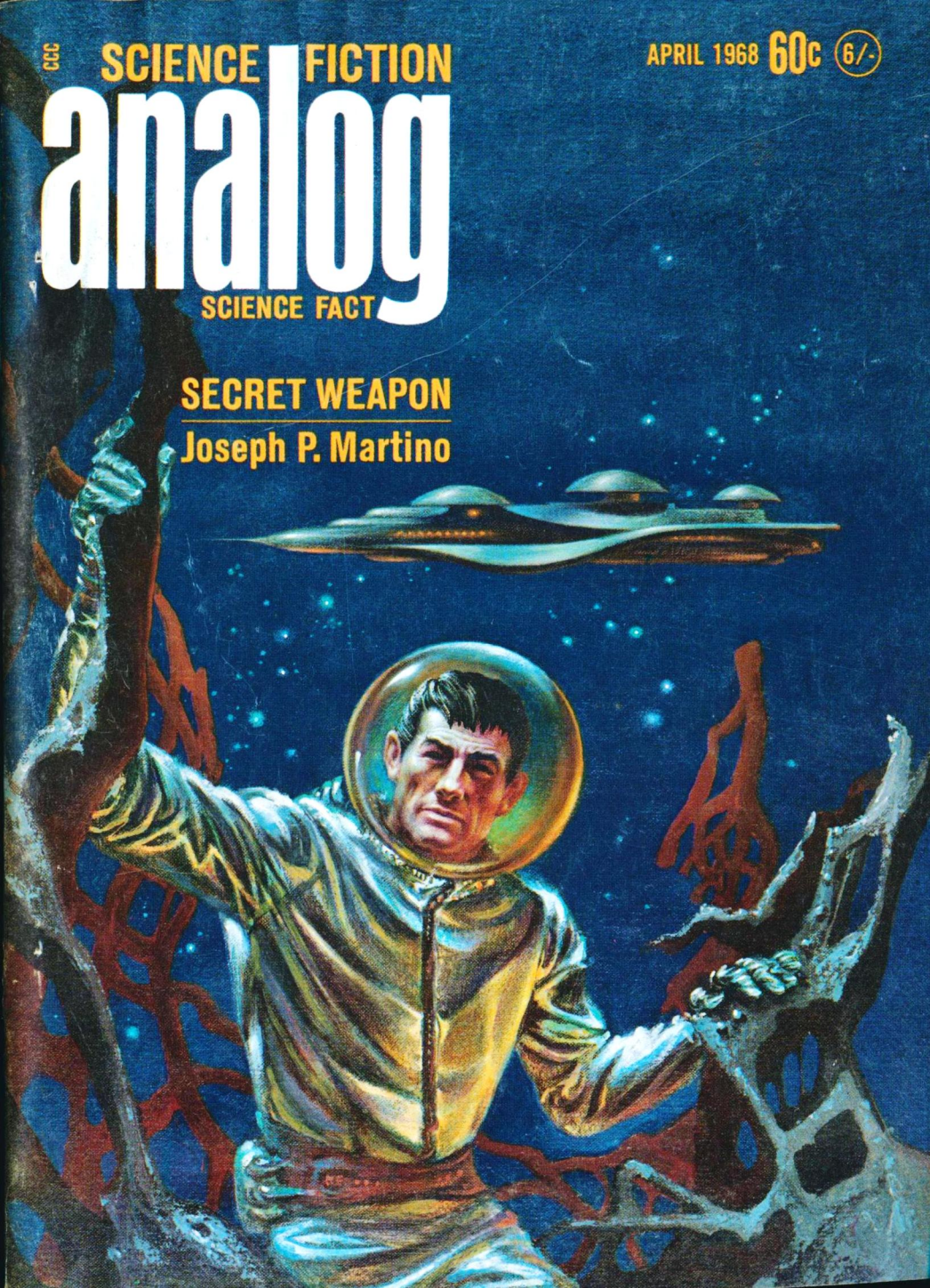
CCC

SCIENCE FICTION analog SCIENCE FACT

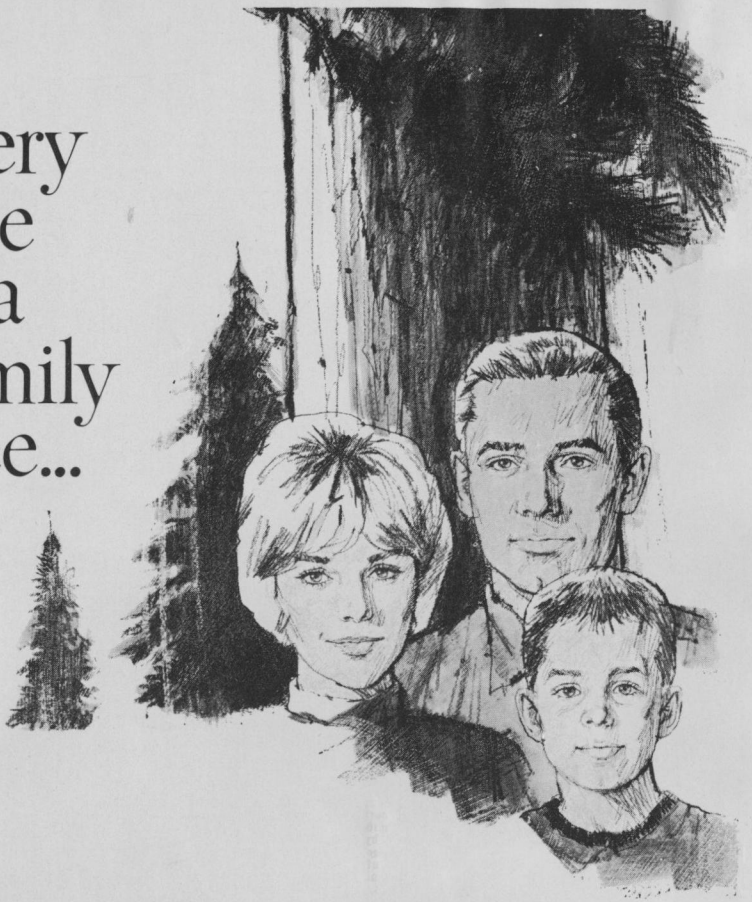
APRIL 1968 60c 6/-

SECRET WEAPON

Joseph P. Martino



every tree is a family tree...



Our trees and our forests provide your family with many happy hours of recreation.

That's why it's so important to protect them from forest fires. Nine out of ten forest fires are caused by careless people who forget Smokey Bear's ABC's: Always hold matches till cold. Be sure to drown all campfires, stir the ashes and drown them again. Crush all smokes dead out.

SMOKEY

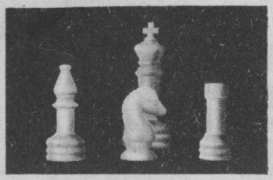
ADVERTISING COUNCIL PUBLIC SERVICE

please! only you can prevent forest fires

Published as a public service in cooperation with The Advertising Council.

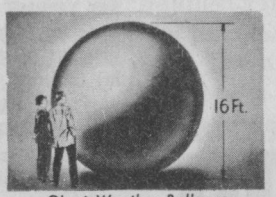
MAIL ORDER SHOPPING MART UNUSUAL VALUES

A selection of products available by mail for readers of Analog.
All merchandise sold on a money-back guarantee. Order Direct by Stock No. Send check or M.O.



AMAZING NEW HOLOGRAMS

Almost unbelievable new 3-D photo-technique for small cost Hologram (on film or glass) result splitting laser beam. Dimension appears carved in stone. Cut in half—parts still contain full scene. Fantastic potential. Use slide projector light source or flashlight bulb filament. Filter incl.
(Film: 4"x3¾") No. 40,969A $15 Ppd.
(Film: 2"x1⅞") No. 30,574A $ 4 Ppd.
(Glass: 4"x5") No. 40,984A $30 Ppd.



Giant Weather Balloons

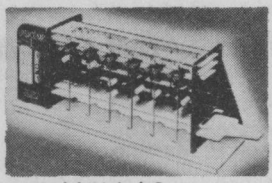
"Balls of fun" for kids, traffic stoppers for stores, terrific for amateur meteorologists. Create a neighborhood sensation. Great backyard fun. Exciting beach attraction. Amateur meteorologists use to measure cloud heights, wind speed, and temp. Made of heavy duty neoprene. Inflate with vacuum cleaner or auto air hose; or locally available helium for high rise.
Stock No. 60,568A ...8' .. $2.00 Ppd.
Stock No. 60,632A ...16'.. $7.00 Ppd.

Wff'n Proof—Games of Logic

Practice abstract thinking and math logic. Developed by Yale prof. If you think learning should be fun, try WFF'N PROOF brain-to-brain combat! 21 games of progressive difficulty. Starts with simple games mastered by 6-year-olds, ends with subtle logic for challenge professional logicians. 8½" x 5¾" case contains logic cubes, playing mats, timer & 224-p. book.
Stock No. 60,525A ..... $6.00 Ppd.

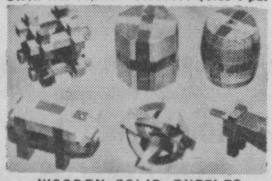
Car of the Future Here Now!

One of most impressive science toys we've seen. Low friction air car rides a fraction of an inch over any surface, including water. Graphically demonstrates same principles that apply to Ford's and Curtiss-Wright's new wheelless aircars. Sturdy red and yellow plastic. 8" wide, 9" deep, 2" high with 4" propeller. Operates on 2 flashlight batteries (not incl.). 48" control line, battery case.
Stock No. 70,307A .....$2.98 Ppd.



Model Digital Computer

Solve problems, teach logic, play games with miniature version of giant electronic brains! Adds, subtracts, multiplies, shifts, complements, carries, memorizes. Colored plastic parts easily assembled. 12" x 3½" x 4¾". Incl. step-by-step assembly diagrams. 32-p. instruction book covering operation, computer language (binary system) programming problems & 15 experiments.
Stock No. 70,683A ..... $5.98 Ppd.

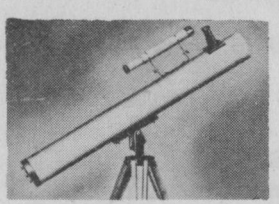


WOODEN SOLID PUZZLES

Here's a fascinating assortment of 12 different puzzles to provide hours of pleasure and stimulate ability to think and reason. Animals and geometric forms. Take them apart and reassemble them. Lots of fun for the whole family —young and old. Will test skill, patience and ability to solve problems. Order yours now.
Stock No. 70,205A ..... $3.50 Ppd.

"FISH" WITH A MAGNET

Go treasure hunting on the bottom! Tie a line to our 5-lb. Magnet—drop it overboard in bay, river, lake or ocean. Your "treasured" haul can be outboard motors, anchors, other metal valuables. Alnico V Type—Gov't cost $50. Lifts over 150 lbs. on land, much greater weights under water.
Stock No. 70,571A .....$12.50 Ppd.



3" ASTRONOMICAL TELESCOPE

See stars, moon, phases of Venus, planets close up, 60 to 180 power—famous Mt. Palomar reflecting type. Aluminized & overcoated 3" diameter f/10 primary mirror, ventilated cell. Equipped with 60X eyepiece and mounted 3X finder scope, hardwood tripod. FREE: "STAR CHART"; 272-page "HANDBOOK OF HEAVENS"; "HOW TO USE YOUR TELESCOPE"
Stock No. 85,050A .....$29.95 Ppd.
4¼" REFLECTOR TELESCOPE
Stock No. 85,105A .....$84.50 TCC
6" REFLECTOR TELESCOPE
Stock No. 85,086A .....$199.50 TCC

GET FREE CATALOG

SEND FOR FREE CATALOG 'A'

Completely new 1968 Catalog. 148 pages packed with nearly 4,000 unusual bargains. Exciting new categories. Many new items. 100's of charts, illustrations. Many hard-to-get war surplus bargains. Enormous selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, etc. For hobbyists, experimenters, workshops. Shop by mail. No salesman will call. Write for Catalog "A" to Edmund Scientific Co., 300 Edscorp Bldg., Barrington, N.J. 08007.

