON (Philadelphia area SF conference) at The Adams Mark Hotel, Philadelphia, Penna. This is the 50th anniversary year of the Philadelphia SF Society. Principal Speaker—Isaac Asimov, Artist Guest—Michael Whelan, Special Guest—Frederik Pohl. Registration—$15 in advance, $20 at the door. Info: PSFS, Box 8303, Philadelphia PA 19101.

15 November
PENTACON II (Indiana Gaming conference) at Grand Wayne Convention Center, Fort Wayne, Ind. Registration—$3 until 15 August, $4 thereafter, $5 at the door. Info: Northern Indiana Gaming Association, Box 11133, Fort Wayne IN 46856.

5-7 December
TROPICON V (South Florida SF conference) at Howard Johnson's Ocean Resort Hotel, Deerfield Beach, Fla. Guest of Honor—Gardner Dozois Guests include Dr. Robert Collins, Lee Hoffman, Brad Linaweaver, Somtow Sucharitkul. Registration—$10 until 31 October, $15 thereafter. Checks payable to: South Florida Science Fiction Society. Info: SFSFS Secretary, Box 10743, Ft. Lauderdale FL 33307.

8-10 December
Conference on the Impacts of Physics on the Frontiers of Medicine at Buena Vista, Fla. Info: L. Scott, Global Foundation, Box 248103, Coral Gables FL 33124.

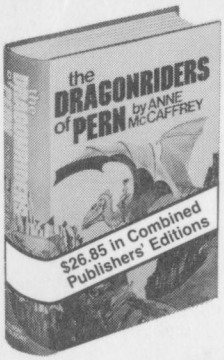
8-12 December
American Geophysical Union Fall Meeting at San Francisco, Calif. Info: Brenda Weaver, Meeting manager, AGU, 2000 Florida Ave. NW, Washington DC 20009.

27 August-2 September 1987
CONSPIRACY '87 (45th World Science Fiction Convention) at Metropole Hotel & Conference Centre, Brighton, U.K. Guests of Honour—Alfred Bester, Doris Lessing; Fan Guests of Honour—Joyce and Ken Slater; Artist Guest of Honour—Jim Burns Special Fan Guest—David Langford Registration—Attending (until 30 September 1986) £25, $40, $A50; Supporting £10, $15, $A20; 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: ConSpiracy '87, Box 43, Cambridge CB1 3JJ, England, U.K. OR Bill & Mary Burns, 23 Kensington Court, Hempstead NY 11550 OR Justin Achroyd, GPO Box 2708X, Melbourne, Vic. 3001 Australia.

3-6 September 1987
CACTUSCON (North American SF Conference) at Hilton, Hyatt Regency, Convention Center, Phoenix, Ariz. Guest of Honor—Hal Clement, Fan Guest of Honor—Marjii Ellers. Registration—$15 supporting; $30 attending until 15 September 1986. Info: CactusCon, Box 27201, Tempe AZ 85282. (602) 968-5673.

—Anthony Lewis

Items for the Calendar should be sent to the Editorial Offices six months in advance of the event.



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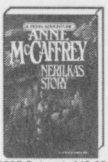

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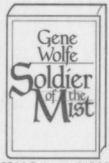

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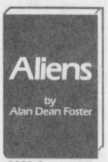

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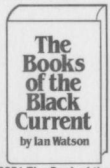

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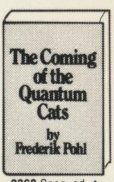

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