NAME

ADDRESS

CITY

STATE ZIP

ORDER BY STOCK NUMBER • SEND CHECK OR MONEY ORDER • MONEY-BACK GUARANTEE

EDMUND SCIENTIFIC CO. 300 EDSCORP BUILDING BARRINGTON, NEW JERSEY 08007

SCIENCE FICTION SCIENCE FACT
analog

JOHN W. CAMPBELL
Editor
KAY TARRANT
Assistant Editor
HERBERT S. STOLTZ
Art Director
ROBERT E. PARK
Business Manager
WALTER J. McBRIDE
Advertising Manager

NEXT ISSUE ON SALE
April 9, 1968
$6.00 per year
in the U.S.A.
60 cents per copy

Cover by
Kelly Freas

Vol. LXXXI, No. 2 April 1968

EDITORIAL AND
ADVERTISING OFFICES:
420 LEXINGTON AVENUE
NEW YORK, N. Y. 10017

Inherited Xenophobia

Editorial by John W. Campbell

The human race—and all other mammals, too—has an acute case of inherited xenophobia; since it is a genetic characteristc, it is not a function of philosophical considerations, but of rough and rugged experience. Our very genes are afraid of strangers—fanatically and to the death. It's not logical, it's not rational—but it's very real and very practical.

Doctors call it "the immune reaction." The cells of our bodies reject all strangers, and attack any aliens that seek to find lodgment in our organism.

Over the course of the last few gigayears our evolutionary ancestors had to develop that reaction, and our more recent ancestors succeeded in living long enough to be ancestors only because they maintained that hair-trigger xenophobic reaction.

The community of cells called "an organism" must maintain trade with the external world and all its visible and invisible enemies and attackers. We have to eat, drink, and breathe—and all food, water and air is laden with constantly hungry would-be invaders.

The early students of microbic life had a hard time proving that life was *not* spontaneously generated, because until fully sterile procedures were worked out, their experimental setups were demonstrating—unrecognized by the experimenters!—the omnipresence of infective microbes.

Organisms *had* to evolve exceedingly sensitive, and subtle—"sophisticated" is the modern term as applied to technological gadgets—techniques for distinguishing friend (self) from foe (*any* other entity).

The system, even after gigayears of trial and error development, still doesn't function perfectly; there are many indications that several of the incurable disintegrative diseases represent failure of the organism's IFF (Identification Friend or Foe) system. Multiple sclerosis appears to be an instance of the IFF system becoming hypercritical, and misidentifying the organism's own nervous tissue as "foe."

On the other hand, there are indications that cancer results from a hypocritical IFF system failing to recognize the deadly, destructive mutated cells of cancer as "foe." While the change in the cells may be induced by a virus, a chemical,

or hard radiation, the cancer itself is *not* a virus, chemical, or radiation—it's a mass of body-cells-gone-wrong. Cells that no longer have the normal cell's self-limiting characteristics, the self-discipline that causes it to stop endless reproduction when the organ of which it is a part is fully developed.

It's probable that we all have some cancer cells—just as we all have many disease-causing microbes in our bodies. But the normal individual's IFF system quickly spots the malign, mutated cells, designates them "foe," and destroys them—just as his IFF system also spots the disease-causers and attacks them.

That inherited xenophobia is absolutely essential to living in a normal planetary ecology. It's even sophisticated enough to recognize allies—nonhuman allies—and permit them to exist in the organism. Provided they stay in their proper place, that is! The various symbiotic bacteria that live in our digestive tract supply us—in return for food and protection—with various vitamins that we ourselves cannot produce. Cholera bacilli, on the other hand, are attacked vigorously if they show up in the intestines. But the normal colon bacilli, if they stray out of the intestines, are immediately labeled "Foe!" and attacked vigorously. Frequently the result shows up as painful boils, or worse. The colon bacilli are "all right in their place, but . . ."

In other words, that IFF system Man's evolutionary ancestors developed (1) *had* to be developed, and (2) *had* to be passed on genetically, and (3) had to be exceedingly sensitive, complex, and fast-acting. The problem that IFF system faces is extremely subtle; the would-be invaders have evolved right along with us, and have sought to develop camouflage techniques good enough to sneak past the defenses. Some disease-causers have been very dangerously successful at camouflage—the TB germ, for instance, can find lodgment, and remain living happily in a man's lungs for years, because the body's immune reactions aren't triggered into violent counterattack.

At the same time, the IFF system must be able to recognize such enormously different cells as the dense, calcium phosphate loaded bone cells, the physically practically strengthless nerve cells, the muscle, tendon, and connective tissue cells, and the chemical-manufacturing-plant cells of liver, thyroid, pancreas, adrenals, pituitary and all the thousands of variants and special function cells as being "friend."

It *must* work—or you die. You *must* have that functioning IFF system, and the functioning enforcing agency of leucocytes and antibodies, or you die quickly.

It *has* to be highly specific; it must not attack any of the million and one varieties of the organism's own specialized cells, and yet it

must attack *any* invader, any alien —except symbiotes operating in their proper place.

Anybody want to try starting from scratch and working out something that would do that?

Any nation's Security Forces would certainly love to see a system that would faultlessly and immediately identify all loyal citizens, and yet spot every would-be infiltrator and/or home-grown deviant crackpot.

The job of organism Security rests on the Immune Reaction system—combined Internal Security, Detective Bureau, Counterespionage, Police Force and Military. And just as the Army Engineers are responsible not only for fighting external enemies, but also for many internal engineering problems, so the Immune Reaction also has the job of cleaning up after such "natural disasters" as a deep-driven splinter that has to be removed, after the alien invaders who rode it into the flesh have been disposed of. After the infection has been subdued, the mechanical mass of wood has to be cleared away somehow.

It took a good bit of work and experimenting for surgeons to discover materials that the body would tolerate in making surgical repairs—special alloys of tantalum, stainless steels, and silver. More recently, various extremely inert plastics have been found useful—partly because their chemical nature is such they defy any biochemical attack, and partly because they're so inert they don't react against and excite the immune reaction.

When surgeons started trying to replace lost parts of the human body—and they've been trying through all of human history!—they didn't, of course, know about the immune reaction. But they repeatedly learned that *something* was there that made it impossible.

The first successes in replacements came with blood transfusions, and the cornea of the eye. Blood transfusions were tried first, of course, with animal blood—usually a lamb's, because everybody knows that lambs are very pure animals.

Since that quite consistently killed the recipient almost as quickly as it did the small donor—the lamb's blood naturally had its own immune reaction, and started fighting the recipient's alien cells, with mutually lethal results—that was dropped.

Transfusions of human blood into human patients had a bewildering inconsistency; sometimes it worked magnificently, and a man surely dying would, in a matter of minutes, bounce back to strength and make a rapid, complete recovery. And usually the patient died very shortly.

The early efforts, of course, ran into two difficulties—the obvious-to-us one of blood-type incompatibility, and the not-so-obvious one

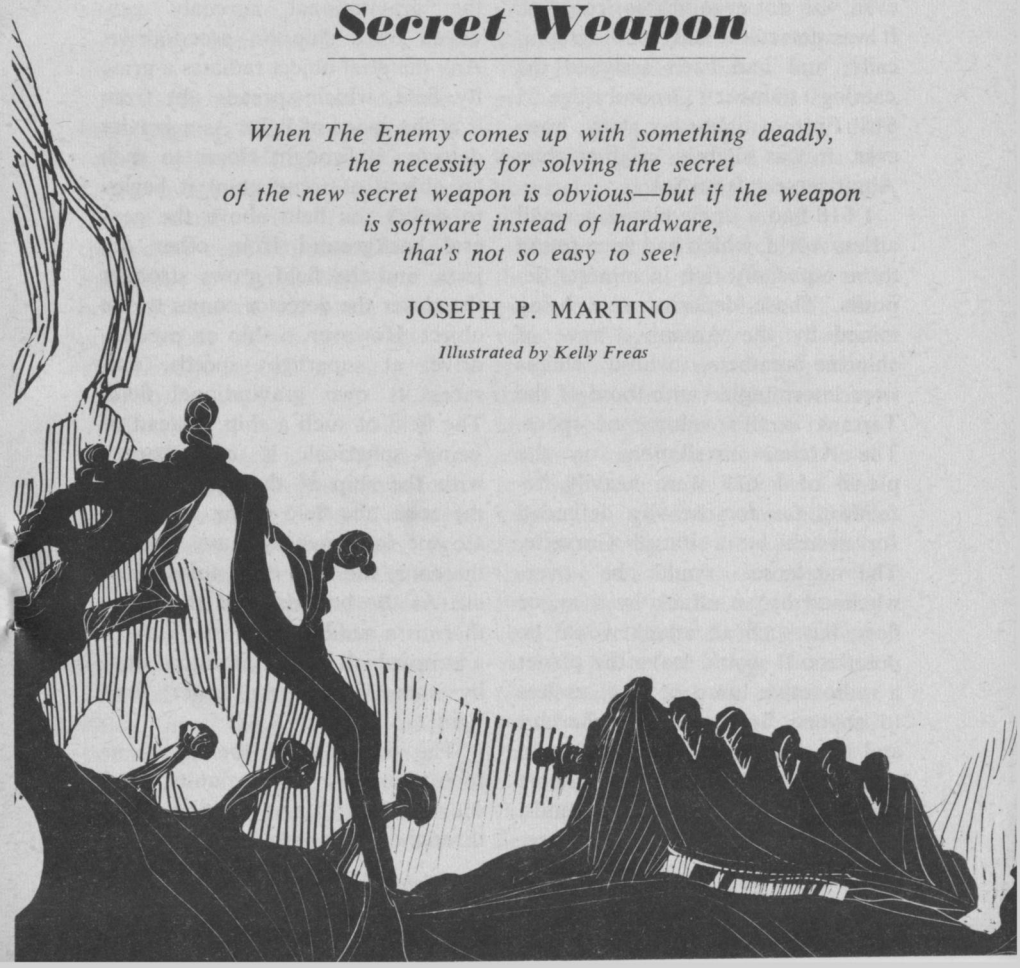
continued on page 174

Secret Weapon

When The Enemy comes up with something deadly,
the necessity for solving the secret
of the new secret weapon is obvious—but if the weapon
is software instead of hardware,
that's not so easy to see!

JOSEPH P. MARTINO

Illustrated by Kelly Freas



The Patrol Corvette *Achernar*, of the Terran Space Navy, plunged through the interstellar emptiness at a pseudovelocity of half a light-year per hour. Sol was dimly visible as a third magnitude star. Almost directly opposite Sol, on the other side of the ship, was Algeiba, known also as Gamma Loonis. From here it glowed slightly brighter than it did when seen from Sol. The brightest star in the sky, however, was not even visible from Sol. It was detectable only photographically, and had been assigned the catalog number Groombridge I 618. From a light-year away, however, it was slightly brighter than Altair, as seen from Sol.

I 618 had a single planet, a small airless world, which had been found to be especially rich in mineral deposits. Those deposits were being mined by the Arcani, a race of chlorine-breathers, whose claims were intermingled with those of the Terrans in this volume of space. The Arcani installations on the planet of I 618 were heavily defended; far too heavily defended for attack by a Patrol Corvette. The defenses could be overwhelmed by an attack by a major fleet, but such an attack would be pointless. It would leave the planet a radioactive lump of slag, useless to anyone. Instead, the *Achernar*, and her sister craft, were trying to assure that the Arcani transport ships, loaded with refined metals, never returned to their home bases.

As the *Achernar* sped through space, it probed at the fields around it with incredibly sensitive gravity detectors. For reference purposes, it measured and recorded the gravitational fields from the nearby stars, planets and wandering lumps of matter, as well as the local component of the galactic field. However, these measurements just established the background. The detectors were really searching for the gravitational anomaly produced by a ship on pseudodrive. Any material object radiates a gravity field, which spreads out from it at the speed of light. As a gravity detector is brought closer to such an object, at some point it begins to detect the field above the general background from other objects, and the field grows stronger the closer the detector comes to the object. However, a ship on pseudodrive, at superlight speeds, outraces its own gravitational field. The field of such a ship, instead of being spherical, is cone-shaped, with the ship at the apex. Inside the cone, the field is the appropriate one for a nearby mass. Outside the cone, the field does not exist at all. At the boundary of the cone, there is a sudden jump in the field, a jump which can be produced only by something going faster than light.

The detectors of the *Achernar* found such a discontinuity, and sounded an alarm which rang throughout the two-hundred-meter

length of the ship. The two dozen crew members rushed to their battle stations. Lieutenant Commander Boris Masevitch, in command of the *Achernar*, arrived on the bridge just as the detectors announced that they had passed through the other side of the cone.

"Cut the Drive," he ordered. As the pilot pressed a button, the thrumming of the Drive ceased, and the *Achernar* stopped dead in space.

"What's she like?" Masevitch asked.

A naval rating at the detector board replied. "Field strength indicates a mass of half a million tons. Drive frequency is typical of an Arcani metal-carrier. Half-angle of the gravity cone indicates she's doing about a quarter light-year an hour. Radius of curvature of the gravity cone shows she went by about five hours ago."

"Pilot."

"Yes, sir?"

"We'll go back into the gravity cone, and follow her at about four light-years an hour." The *Achernar* could make five light-years per hour maximum speed, but the danger of Drive burnout limited her to a maximum of one hour at that speed. She was good for twelve hours at four light-years per hour. Below three, there were no limitations imposed by the Drive.

Commander Masevitch seated himself in front of the Combat Information Display. The three-dimensional display showed two nearby stars, his own location, and the deduced location of the Arcani freighter. The ship's Combat Computer took into account the gravity field as measured by the detectors, and the local undisturbed field, as measured during hundreds of hours of patrols, and computed where the enemy ship must have been when it emitted the gravity field. It then predicted the future track of the ship. The prediction was compared with later measurements, and the prediction refined. Errors in the detectors, plus uncertainties in the local field, gave rise to a volume of uncertainty containing the position of the enemy ship.

Commander Masevitch focused the Display on the freighter, and expanded the scale. Initially, the volume of uncertainty had been a sphere with a diameter of about thirty light-minutes. After ten minutes of pursuit, the volume of uncertainty had been narrowed to a few light-seconds in diameter. The longer the smoothing time allowed for processing the measurements from the detectors, the more surely the position of the enemy ship could be determined. Yet the longer the wait before firing, the more risk there was that the enemy ship would change course, and throw all the tracking calculations awry.

Commander Masevitch watched the Display with growing impatience. He willed the volume of un-

certainty to shrink faster. Finally, after fifteen minutes of pursuit, he decided he could delay no longer. He called to the fire control officer.

"Mr. Chu!"

"Yes, sir?"

"Fire three torpedoes immediately, in the usual spread."

Three torpedoes leaped from the armament bay. They were small spacecraft in their own right, with a pseudodrive generator capable of pushing them forward at ten light-years per hour. At this speed, of course, their Drives would burn out in five minutes. But they could overtake the fastest Naval vessels in use by either side, if launched at close enough range. The torpedoes followed a programmed path which would take them through the computed position of the freighter, at the time the freighter was there. Since there was, of course, no way they could detect the presence of the freighter, they were detonated at a pre-set time after launch. One timer was set slightly slow, one slightly fast, and one at the correct estimated time to intercept.

The "fast" torpedo detonated slightly behind the Arcani freighter. Had the freighter actually been somewhat behind the calculated position, it would have been destroyed. As it was, however, the glare of the explosion didn't even catch up with the target. The "correct" torpedo burst slightly ahead of the freighter. The detonation created star-surface conditions throughout a volume of space ten thousand kilometers in diameter. The radiation flux that struck the freighter vaporized the thin hull, drove through the interior, and boiled away thousands of tons of mass. Within a few hundred nanoseconds the Drive failed, and the ship halted. The storm of energy which had struck the ship left it a lifeless wreck, floating in space. Many seconds later, the dim glare of the "slow" torpedo cast a pale glow over the hulk.

The *Achernar* pulled abreast of the Arcani freighter and halted. The officers on the bridge examined the remains of their target.

The fire control officer asked, with a smile, "Want me to put another shot into her, sir, just to make sure?"

"Don't bother. That hulk isn't going anywhere. Good shooting. Pilot."

"Yes, sir?"

"Put us back where we're supposed to be. We don't want any freighters to slip through the net while we're hanging around here."

Each Patrol Corvette was assigned a specific course and time schedule for its patrolling. Although the patrol patterns were chosen randomly, so that knowledge of the location of one ship told nothing about the locations of the rest, the entire set of patterns was carefully designed so that a freighter which slipped by one Pa-

trol Corvette would almost certainly be intercepted by at least one other. So it was necessary that they take up their course, at the place they would have been had they not come on the trail of the Arcani freighter. And the sooner they did that, the less chance there would be that a ship would get through that they should have intercepted.

The pilot put them on a course that merged neatly, in time and space, with their assigned patrol schedule. The ship stood down from Battle Stations, and two-thirds of the crew returned to their off-watch activities. The detectors continued to search for the telltale gravity cone left behind by a ship traveling at superlight speeds. But space is vast, and the number of ships in it is small. Sometimes hundreds of hours went by without a whisper from the detectors. Even that didn't mean that there were no Arcani freighters about, of course. Some may have crossed the path of the *Achernar* enough hours ago that their gravity field had disappeared behind the local background. Others may have passed far enough away that their fields decayed into indetectability before they crossed the path of the *Achernar*. Others may have passed close behind the *Achernar*, and so their gravity fields, too, went undetected. In addition to the freighters, there were also Arcani naval vessels, similar in size, armament, and function to the Patrol Corvettes. With a mass of only a few thousand tons, they could be detected only at much shorter range than a freighter. But occasionally a Patrol Corvette did come across the trail of an Arcani warship. Or vice versa. Then one of the pursuers became the pursued. Without its knowledge, of course, since there was no way a ship could detect another ship behind it.

Thus it was that the first knowledge the *Achernar* received that it was being tracked by an Arcani vessel was the burst of a torpedo a few light-milliseconds ahead. The outer layers of armor boiled away. But then they were designed to do that. The duty officer ordered the Drive cut, then ordered Battle Stations. Commander Masevitch reached the bridge within five seconds of the original burst, which had been followed by another one, somewhat farther away.

"Pilot! Full speed, at right angles to our course. Make a circle, half a light-year radius. Let's try to get behind them."

With luck, the *Achernar* could circle back into its own gravity cone, and get behind the Arcani craft. Then, using their accurate knowledge of their own course, they could sort out their own field from the field of the Arcani craft, and locate it well enough to fire. However, their luck ran out. Their maneuver was barely started when a second spread of torpedoes caught them. The rest of the armor

boiled away, all the compartments were holed, and the Drive cut off. When the Arcani warship pulled up to examine its handiwork, the *Achernar* floated in space, motionless and devoid of life.

Professor Victor Fedeyev, of the University of New Dubna, on the second world of Alpha Centaurus, sat on his luggage and waited patiently. Within the last week, he had learned of, and come to appreciate, the ancient military slogan of "Hurry up and wait." Exactly seven standard days ago he had been in his office at the University, examining the computer-digested results of his last set of gravity-measurements, and planning the next set. He had been interrupted by the arrival of the Dean of the School of Sciences, and a Naval officer. The officer had stated only that he was needed to solve a serious problem which had come up in the border war with the Arcani, if he were willing to provide his services to the Government. He would, he was assured, receive per diem plus a standard consulting fee, and Government insurance for possible injuries from enemy action. This last had disturbed him somewhat, but not enough to make him reject the offer. It seemed that his decision to go was the last one he had made. Since that time he had been alternately hastened to somewhere or other, then made to wait idly until it was again time to be hastened. And neither the waits nor the rushes had been explained to him. All went according to some plan he had no part in making.

Finally the last of a series of interstellar runs aboard Navy courier craft had dumped him on a space station circling the only habitable world of a star known as Ross 128, some eleven light-years from Sol. He had managed to learn that this world, known as Haven, served as the main Navy base for operations against the Arcani. Ships needing major overhaul were taken to the shipyards down on the planet. Those needing only routine servicing and resupply were taken care of in orbit. The crews received a week's leave planetside, while their ships were being worked on. The space station served as a transfer point, with shuttles taking the crews to and from Haven. Hundreds of men and women, almost all in uniform, wandered back and forth in the giant waiting room of the station, listening for their shuttles to be announced.

A small cluster of men passed near Fedeyev. He examined their uniforms, and with his newly-gained knowledge, identified them as Apprentice Spacemen, assigned to a Patrol Corvette-class ship. Their apparent youth surprised him. Most of them, he realized, were younger than the graduate students he was exposed to daily.

". . . Made it back alive," one said. "I'm really going to celebrate."

"You bet," chimed in another. "I feel almost like I've been given a reprieve from a death sentence. I didn't really believe we were going to make it until the skipper said the patrol was over, and we were going home."

"Listen," added a third, "why don't we all go to a place I know about, beyond the commercial side of the port. One hundred credits gets you a room and three meals a day for your whole leave, plus all you can drink, and some feminine company besides."

The second speaker began doubtfully, "A hundred credits is a lot of money. That's over a month's pay."

"Why try to save it? You probably won't live through your next patrol anyway. Come on, live it up while you can."

"That's right," added another. "What good's money to a dead man? It's worth it to forget about that next patrol for a week."

As the young spacemen drifted away from him, still debating how to spend their leave, two officers wandered by on the other side. Both were commanders, by their stripes, and both wore the double-diamond of ship commanders. Probably both are in command of Patrol Corvettes, Fedeyev decided.

". . . Tell you they can't do it," one of the officers was saying. "There's no way they can possibly deduce the routes of our patrols. They're generated by a computer, on a random basis."

"Then how do you explain the loss rate? They must be lying in wait for us," his companion asked.

"That's simple," the first one replied, darkly. "There's a traitor somewhere in Headquarters. Some rotten traitor is selling the information to the Arcani. That's how they're knocking us off so easily."

"Maybe you're right."

"Of course I'm right. There's no other . . ."

Fedeyev's attention was drawn to two rather attractive young women walking by him. Both, by their uniforms, were clerk-typists assigned to the maintenance depot at the space station.

". . . Really don't know what to do," one of them was saying.

"How do you mean?" her companion asked.

"I find it harder and harder to keep telling the boys no, when I know they have a good chance of getting killed on their next patrol."

Her companion's reply, if any, was blotted out by a shout behind him.

"Victor! Victor Fedeyev!"

He shot to his feet and swiveled around. Who here knew his name? Someone was pushing his way through the crowd towards him.

"Carl Hanson!" They shook hands vigorously. "Carl, I haven't seen you since the Physical Society meeting on Ganymede, back in the home system, five years ago. Where are you now? And what

have you been doing? And what're you doing here?"

"Victor, it's good to see you. Has it really been five years? Gloria still talks about that night club the four of us went to. You remember, the one with the Russian dance troupe, performing in low gravity? And how's Valya?"

"Valya's just fine, and so are Davidov and Alexei. But listen, have you some luggage around here? Let's get our baggage together, and then we can talk."

"Yes, a couple of suitcases and a trunk over here. Let me help you carry yours over to where mine is." They both picked up items of Fedeyev's luggage. "Also," Hanson went on, "I've got some big crates of equipment somewhere around here, that are supposed to be delivered down on the planet for me. That is, if they haven't been misrouted somewhere, and ended up on the other end of the galaxy. I haven't seen them since I left Pluto."

"Oh, you're on Pluto now? I'd completely lost track of you when I left the home system. I went back to New Dubna, and I'm with the University now."

"Yes, I know. I've seen some reports of your work. I gather you're now a leading light in the field of gravitational theory. Here, this is my luggage. But tell me, are you here for the Navy, too?"

"Yes, but don't ask me why. I was assured that there's some important problem here, but I haven't the foggiest notion of what it is. Did they tell you anything?"

"Nothing more than that, either. Just enough to convince me it was worth coming all this way for." He added abruptly, "What shuttle are you on?"

"Number Seventeen. It's due in fifteen minutes."

"That's mine, too. Well, let's sit down here. We've got a lot of years to catch up on. First, you. Tell me what you've been doing since you went back to New Dubna."

"Both Valya and I came from there, you know. So when the University offered me an appointment that matched what I was getting then, I couldn't turn it down. Right away I was put in charge of a big project, which gave me a chance to check a lot of the recent work in gravitational theory. I don't know whether you know it or not, but Alpha Centaurus is really a triple-star system. The gravity fields in the system are really very complex. I've been mapping them precisely, for the last three years. In a year or so I expect to have enough data to give a real check to some current theories.

"We're really pushing the theoretical limit in the sensitivity of our detectors, and we're using a couple of new wrinkles, as well. For instance, we have two of the only five nucleonic clocks built so far. They're good to one part in 10^{18}. We had to pay a quarter of a mil-

lion apiece for them. That really put a dent in our budget. But it was worth it. They'll cut our research time in half.

"We put one of them on a planet, and take the other on a spaceship. We broadcast the signal from the planet-based one, and compare it with the one in the ship. Then, if we take enough measurements so we have as many equations as we have unknowns, we can solve for both the distance between the ship and the planet, and the gravity field between them. We've had some interesting partial results, like rejecting a couple of theories that were inconsistent with the data we were getting, but the real payoff is still to come. And how about you? What're you doing?"

"Nothing really spectacular. I'm with the Radiation Physics group on Pluto. The theory in our field is in pretty good shape. We're just cleaning up the loose ends, and so on. Primarily we're dealing with the radiation-matter interaction. Our real forte is building sensitive detectors. That's the whole point of putting the station on Pluto. Anywhere else, to cool your detectors, you need thousands of liters of liquid helium. It's expensive, and involves you in a lot of complications. On Pluto, we just lay our detectors out on the surface, during the night. Our apparatus comes into radiation equilibrium with the galaxy in a hurry, and besides that, we've got both the radius of Pluto's orbit, and the mass of the planet itself, to shield us from the effects of Sol. There's a lot of fine detail about the interaction of radiation and matter that we're still digging out. It's challenging work, but there's no glamour in it."

"Well, this work for the Navy ought to give you an interesting break, then. It may not be a challenge, but at least there's some glamorous appeal to being whisked across a dozen or more light-years to help solve a military problem."

"It might be glamorous at that. Military work tends to be gadgeteering, and we instrumentation people are nothing but glorified gadgeteers. I hope you won't mind leaving theoretical calculations aside and getting your hands dirty with some equipment, Victor."

"Don't worry about me, Carl. I've changed a lot since my days as a student on Terra. There's nothing to make a man appreciate experimental work like too many plausible theories, and not enough data to decide among them. I've become the busiest little experimenter you ever saw."

Just then a man's voice blared out over the annunciator. "Shuttle Seventeen is now ready for boarding at air lock Number Three. Have your orders and passes ready. All aboard."

"That's ours, Carl. Any idea where we're going, or what we do when we get there?"

"Down to Haven, I suppose. And

I've found, over the past few days, that there's always somebody around who can tell you what to do when you show him your orders. You just have to find the right man to ask."

They stowed their luggage aboard the shuttle, and strapped themselves into adjacent seats. Soon all the seats were filled, most of the passengers evidently being men just back from a patrol, and taking their planetside leave before going out again. Others appeared to have routine business either at the space station, or at the Headquarters on Haven. Fedeyev and Hanson found that they were the only two civilians aboard the shuttle, although there had been a few in the waiting room in the space station. After a short time they heard some metallic sounds as the shuttle cast off from the station. Then the pilot's voice came over the speaker.

"Those of you on the left-hand side can look out the windows and see a captured Arcani ship of the Patrol Corvette-class. She was brought in two weeks ago, and has been hanging there in orbit ever since." Fedeyev and Hanson craned their necks and looked out the window.

"See it, Carl?"

"Yes, right over there. I admit I don't know much about spaceships, but it seems to have an alien appearance to it. No human designer would have shaped anything exactly like that."

"I guess you're right. I suppose there's a lot of the designer's cultural sense of 'oughtness' in the design of a spaceship. Still, though, technological solutions to problems should show some common traits, regardless of culture."

The pilot's voice sounded again. "Make sure you're strapped in tightly. We'll be entering atmosphere in a couple of minutes, and it might get bumpy."

Shortly after midday, Fedeyev and Hanson were ushered into Admiral Suvarov's office by the lieutenant who had been their escort since they had stepped off the shuttle.

"Admiral, this is Professor Fedeyev, and Dr. Hanson. Gentlemen, Admiral Suvarov."

The admiral rose and extended his hand. "Good afternoon, gentlemen. Have you shown them around, Mr. Collins?"

"Yes, sir," the lieutenant replied. "They have a room at the Visiting Officers Quarters, and passes so they can eat at the Officers Club. Also, I've shown them the rooms where their laboratory equipment is to be installed."

"Your equipment arrived in good shape, did it?" the admiral asked.

"Yes, it did," Fedeyev replied. "Lieutenant Collins helped us locate it, and it appears to be intact. We can get it set up in a day or so. But

it's not clear to us what we're supposed to be doing with it."

"Of course. I really appreciate the fact that you both dropped your work and came to help us, especially since we couldn't tell you any more than we did. Now that you're here, of course, you'll get the full story. But first let me give you some background."

The admiral moved across the room to a three-dimensional situation display. "Here," he said, "is Sol. And over here is where we are. And off here in the war zone. The war zone is roughly a cylinder, three light-years in radius, and about twelve light-years high, with the long axis pointing away from Sol. There are some half a dozen stars in it, none of them closer to Sol than about eight light-years.

"All of these stars have at least one airless planet, which means we and the Arcani can use them about equally well. We've claimed some of them, they've claimed others. And in some cases we've both tried to claim the same ones. Our claims are all mixed up with theirs, and there's no clear-cut division of this area into respective spheres of influence. We're filling the space with Patrol Corvettes, and hunting down their freighters. The goal is to run their losses up to the point where they'll decide it's cheaper to come to terms with us. And they're doing the same thing."

"Sounds like a rather silly thing to have a war over," Hanson said.

"After working hours, Dr. Hanson, I might agree with you," the admiral replied. "But during duty hours, I fight the wars our civilian leadership decides should be fought.

"Now over here," he said as he stepped back to his desk, "are some charts showing how we're doing. This one," he pointed, "gives the number of Arcani freighters we destroy, on a monthly basis. You will notice that for nearly a year, since the war started, we've been averaging about ten freighters a month. Unfortunately, they were getting about the same number of ours.

"For some time, we'd been planning to increase our force of Patrol Corvettes in the war zone. Up until the last couple of months, we'd been doing no better than replacing our losses. But during the last two months, we finally received some reinforcements. In fact, we doubled our force, from about fifty, to just over a hundred. And as might be expected, last month we destroyed twenty enemy freighters."

"Excuse me, Admiral, but what's that other line on the chart?" Fedeyev asked.

"This one? That's the number of Arcani Patrol Corvettes we destroyed. You can see we were getting about four a month, which went up to six the month before last, and down to three last month. Even though the Patrol Corvettes are much harder to detect than freighters, we attack them when-

ever we can, since that helps cut down our freighter losses.

"Now these charts here show the problem we've suddenly come up against. We thought that doubling our forces, and increasing their losses, would give us an edge in the war. It would end the stalemate that's been going on for months. But you see, our freighter losses jumped to twenty a month last month, so we're still at a standoff there. But our Patrol Corvette losses jumped from about four a month, comparable to their losses, to eight the month before last, and sixteen last month. That's a full sixth of my force. We can't continue to take losses like that. And you can just imagine what's happened to the morale of the crews."

"Yes, I know," Fedeyev replied. "I heard some of them talking while I was waiting in the space station. They sounded pretty defeatist to me."

"They do at that. My staff has been pressuring me to issue an order against defeatist talk. But I'm not going to do it. It wouldn't be effective, and it would only convince most of them that their favorite rumor was true."

The admiral sat down and folded his hands on the desk in front of him. "So, that's our problem. Somehow, they're beating us, despite our increased forces. We've racked our brains to understand what's gone wrong. We've decided the Arcani have come up with some kind of secret weapon. We've come up with two possibilities. Either they've developed some better detector, which allows them to spot more of our ships, or they've developed a more effective warhead, with a greater lethal radius, so they don't have to know the position of our ships as accurately in order to fire.

"We made inquiries, and you two were recommended to us as among the best we could get to advise us on this problem. Professor Fedeyev, we made a special effort to capture an Arcani Patrol Corvette. When one of our ships came back and reported they had destroyed one, we sent out a salvage ship and retrieved it. It's in orbit, up near the space station. We'd like you to go over it, look at its gravity detectors, and see if they are significantly more sensitive than ours. Or, if this ship is still equipped with the old model, to see if they are using some technique which could easily be extended to give greater detection range. We will, of course, give you all the assistance you need. We have had some R&D people out from Terra looking it over the past few days, but they are concentrating on the Drive and the Fire Control System. You may find it useful to discuss with them what they have already learned.

"Dr. Hanson, we also made a special effort to retrieve one of our damaged Patrol Corvettes. When one failed to return from its patrol,

we sent out a salvage ship to retrace its route. By some bit of good luck, we found the ship. It was brought back, and it's here in the Yards for study. It's called the *Achernar,* I believe. Anyway, we want you to examine the battle damage, to see if there are any clues as to whether the Arcani have developed something new in the way of weapons.

"Now I can't impress upon you too deeply the importance of this problem. If it goes unsolved more than two or three months, we'll simply have to fold up and leave the area. We'll have to turn that whole volume of space over to the Arcani. That in itself wouldn't be a disaster. But they wouldn't stop there. If this problem goes unsolved for a year, it could well be a major disaster for the whole of humanity. Our place among the stars is at stake. Now do either of you have any questions?"

Hanson and Fedeyev looked at each other. Fedeyev finally replied. "I don't think either of us could ask an intelligent question right now, Admiral. I'm sure we'll want more information later, but right now we don't know what we need."

"That's fine, gentlemen." He stood up, dismissing them. "Let me know in a week how you're coming."

Outside the admiral's office, the two men stood and stared at each other. Fedeyev finally spoke. "That wins the prize for something-or-other. The enemy may or may not have a secret weapon. I'm to examine a captured vessel, on which it may or may not have been installed before the vessel was blasted. And you're to look at a battle-damaged hulk, on which the weapon, if it exists, may or may not have been used. *Whew!*"

"O.K., Victor, it does sound fantastic. But the problem is a real one. And false modesty aside, they did pick two of the best men available to tackle the problem as they understood it. In your case they certainly did, and I fancy myself among the leaders in my field. We've got to give it a try."

"Of course we'll give it a try. I just don't entertain any illusions about succeeding. However, I am eager to find out just how the Arcani build gravity detectors. I might well learn something I can use myself."

Victor Fedeyev looked at the clock built into the helmet of his spacesuit. It indicated the passage of three hours since he had boarded the captured Arcani ship. He decided there were two ways to look at it. Three hours gone already, and still nothing accomplished; or, only three hours and already he felt miserable. And there was another hour to go before the working party would take a break and eat their midday meal at the space station.

At first, the thought of working in space hadn't bothered him at all.

After all, during the three years he had been with the gravity project at the University, he'd logged over four thousand hours working in space. It had suddenly dawned on him, though, that virtually all of that time had been spent inside a spaceship, working in his shirt-sleeves, breathing air supplied at one standard atmosphere, and with an artificial field of one standard gravity underfoot. For all practical purposes, he might as well have been in a laboratory solidly anchored to some planet. And on those few occasions when he'd had to don a spacesuit, it had been for never more than an hour at a time, and that time had been spent working on apparatus which had been designed to be manipulated by a human being in a spacesuit.

The equipment aboard the Arcani spaceship might have been designed to be used while the operator was wearing a spacesuit—critical equipment aboard human spaceships was designed that way—but it had most certainly never been intended to be used by human beings, either in or out of a spacesuit. And of course there was no artificial gravity aboard the ship. It would be a long time before the human team examining the ship felt sure enough of what they were doing to activate the lighting system, let alone the artificial gravity.

After a couple of hours he had begun to notice the symptoms of space sickness. After three hours, they were nearly overwhelming. He knew that he couldn't depend on antinausea tablets indefinitely. If he were going to do any useful work here, he was going to have to become accustomed to free fall. But he clearly wasn't going to make it to lunch-time without a pill. Grimly, he manipulated the lever which brought a tablet before his lips. He held it on his tongue, then took a swallow of water from the nipple beside his right cheek. He then pulled himself hand-over-hand along one of the cables the human working parties had strung through the ship, until he reached the next compartment. There two Navy Electronics Officers were working.

He watched as one of them manipulated an instrument which looked like a pair of tongs, but which was completely unfamiliar to him. The man used it with some dexterity, however, as he worked on a pair of interlocking elliptical metal rings. One was apparently held against the other by a spring. The man leaned on the tongs, separating the rings slightly, then opened the tongs, moving one ring inside the other.

"What in the galaxy are you doing?" Fedeyev asked.

The man finished his mysterious actions, and turned to face Fedeyev. "We found these tonglike things in what looks like a machine shop, on one of the lower decks. They appear to be the Arcani equivalent of a screwdriver. These

two little rings are the equivalent of a nut and bolt. As you slide this ring into the narrower portion of this other one, this spring is stretched, and whatever the spring is fastened to is held tightly to whatever the other ring is mounted to. In this case, it's holding an electronics package onto this rack."

"You mean they don't use screws? Just these spring-and-ring arrangements?"

"It won't seem so strange to you if you remember that a screw really depends on the springiness of its threads to hold things together."

"Is this thing any better than a screw? Why do they use it?"

"Right now I can't say. Even if we found that it is better than nuts and bolts, I doubt we could get all of humanity to switch over. And, if we found that nuts and bolts were better, I doubt the Arcani would be interested. The real point is that we've got a whole spaceship, based on a technology so different that even the simple things, like nuts and bolts, aren't the same as we use, and we have to figure it out. Right at the outset we settled on a rule. No human tools will be brought aboard this ship, unless absolutely necessary. There'd be too much temptation to 'get a bigger hammer' every time we didn't understand something right away.

"So far the rule has paid off. It's forced us to look at things from their viewpoint, and to figure out what we're doing, every step of the way. When we first came on these fasteners, we could have brought in pliers, or even a hacksaw, and taken things apart. But we didn't. We tried to figure out what had to be done, then looked for the tool the Arcani did it with. We've made some mistakes, but on the whole we're beginning to get some insight into their technology, and in the long run things will go faster this way."

"Maybe so, but I don't have that kind of time. I can't afford to spend several years picking this ship apart, bit by bit. Can't you at least identify the functions of the various components? That way I could concentrate on the gravity detectors, which are my only concern."

"Essentially, that's what we're trying to do. But it's not so easy. Take this electronics package, for instance." He pointed at the object he had been working on. "That is, we think it's an electronics package. We've gone through mechanical disassembly of a couple of them, and the insides look like monolithic integrated circuitry, with a few examples of what could pass for printed circuit boards stuck in here and there. Now, how would you go about determining their function?"

"The thing to do, I suppose, would be to put in a test signal somewhere, and see what comes out elsewhere."

"I agree. But before you can do

that, you've got to supply power to the thing. And there we're stuck for the moment. We've found what we think is the power room. The generator appears to be a fusion-powered MHD generator. We think it was damaged, probably from a short circuit that happened during the attack, while part of the ship was being blown away. But even if we were sure it was intact, we're not about to try to start up a fusion generator without being sure we understand it."

"Can't you bring in your own power? Disconnect the ship's generators, and use external power?"

"Ultimately, that's probably what we'll do. But first, somehow, we'll have to figure out what kind of power their generator put out. What voltage? AC or DC? If AC, what frequency and waveshape? And how many phases? We're beginning to realize that a lot of our own technology is purely historical accident. We use AC because you can change voltage easily with a transformer. We use a sinusoidal waveform because it makes designing generators and transformers easier. Four hundred cycles happens to be based on a mid-Twentieth-century engineering compromise, which we've never changed since then because there was always too much invested in existing equipment. Their power is just bound to be different from ours. Mind you, I'm not saying it's impossible to figure things out. We'll do it. But we're not going to do it overnight."

"But surely you can figure out some things just by looking for interconnections between pieces of equipment. That provides some sort of association between them."

"Again I agree with you. It's just that interconnections aren't all that obvious. For instance, if you wanted to control the flow of high current, at low voltage, at some distance from you, how would you do it?"

"I'd use a relay. Put the relay where the current is to be controlled, and operate it by a low-current circuit from where I wanted to be. A couple of wires, a pushbutton, and a relay, and you're in business. If you can't tolerate the delay of a solenoid-type relay, use a solid-state circuit of some kind."

"And what if you wanted to control several circuits at the same remote location?"

"Just take several pairs of wires, or possibly one return wire common to all circuits, and run them in a cable to a set of relays. Do you mean they don't use relays?"

"Oh, no. They do use relays. All solid state, but still they can be considered relays. One of our first achievements was figuring out their equivalent of a pushbutton control arrangement. It took us nearly a week to do it, though. They don't use wires. They use a circular waveguide. Instead of a pushbutton they use a capacity-operated electronic switch, which supplies voltage to a

diode oscillator which generates microwaves. These are fed in at one end of the waveguide. At the other end a diode rectifies them, and supplies voltage to operate a relay. If they want to operate several relays, they use several diode oscillators, at different frequencies. At the far end, they use a series of stubs, each one cut to a particular frequency, and with the diode stuck in at the anti-node of the standing wave. I kind of admire the ingenuity of the system. It avoids the problems of splicing cables. On the other hand, microwave plumbing can be nasty, too.

"But anyway, you can imagine the problems of figuring out which 'pushbutton' is associated with which relay, when you don't know the frequencies of the various generators. And judging by the number of waveguides running throughout the ship, we've tentatively decided that all their signal transmission is in this same form. They probably transmit all their signals in a digital code, with each one going at a different frequency. So right now it's impossible to tell which of the boxes at one end of a waveguide is associated with which of the boxes at the other end. And it will be some time before we can manage it."

Fedeyev fell silent. There was no doubt the man knew what he was talking about. He'd spent over a week working on the Arcani vessel already. The job was apparently going to be much tougher than the admiral had presented it to be. Fedeyev had originally had little doubt about being able to determine the sensitivity of the Arcani gravity detectors. Now he was beginning to wonder whether he'd even recognize them if he did find them. His thoughts were interrupted by a shrill tone on his suit radio.

"There's the lunch whistle," one of the Navy men remarked. "Let's knock off for chow."

On the evening of his third day of working on the Arcani ship, Fedeyev went to the Officers Club for dinner. He was later than usual, and found that the dining room was nearly filled. He seated himself at the last vacant table. He had just placed his order on the table's menu-board, when an officer, a captain by his stripes, walked up.

"Mind if I sit down?"

"Not at all, Captain. I'm by myself."

"Thank you." The officer proceeded to punch his order on the menu-board, then turned back to Fedeyev. "I'm Captain Hall. I'm on Admiral Suvarov's staff."

"I'm Victor Fedeyev."

"Oh, yes, you're one of the civilian scientists they brought in to look at the captured Arcani ship. You've been spending all your time up there, I suppose."

"As a matter of fact, I have. I was up there all day yesterday, and the day before. I spent most of this morning up there, too, but came

down after lunch. I needed to do some calculating. Excuse me, but I'm not completely familiar yet with Navy uniforms. What's that insignia over your left coat pocket?"

"This? It's a chaplain's insignia. I'm the Command Chaplain. With a Base this size, I have two other chaplains working for me, but I have the responsibility for the whole Base."

Just then their orders arrived, brought by human waiters instead of the serving robots used by most restaurants.

"It smells delicious," Fedeyev remarked. "You know, this is the fourth time I've eaten here, and I've enjoyed the meals every time. The food is good, and the Club has a very pleasant atmosphere."

"Well, thank you. I'm pleased to hear you say so, since I had a large share in getting the Club established and decorated."

"I must say I'm surprised. I would have thought you'd be preaching against this place, considering some of the heavy drinking I've seen going on."

"It's a relative matter. I certainly don't condone excessive drinking. But even with that, it's better that men come here than that they go to the pleasure houses over on the other side of the commercial port. As for preaching, I find it doesn't do much good. For the new recruits, on their first enlistment, yes. But by the time a man is past that stage, he's pretty much made up his mind what kind of a life he wants to lead. It's my objective to see that the man who wants to lead a decent life has the opportunity; that he has some alternative to the pleasure houses and vice dens besides his barracks."

"I can see I had the wrong impression of a chaplain's activities. Don't you do any of the more conventional religious activities?"

"Oh, yes, we run the full gamut. A couple of christenings, two or three weddings, and a funeral or two every week, as well as the usual counseling and so on."

"Almost like a civilian church, then?"

"Well, not entirely. Once in a while here we get something really out of the ordinary. For instance, last week I conducted burial services for the Arcani bodies that were on the captured ship you're working on."

"I wondered what had happened to the crew. I assumed the bodies had been dissected for biological study."

"Two or three of them were, but after the examinations were finished, I buried those, too."

"With full military honors?"

"Oh, no. I decided that wouldn't have been appropriate. The most I did was get them Government Issue caskets."

"I still find the idea somewhat startling."

"So did the admiral. But I pointed out to him that even though

we don't know the manner in which the Creator manifested Himself to them, nor the rites by which they commend their dead to His care, surely our prayers weren't going to do any harm, and they might do some good. So he went along with it."

After the meal, the waiters brought dessert; a frozen concoction Captain Hall had recommended. Fedeyev finished it, folded his napkin, and stood up. "Captain, I've enjoyed talking to you. Now, if you'll excuse me, I have a good deal of work waiting for me back at my room."

"Go right ahead. And I hope you're successful in your work. It'll make my tasks a lot easier when the morale of the men goes back up."

Fedeyev walked across the Parade Ground between the Club and his quarters. He breathed deeply of the night air. The gravity of Haven was slightly less than that of New Dubna, which added some spring to his step. The oxygen content of the air was a little higher, and the temperature ranged from about 15° C at night, to not more than 25° C in the daytime. All in all, a pleasant world, he thought. Still, he had no desire to stay here one day longer than necessary. He quickened his pace and walked through the main entrance to the building he was staying in.

He entered the room he shared with Carl Hanson, to find the other man already there. "Hello, Carl. I didn't know where you were, so I went to dinner without you."

"Hi, Victor. Never mind. I was busy over in the Headquarters, and ate at the cafeteria there. Looks like you decided to quit becoming an experimenter, too." He pointed at the papers scattered over the desk Fedeyev had been using all afternoon.

"Yes, I came to the conclusion that I wasn't going to find the Arcani gravity detectors in any hurry, so I'd try another tack. I spent the afternoon constructing a mathematical model of the detection and interception process. Then I went over to Intelligence and dug out some data on the uncertainty in gravity measurements in the war zone. They keep a complete record of all the readings of the gravity detectors of all the Patrol Corvettes, from each mission. Essentially, they're doing the same thing I'm doing in the Centaurus system. They're mapping the gravity fields throughout the war zone. Of course, they're not doing it to the same accuracy or spatial resolution I am.

"Anyway, given the uncertainty in background measurements, and the inherent noise of the detectors, I can compute the maximum detection range for any detectors, all the way up to the theoretical limit of sensitivity. Then plugging the range into my detection and interception model, I can determine how many

of our ships the Arcani ought to be able to find, on the average. If, as I suspect, even detectors working at the theoretical limit won't explain the losses the Navy is suffering, that will put the monkey on your back, my friend. You'll have to explain the new warhead of the Arcani."

"Sorry, Victor, but I beat you to the punch. I've proven that the Arcani can't have better warheads."

"What! How? You mean you were able to make some sense out of the damage to that ship? And suppose the Arcani didn't use their new warhead on it?"

"No, I gave up on that ship. I'm used to working with radiation-matter interactions in a well-instrumented laboratory, where I can identify events and time them down to a tenth of a femtosecond. But this business of being given a lump of metal, that was melted and cooled, and being asked to tell how it got that way, was too much. I worked over that ship for a couple of days, but last night I decided to give it up, and try something else.

"It occurred to me that, barring any better detectors, the only thing a better warhead could do was convert an unsuccessful attack into a successful one. That is, if the new warhead were better than the old one, it would be successful in a case where the old one wouldn't have been. So I went to Intelligence, to see if they kept any records on successful and unsuccessful attacks by either side.

"I found that they did. We know the number of our ships that didn't get back, so that tells the number of successful attacks the Arcani made. We also know the number of our ships that were attacked, but which escaped. So I could compute the proportion of Arcani attacks on our ships which were successful. Likewise, they had records of each attack one of our ships made on an Arcani ship, and whether or not it was successful. It turns out that an attack will be successful in about four out of five cases, whether the attacking side is the Arcani or ourselves.

"Anyway, up until two months ago, we were averaging four ships lost a month, and one ship reporting an attack from which it escaped. Last month, we lost sixteen ships, and four ships reported they were attacked but escaped. The proportion is the same. They're making four times as many attacks as before, and four out of five of them are successful. If they had been using only a new warhead, they would have been making the same number of attacks as before, but a bigger proportion of them would have been successful.

"Too bad, Victor, but it means they've got a better detector than they had before. It's back to work on that Arcani ship for you."

A ray of hope struck Fedeyev. "Wait a minute. With a better warhead, they might be making attacks now in cases where they wouldn't

have bothered before. They'd have known the attack couldn't be successful, so they didn't try."

"That won't work either, Victor. I asked about that. I was told that the normal cruising speed of these ships is so much below their maximum speed that if they detect an enemy ship, they can almost always speed up enough to catch it and get in firing position. Our tactical doctrine calls for our ships to pursue any enemy ship they detect, regardless of how far away it is at the time of detection. There's no reason to assume the Arcani follow a different doctrine, since the same laws of physics apply to them. There are a few cases, of course, where for one reason or another one of our ships begins a pursuit but can't get into firing position, but the average number of these over the last several months is too small to explain a fourfold increase in losses."

Fedeyev slumped in his chair. "I see," he said slowly. He riffled through the papers on his desk. "Looks like these are going to work the other way, now. Using your data, with my model, I can estimate the detection range they must be achieving, and calculate the sensitivity of their detectors. Let me have a look at what you got from the Intelligence people."

"I don't have it with me, Victor. It's classified, so they wouldn't let me take it out of the building. However, you can go over there in the morning and get it."

"Looks like I'll have to do that." He stared morosely at his worksheets. Suddenly there was a yell from the hallway outside, followed by four voices singing in not very close harmony.

"Sounds like the nightly party is starting," Hanson observed. "Those Patrol Corvette officers really whoop it up every night."

"Can't blame them, I guess," Fedeyev replied. "In their shoes, I suppose I'd do the same thing to try to forget my next patrol. As the chaplain explained to me this evening, it's better they do it here than go over to the red-light district."

"Maybe it is from his standpoint, but we'd get more sleep if they spent their time over there."

There was a knock at the door. Hanson opened it. A Navy officer leaned in, holding the door jamb with one hand and waving a bottle in the other. "Say, we're havin' a li'l party down here in the lounge. Care to join us?"

Fedeyev heaved himself out of the chair. "Might as well. I can't do any more work tonight anyway." He and Hanson headed for the lounge.

Fedeyev seated himself next to a man who had an open bottle and several glasses on a small table in front of him. "I'm Victor Fedeyev."

"Pleasure meeting you, Victor. I'm Commander Vladimir Sokolnikov. I'm commanding officer of the Patrol Corvette *Rigel*. Here, try

some of this. It's a local product. Very weak. You can enter into the spirit of things without actually taking on much alcohol."

Fedeyev tried it. "Very good. Thanks. I'm not really a heavy drinker. But I can't do any work tonight, and I figured I might as well be sociable. Incidentally, Commander, are you from New Dubna, by any chance?"

"No, although I have some distant cousins there. I'm from Moscow, back on Terra. A great-uncle of mine emigrated to New Dubna when the colony was still young. It's a nice world. I've visited it a few times, and looked up some of my relatives there."

Carl Hanson leaned over from a nearby chair and called to Fedeyev. "Victor, I'd like you to meet Commander Griswold, here. His ship, the *Sirius*, was attacked on his last patrol, but the attack was unsuccessful."

"Oh? Can you tell us anything about it, Commander?"

Griswold put down his glass, which evidently contained the same local liquor Fedeyev was drinking. "What's to tell? First thing I knew there was a torpedo bursting ahead of me, but not close enough to do any damage."

"Anything unusual about the torpedo? Greater lethal radius, or anything?"

"Not that I could tell. Looked like any other one I've ever seen. I've never escaped a near miss before, but I've seen our own torpedoes burst often enough."

"What did you do then?" Hanson asked.

"The usual. I went to full speed, then cut to one side. I circled back, hoping to catch the Arcani ship that fired at me, but no luck. He changed course, too, and I lost him."

Just then another man came up, glass in his outstretched hand, and a finger extended, which he proceeded to wave under Fedeyev's nose. "So you're the gravity expert. You tell me, then, how come the Arcani can tell when there's a ship chasing them, at superlight speeds?"

"But they can't," Fedeyev protested. "The gravity cone is entirely behind the pursuing ship. They can't possibly detect it."

"That's all you know, then, Mister Expert. You jus' heard C'mander Griswold say they changed course as soon as he got on their tail. An' twice on my las' patrol, they did it to me. Twice, mind you, I got on the tail of an Arcani Patrol Corvette. Both times, they went to top speed an' changed course b'fore I could fire. How d'you 'splain that?" he ended triumphantly.

Before Fedeyev could reply, his questioner was elbowed aside by another man who lifted his glass high and bellowed "A toast! A toast to Boris Masevitch!"

While the newcomer downed a big swallow, Fedeyev asked Commander Sokolnikov, "Who's Boris Masevitch?"

"He was in command of the *Achernar,* the ship your friend is studying."

The newcomer lowered his glass, and continued in a more moderate tone. "It makes my blood boil to think of my ol' frien' Boris Masevitch pickled in a big jar of alcohol, in some Arcani museum. It's jus' not right." He stumbled off, muttering to himself, " 'M gonna get as much alcohol inside m'self as he's got aroun' him."

"What's this about the commander of the *Achernar* being in an Arcani museum? Carl, what happened to the crew of that ship?"

"I understand that the bodies of the crew were removed by the Arcani. I noticed that some of the amplifiers were missing from their racks. I had assumed they had been removed for salvage purposes, and I complained because I thought I might learn something from studying their more radiation-sensitive components. But I was told the ship had been found that way. Evidently the Arcani had stripped it of all easily removable apparatus, as well as the bodies of the crew."

Fedeyev sat silently for a while, then stood up and drained his glass. "Excuse me, gentleman, but I've got some thinking to do."

The session with Admiral Suvarov had been a stormy one, but he had been worn down, point by point. First, that the Patrol Corvettes *Rigel* and *Sirius* should travel together on their next patrol. Next, that Fedeyev and Hanson should go along on the patrol. And finally, that each of the two ships should have a nucleonic clock and some associated electronics installed on it. The admiral had protested at great length, but he finally relented, as much because of the enthusiasm of Commanders Sokolnikov and Griswold, as the fact that Fedeyev and Hanson had him over a barrel.

There had been some delay in obtaining the two clocks from New Dubna, but by dint of round-the-clock work at the Yards on Haven, where the two ships had been brought, the installation was nearly complete, and the ships would leave only a few hours behind their originally scheduled departure.

Fedeyev returned to the *Rigel* and went to the bridge, where Hanson was waiting.

"The installation there's done. As soon as this one is finished, we can check the two clocks together."

"Good. Commander Sokolnikov is anxious to meet the departure time he gave the admiral. But Victor, I'm still surprised at your selling these two clocks to the Navy for a quarter million apiece."

"Why shouldn't we get what we paid for them? They've been maintained properly since we bought them. They're as good as new. Better, even, since we have three years calibration data on them."

"I'm not worried about you cheating the Navy. The Navy's big

enough to look out for itself. I'm worried about what this'll do to your research program."

"Well, ease your mind, Carl. There's method in my madness. Keep in mind that this will give the Navy something they've never had before, namely the ability to let two ships work in cooperation with each other. They never could do precise maneuvering at superlight speeds, because the drift in their inertial navigation systems was too high. One ship wouldn't know where the other one was, to within a few light-minutes, after just a few hours in space. Each would have to spend half its time in the gravity cone of the other, just to refine their knowledge of the other's position.

"With these clocks, the situation is completely different. Each ship will continually broadcast the time according to its own clock, as well as its current position as indicated by its inertial navigation system. Each one then need spend only a minute or two out of every half hour in the gravity cone of the other, which now also becomes the electromagnetic radiation cone. It can compare its own clock with the broadcast signal from the other, and very rapidly obtain the relative error of the two inertial navigation systems. The two ships will know each other's position to within a few light-milliseconds. They can do precise maneuvers at high speed, without danger of ramming each other, or firing on each other.

"So I doubt the Navy would be willing to give me back my clocks. If I had loaned them, under some sort of return agreement, the Navy would probably requisition them, and pay what they felt like, in their own good time. As it is, the University has all its money back. And when the Navy finds out how useful these clocks are, they're going to want to buy a lot of them. They'll put an end to the present situation, where the clocks are hand made, one at a time, with a six-months lead time on every order. Within less than a year these clocks are going to be mass-produced at low cost. We'll be able to buy three or four of them, for less than we paid for these two, after the Navy orders are filled. I expect to speed up our research program considerably."

An enlisted electronics technician came up to them. "Excuse me, Professor, but the clock installation is finished now."

The clock comparison completed, the two ships were sealed and launched. They rose into orbit for a final check of all air-tight seals, then headed out-system. In slightly over twenty-four standard hours, they had reached the war zone. They then took up the patrol pattern which had been devised for them through long and careful calculation. According to the plan, after fifteen minutes the *Rigel* crossed through the gravity cone of the *Sirius*. Fedeyev was on the bridge with

Commander Sokolnikov, watching the operation carefully. Both were standing behind the radio operator's console, which for the first time in the memory of anyone aboard was manned while the ship was on pseudodrive at superlight speed.

"We've entered the gravity cone, sir," the man at the detector board called out.

"Radio transmission burst received," the radio operator announced. "It's going through the computer now."

Fedeyev and Sokolnikov stepped to a new display panel which had been installed while the ship was in the Yards at Haven. One indicator showed the clock time contained in the transmission from the *Sirius*. Another showed the time indicated by the clock on the *Rigel,* at the time the transmission arrived. The time difference was converted into a distance, on a third indicator. A fourth indicator showed the calculated gravity field of the *Sirius* at that range. A fifth showed the measured field at the instant of reception. A green light at the end of the board glowed, showing that the difference between the measured and calculated fields was accounted for by the known background in that region.

"We're off to a good start, Commander," Fedeyev said. "No intruding ships have been up this gravity cone before we got here. Now we've got to follow our prescribed course, so that in fifteen minutes they'll be inspecting our gravity cone."

Just then a strip of paper was extruded from the radio console. The operator tore it off and looked at it.

"There was a teletype message included in that last transmission, sir. It's for Professor Fedeyev."

Fedeyev took the tape and read it. VICTOR. HOPE YOU HAVEN'T FOUND ANY ARCANI SHIPS ALREADY. CARL

Sokolnikov, looking over Fedeyev's shoulder, spoke up. "Can't say as I blame him for those sentiments. I'd hate to think of an Arcani ship on my tail already. It'd go a long way towards convincing me those rumors about traitors in the Headquarters are true."

"I sympathize with him, too," Fedeyev replied, "but our job out here is to find Arcani ships. The sooner we find one, the sooner we can go home."

The ship soon fell into the routine of the patrol. However, the workload for the crew was heavier than normal for a patrol. To start with, Patrol Corvettes normally carried only one radio operator, since the radio was used only when the ship was leaving, or arriving, at its base. Furthermore, the radio operator doubled as an electronics technician during most of the patrol. Admiral Suvarov had granted an additional radio operator on each of the two ships, but could not supply the three Sokolnikov and Griswold had requested, primarily

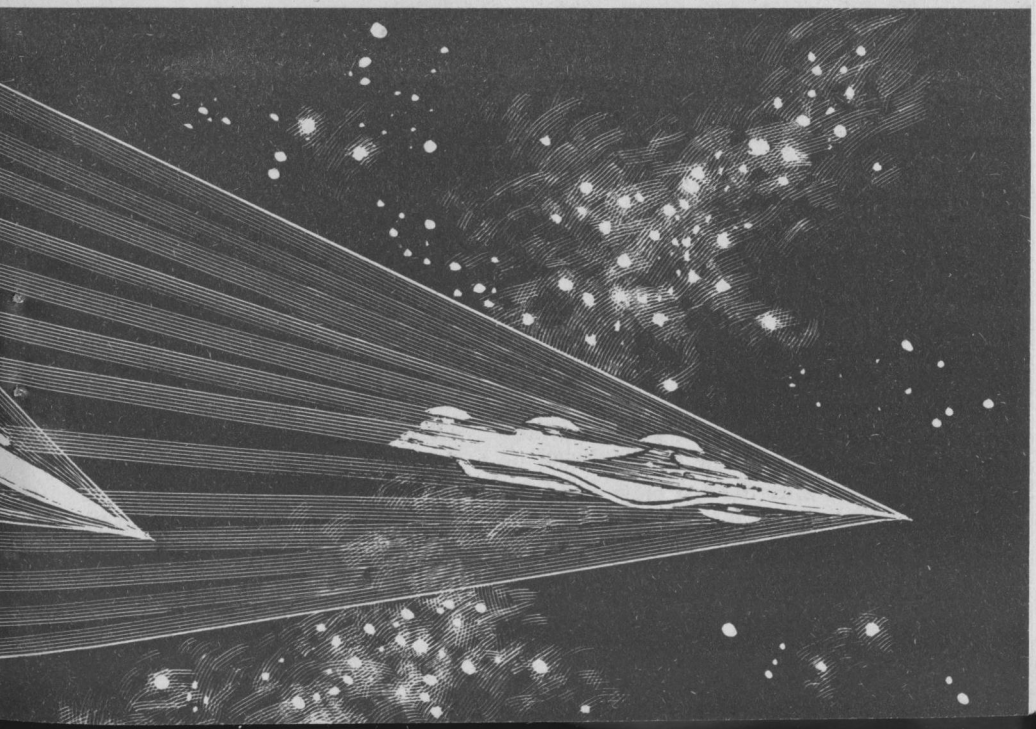
because there were only two unused bunks on each ship, one of these being in the sick bay, and those had been assigned to Fedeyev and Hanson. There simply was no room for yet another man.

At first, the two radio operators took twelve-hour watches. After this proved too fatiguing, they took alternating six-on, six-off watches. Finally, they simply had to train another electronics technician as a radio operator. While the skill of these trainees never approached that of the two fully-trained men, they did take some of the burden off them.

The situation with the pilots was even worse. Each ship normally carried three pilots, so no problem had been anticipated. But on a normal patrol, the course of a ship was usually an arc of a circle, often maintained for hours at a time. The autopilot kept the ship on course, with the pilot intervening only to change course, or when the inertial navigation system was reset on the basis of star sights.

The new patrol scheme, with each ship crossing the other's track regularly, was another matter. The autopilots could not handle the job, and the ships were under manual control continuously. The precision navigation put quite a strain on the pilots. After a week, their watches had been shortened to two hours, from the customary eight. And each two-hour watch involved more work than the usual eight-hour watch did.

Finally, in the middle of the third week, it was decided to re-program the Combat Computer to take on the task of following the planned course. This was a heroic measure, not normally considered possible in flight. Fortunately, the computer technicians on the two ships were able to split the job, exchanging subroutines by way of the periodic intervals of radio communication. Finally, near the end of the fourth week since leaving Haven, the job of course-following was turned over to the Combat Computers, and the workload on the pilots dropped back to normal.



With the strain on the two groups of specialists eased, things might have been considered normal. However, another factor began to contribute to the strain. The usual length of a patrol was thirty-two days. This, plus time to and from Haven, plus what seemed to be inevitable lost time at both ends of the trip, added up to a normal patrol of exactly five standard weeks. Thus, by the end of the fourth week, the crew was beginning to look forward to going home.

Fedeyev and Sokolnikov conferred with each other, and with Griswold and Hanson by radio. They still had not detected any Arcani vessels. All agreed that Admiral Suvarov was not likely to approve a second patrol like this one, when the first had been unsuccessful. And even were he to approve it, Fedeyev and Hanson probably would not be permitted to accompany the patrol. So it was decided to extend the patrol a week.

The reaction of the crews was less than joyful. This patrol had already been harder than the usual one, and the workload higher than normal. And in the background loomed the threat of the Arcani secret weapon. However, the crews were professionals, doing a professional job. Their spirits picked up again after the first blow of the announcement that the patrol was being extended. When it was announced later that they would have to stay out for a sixth week, the crews seemed to take it with resignation.

But the situation was definitely deteriorating. Quarters aboard a Patrol Corvette are cramped at best, and were more so on this patrol. So nerves grew frayed, tempers short, and the atmosphere less and less pleasant. By the end of the sixth week, it was clear that everyone needed a rest.

Finally Commander Sokolnikov decided not to delay matters any longer. He called Fedeyev to the bridge.

"Professor, you know how much this patrol meant to me. I jumped at the chance to make it, when you explained how you thought two ships could work together and protect each other against whatever it is the Arcani have. And there's still the strong temptation to continue just a little longer, in the hope that we'll find something. But we can't do it. It's unreasonable to push the crew any harder than we have. Here's the message I propose to send to Griswold in a few minutes."

He handed Fedeyev a tape which read GRISWOLD. PROPOSE WE TERMINATE PATROL. IF YOU CONCUR, I WILL MEET YOU NEXT TIME YOU CROSS MY TRACK. SOKOLNIKOV.

Fedeyev handed the tape back to Sokolnikov. "I guess you know how I feel, Commander. I wanted to tie my assignment for the Navy up in a complete package, and I thought that this patrol would do it. But I

can't stay away from the University much longer, anyway. I'll have to report my conclusions and conjectures, and hope someone else can follow them up. I really can't understand this, though. By my own calculations, there was a ninety-seven percent probability that we would have detected an Arcani ship by now. But we can't spend any more time at it. Let's call it quits."

"Pilot, how are we doing?"

"In just over three minutes, sir, we'll reach the point where they'll cross our track."

Sokolnikov handed the tape to the radio operator. "Put this on in one minute, and keep it repeating for four minutes. We ought to get their answer when we cross their track in fifteen minutes." Fedeyev watched silently as the tape disappeared into the transmitter. He tried to console himself with the thought that the idea had been worth trying, but just hadn't paid off.

Fifteen minutes later, Fedeyev was standing behind the radio operator's console. He couldn't imagine Commander Griswold proposing to continue the patrol, but he wanted to watch the message arrive.

"We've entered their gravity cone," called out the man at the detector board.

"Radio message being received," announced the radio operator.

Fedeyev reached for the tape, then drew his hand back. After all, he reminded himself, it's probably addressed to Sokolnikov.

Sokolnikov read it, but never got a chance to comment.

"Another gravity cone detected, sir," came a cry from the detector operator. His voice was nearly drowned out by the Battle Stations alarm. "It's about the right strength and Drive frequency for an Arcani Patrol Corvette. They're about three minutes ahead of us, and doing four light-years an hour."

"Pilot, push us up to five. Fire Control, prepare for an intercept."

Fedeyev did the figuring in his head. The Arcani ship was one fifth of a light-year ahead. That meant the *Rigel* could catch her in twelve minutes. But the *Sirius* was doing only two light-years per hour. The Arcani ship would catch her after a chase of only slightly over eight minutes, or just five minutes from now.

"We'll never make it, Commander," Fedeyev shot out. "Can't we go faster than that?"

"No, but we don't have to. Look, if we were to follow our normal path, we'd be crossing in front of the *Sirius* in a little over ten minutes. By cutting across the chord of her path, and going to top speed, we can reach her in about three minutes."

"She'll be safe, then?"

"Not necessarily. Remember, the Arcani ship doesn't have to get very close to her. One of our torpedoes has a range of nearly a light-year, and theirs must be about the same. Their only real need is to track the

Sirius for long enough to be able to aim accurately. In fact, a torpedo could well arrive while we're in the vicinity, and nail us both."

"What do you plan to do?"

"A number of things. While you and Hanson were exchanging messages about gravity fields and so on, Griswold and I were exchanging messages about possible tactics. We worked out a number of ideas on what to do if one of us discovered an Arcani ship on the tail of the other. The best one seemed to be to fly an intercept course, passing slightly ahead of the one being pursued, broadcasting a warning. That's why I've insisted on having the radio manned constantly, not just when we were to receive a scheduled message."

"Then what will you do?"

"The best thing to do is for both ships to retrace the course of the one being pursued. That way the pursuer doesn't learn anything's gone wrong until both ships pass him going the other way, and he picks up another gravity disturbance. So that's what we'll do. What we do after that depends on what he does."

Fedeyev watched the Combat Information Display. It showed the planned course of the *Sirius,* which was indicated by a bright dot crawling along the curved line. If, Fedeyev reminded himself, she hasn't been blasted already. Behind the *Sirius* came the Arcani ship, represented by a large diffuse ball. The volume of uncertainty was nearly a light-hour in diameter. Both the *Sirius* and the Arcani ship were converging on the spot of light in the center of the Display which represented the *Rigel.*

"Will we make it in time?" Fedeyev asked.

"Can't say," Sokolnikov answered abruptly. "I don't have any more information than I had two minutes ago. If the Arcani ship hasn't fired before we get there, we'll make it in time. It normally takes at least fifteen minutes worth of tracking to determine a target's position with enough accuracy to fire. But the Arcani may have something which cuts down the tracking time they need."

"How close will we pass the *Sirius?*"

"About ten light-milliseconds. That's ample margin, since the relative error of our two inertial navigation systems isn't over about three light-milliseconds."

"We ought to be able to see her at that range, with a good telescope, shouldn't we?"

"Hardly. At the speed she's going, any light reflected from her would be left far behind. Even if you knew where to look, she'd appear perfectly black. You could detect her only if she occulted something. We'll have to wait a few more seconds to know if she's still there."

On the Display, the spot of light representing the *Sirius* came abreast of the *Rigel,* and swept behind it.

"Pilot, take up the reverse of the *Sirius'* course. Drop speed to four."

"Yes, sir." The pilot's fingers flew over his console, setting the course constants into the Combat Computer, which would guide the autopilot.

"We'll know soon," Sokolnikov said, a trace of grimness in his voice. "If they were still there to receive our message, they'll reverse course at full speed, and overtake us. They'll use our radio signals to avoid ramming us, and pull ahead. We'll get their signals shortly."

Fedeyev watched the movement of the sweep-second hand on the clock dial. Five seconds. Ten seconds. Fifteen seconds.

"Message being received," sang out the radio operator.

Fedeyev suppressed a whoop of joy, and dashed for the radio. Sokolnikov beat him to it, and grabbed the tape.

It read SOKOLNIKOV. RECEIVED YOUR WARNING. FOLLOWING AGREED PLAN. YOU LEAD. GRISWOLD.

"Pilot. Reverse course. Follow that Arcani ship. Go to full speed."

Fedeyev watched the Display, as he didn't want to bother Sokolnikov while the latter was running a battle. The Display showed the Arcani ship as still following her old course, but that was based on pure prediction from the old measurements. The Arcani ship might have changed course when the two Terran ships passed by her. She would have to change course when she reached the point where the *Sirius* had reversed course, anyway.

"Target has changed course," announced the man at the detector board. He relayed his readings, but the Combat Computer had already revised the Display to show the Arcani ship moving to one side. The volume of uncertainty expanded on the Display, then started shrinking again, as the Computer integrated more and more detector readings.

"Did you relay that information to the *Sirius?"* Sokolnikov asked the radio operator.

"Yes, sir. As soon as I got it from the Computer."

Fedeyev noticed that the Display had showed the *Sirius* changing course, although there was no possible way to detect that fact. Evidently the Display was based on the assumption that the *Sirius* was following an agreed tactical plan. He watched the points of light representing the two Terran ships as they followed the Arcani ship, apparently not gaining in the slightest.

Commander Sokolnikov stood beside Fedeyev and watched the Display for a while, then spoke slowly. "We'll never catch him at this rate. He can go as fast as we can, for as long as we can. And he's putting enough wiggles into his path that we can't fire with any hope of hitting him."

"He'll get away, then, Commander?"

"Yes, I'm afraid so. I'll chase him for another fifteen or twenty minutes, but if we haven't gained anything, or if he hasn't straightened out so we can fire with a reasonable chance of hitting him, I'll have to call off the chase. If he were going in some large curve of some kind, I'd send the *Sirius* across the chord, in an attempt to intercept him. But since he's going in a straight line, there's no way to take a shortcut on him."

They both stood and watched the minute-hand move slowly across the clock dial. The distance separating them from the Arcani ship maddeningly stayed the same. Finally Commander Sokolnikov broke his silence.

"We've got only thirty more minutes at this speed before the Drive starts overheating. We'll then have to drop back to three light-years an hour until it cools down. I'd hate to be caught by another Arcani ship then, when he can outrun me. And since we're not gaining any, I think we'd better call off the chase. I really hate to, Professor. After waiting six weeks without spotting even one ship, it's galling to have the first one escape from you." He turned to the radio operator. "Message for the *Sirius*. Tell them we'll stop dead in space at"—he glanced at the clock again—"0817 Standard." He turned back to Fedeyev.

"This must be a blow to you. I imagine you wanted another Arcani ship to study. But don't feel too bad about it. Whatever that ship had, at least you've given us a way to counter its effectiveness. As soon as the *Sirius* pulls up with us, we can start back for Haven."

"Not so fast, Commander. I'm sorry about losing that ship, but that's not what I really came on this patrol for. I was looking for something, but I didn't expect to find it on an Arcani ship. I want to backtrack along the course of that ship, to the point where it entered the gravity cone of the *Sirius*, then I can start looking in earnest."

Sokolnikov tried to get more information out of Fedeyev, but the scientist was adamant. Finally, Sokolnikov decided to acquiesce.

"Very well, we'll do as you request. I was told to give you full cooperation, and I will. But not more than twenty-four hours. After that we go back to Haven, whether or not you find what you were looking for."

"Fair enough, Commander. I don't want to seem so secretive, but I'm not sure myself exactly what I'm looking for, and I won't know until I find it. But I agree on your time limit. In fact, if I haven't found it in twelve hours, I'll quit."

"Will you need the *Sirius* to help you search?"

"No, everything I need I have on board here."

"Good, because I'm not going to feel comfortable unless she's covering our trail. I think I can set up a maneuver in which she can cover

her own trail as well. It won't be as efficient as if both ships were cooperating, but it will be better than nothing."

Within two hours, they had retraced the path of the Arcani ship to where it had detected the passage of the *Sirius*. In the meantime, Fedeyev had been hard at work at the detector board.

"Your gravity detectors aren't as sensitive as the ones I'm used to using, but they'll do the trick," he finally announced to Sokolnikov. "Now I want to pin down as precisely as I can the exact course and speed the Arcani ship was following before she spotted the *Sirius*."

For nearly two hours he crossed and recrossed the path of the Arcani ship, making hundreds of gravity measurements and feeding them into the Combat Computer. Finally he was satisfied.

"That ought to do it," he announced. "Fortunately the Combat Computer is programmed to process gravity data and derive a location from it."

The Computer digested the data silently for a few seconds, then presented the results on the Combat Information Display. A thin violet line traced the course of the Arcani ship, and figures appeared beside the line, indicating the time the ship had been at various points.

"I've never seen the display used at this high a magnification before," Sokolnikov remarked. "What's the uncertainty in position?"

"I've got her located down to a few hundred meters, Commander. I don't even want to express it in terms of light-speed units."

"How did you manage it? We've never come near that close."

"That's because you don't have a couple of hours to do it in. Besides, I've used some tricks that work fine in gravity research, but which you can't use when you're chasing somebody. Now we'll follow the extension of this course, where the Arcani ship would have gone if she hadn't changed course to chase the *Sirius*."

The pilot fed the new course constants into his console, and the autopilot steered them through the gravity cone of the *Sirius*, and out the other side.

Fedeyev indicated a violet line in the Display. "That's the projected course of the Arcani ship. I'm going to spiral around it, at fairly low speed, taking more measurements."

Again Fedeyev went through a sequence of gravity readings, feeding them into the Combat Computer as he took them. Slowly a hazy violet line built up in the Display, wavering back and forth but always remaining near the line representing the projected course of the Arcani ship.

"Whatever it was, it was doing about ten light-years an hour," Sokolnikov remarked as he watched the Display.

Finally, after three hours and hundreds of measurements, they had traversed nearly a light-year. The course of the fleeting object they were tracking was beginning to be well pinned down. The object itself was shown by a small globe of light, so many light-years ahead as to be almost off the Display. However, Fedeyev didn't seem to be concerned by this. He continued to take measurements as they crept ahead.

Then, suddenly, his attitude changed. "Here's what I've been looking for," he said, almost to himself.

The Display altered abruptly, as the Computer took in more and more readings. The object they were pursuing was no longer shown as vanishing off the Display. It was hanging dead in space, just a few light-hours ahead. The volume of uncertainty about its position shrank steadily, until it had a diameter of around twenty light-milliseconds. Fedeyev turned to the fire control officer.

"That's it. It's hanging dead in space ahead of us. I imagine its Drive burned out, after a short burst of speed. However, it might be boobytrapped. Do you think you can put a torpedo close enough to disable it without vaporizing it completely? Remember, it has a mass of only a hundred tons or so."

"Yes. I think so."

Fedeyev turned to Commander Sokolnikov, who nodded his assent. The torpedo leaped ahead. Two minutes later, the *Rigel* went to top speed after it. They stopped at the calculated position of the object. A few more minutes work with the gravity detectors, followed by the use of a radar, sufficed to locate the object. They quickly pulled alongside of it. It hung motionless in space, a scarred and pitted chunk of metal, its sides still hot from the blast of the torpedo.

"So that's their secret weapon, is it?" Sokolnikov asked.

"Looks like I came too close," the fire control officer remarked. "I should have given it a little more lead."

Fedeyev turned to Sokolnikov. "It's badly damaged enough that any boobytraps on it should be disabled, isn't it?"

"Yes, but it looks like it's so badly damaged you'll never learn anything from it. We not only lost that ship, but wrecked this thing, too."

"Haul it aboard anyway. After my experience with the captured Arcani ship back at Haven, I'm convinced I'd learn nothing from it even had we captured it intact. But it doesn't matter. I know what it was and what it did, anyway. All I needed was the physical evidence to prove that my ideas were more than just speculation. As soon as it's loaded aboard, we can go back to Haven."

Fedeyev looked around the conference room. With him at the ta-

ble in the center were Commanders Sokolnikov and Griswold, as well as Carl Hanson and three other officers from Admiral Suvarov's staff. The seats around the sides of the room were also filling up with officers from the staff, as they filtered into the room in ones and twos. But the seat at the head of the table, reserved for the admiral himself, was still empty.

Fedeyev got up for the dozenth time, and checked the blackboard he had asked to have brought in. Then he looked at the clock again. The admiral was five minutes late. He sat down, picked up a pencil, and began to draw circles on the pad in front of him. He dropped the pencil as someone shouted "Tenshun!" The officers in the room shot to their feet. Fedeyev stopped just in time and remained seated.

Admiral Suvarov, flanked by two lesser admirals, entered the room. He seated himself at the head of the table, while the other two took seats at the wall.

"Good morning, gentlemen," the admiral began. "Professor Fedeyev, I've called this meeting at your request. I understand you feel you have completed your task, even though the patrol you went on was not exactly successful. While the Arcani ship you found may have been carrying their secret weapon, it unfortunately escaped. And the device you captured was so badly damaged that nothing can be learned from it, beyond the fact that it was an item of Arcani manufacture. However, I am anxious to hear your report."

"Thank you, Admiral," Fedeyev replied. He hesitated momentarily, as though trying to choose the right words. "I do feel that I have completed my task, in the sense that I have found an explanation for the phenomenon you asked me to investigate. At any rate, I want to present my explanation to you and your staff.

"To start with, Dr. Hanson and I were asked to try to identify a 'secret weapon' the Arcani were presumed to have. I think we all understand what is meant by that term, that is, some technological advancement which gives one side, in this case the Arcani, a significant advantage over the other. You had decided that the Arcani had such a device, and that it had to be either a better detector, or a better warhead. So you chose the two of us to make the investigation, because of our presumed competence in the proper fields of science.

"In the course of our investigations, we not only looked over the equipment you had provided for us, but we also made use of various records maintained by the Headquarters. First, I'd like to have Dr. Hanson present his conclusions, based on his examination of the records. Carl, go ahead."

Hanson related the reasoning which had led him to conclude that the Arcani successes could not be

attributed to an improvement in warheads. At first, there was no reaction, then a few of the Navy men started nodding their heads in understanding. With apparently this much of his audience with him, Fedeyev continued.

"Dr. Hanson's conclusions made it appear that the answer had to lie in the field of detectors. Before I give my conclusions on this, however, I'd like to review some other things with you."

He got to his feet, and stepped to the blackboard. "After I spent some time examining the Arcani ship, I stopped and derived a mathematical model for the interception process. I'll put it on the board for you."

He wrote: "Expected Encounters = (constant) × (Speed of friendlies) × (speed of hostiles) × (weeks on patrol) × (detection radius) ^{2} × (number of hostiles)."

"I've worked out the value of the constant, but it's irrelevant at the moment. This formula gives the expected number of times one of our ships will detect an Arcani ship on a patrol. As Dr. Hanson has told you, on the average, four out of five of these encounters are converted into kills.

"Now note one important feature of these encounters. If the paths of two ships cross, it is a matter of pure chance which one detects the other. That is, the one which gets there first will be detected by the other, which passes behind it and through its gravity cone. So this formula also gives the expected number of times an Arcani ship will encounter a Terran ship on a patrol."

He suddenly realized that he was slipping into his habitual classroom manner. He decided this audience wasn't going to take well to being lectured to, and sat down again. He reached for a glass of water, took several swallows, and tried to relax.

"Now," he continued, "the number of Terran ships was doubled, and as predicted by this formula, the number of Arcani freighters destroyed was doubled. But this formula also predicts that if the number of Terran ships was doubled, the number of Terran ships destroyed would likewise double.

"How to explain the fact that the Terran losses jumped fourfold, instead of only doubling? Well, keep in mind that the number of Terran freighters lost also doubled. We've settled already that the Arcani don't have a better warhead. It could be due to a better detector. But it could also be due to a doubling of the number of Arcani ships."

He stopped, waiting. There was a moment of silence, then one of the officers at the table, a captain wearing a puzzled expression on his youngish face, spoke up. "Let me make sure I understand your formula. It gives the number of times one of our ships and an Arcani ship pass within detection range of each other. Half the time, ours will detect the Arcani, and vice versa the other half."

"You can forget the half," Fedeyev interjected. "Just absorb it into the constant. That formula gives the expected number of times one of our ships detects an Arcani ship, or the expected number of our ships detected by an Arcani ship."

The captain went on. "Then doubling the number of our ships would double the number of detections by Arcani ships. That sounds reasonable. And if they doubled the number of their ships out on patrol, that would double the number of detections again, for a fourfold increase. So that's your explanation."

"That's preposterous!" burst out one of the junior admirals who had entered with Suvarov. That seemed to be the signal for more outbursts around the room. Fedeyev stole a quick glance which showed that there were at least as many arguing for him as against, then concentrated his attention on Suvarov, as surreptitiously as possible.

Finally the old admiral slammed his hand down on the table. "All right!" he bellowed, in a voice that seemed as though it would carry the thousand-meter length of a battleship without benefit of a loudspeaker. Instantly the room became deathly silent, and Suvarov continued in a lower voice. "Professor Fedeyev, as I understand it, you're telling me that the Arcani have not devised either an improved warhead or an improved detector. That our losses have gone up simply because we've provided them with more targets to shoot at, and they've put out more ships to do the shooting."

"That's a good way of putting it, Admiral," Fedeyev replied. "We demonstrated pretty clearly that they didn't have a better warhead, and the only question remaining was that of the detector. We've found a way of explaining all the known data, without postulating the need for a better detector. So we conclude the Arcani don't have one."

This was the crucial point. Fedeyev was used to thinking as a scientist. He had proposed a plausible theory which explained all the facts. He even had Occam's razor on his side. But this was a mode of thinking which was completely alien to Admiral Suvarov.

Suvarov spoke up again. "But you don't have any real proof. Nothing but hypotheses and speculation. What's worse, your formula is nonsense. It ought to work for us as well as for the Arcani. Their losses should go up four times, too. But they didn't. So the Arcani *must* have a better detector. One good enough to explain the difference between our losses doubling, because of the doubled number of ships, and the fourfold increase in losses we actually did have."

A tight smile flickered briefly on Fedeyev's lips. The admiral was following his logic. He might bluster a bit, to save face, but now that he

had started thinking within the framework Fedeyev had set up, he was likely to continue doing so.

"Excuse me, Admiral. My formula doesn't predict losses on either side. It predicts only the fact of detection. Those detections must still be converted into kills. The formula says nothing about the effectiveness of the conversion. And if you check the records available in your Headquarters, you will find that the number of times an Arcani ship was detected has gone up four times, as predicted."

The admiral cast his glance around the room. Fedeyev guessed that someone's head was going to roll because this significant fact hadn't been brought to the admiral's attention by his own staff. But then the admiral was back at Fedeyev.

"Very well, that fits your explanation, too. But you still haven't explained all the facts. What about that thing you brought back? It's so badly damaged we can't tell what it is. How do you know that isn't a secret weapon?"

"Let me remind you, Admiral, how that thing was found. I had a theory which could explain the facts you had given me, plus the ones I had dug out of your records. If my theory were correct, a certain thing had to exist. So I talked you into letting me go on a patrol, a patrol which was set up according to my plans. I went through a very careful search, in a particular place, looking for that thing which had to exist. And I found it. That Arcani device we located and blasted. It doesn't matter that we can't dissect it. There's only one purpose it can serve, and the fact of its existence, at the place it had to be, provides the capstone of my logical structure. It validates the whole chain of deductions. It provides the concrete piece of evidence that proves the theory right."

Fedeyev decided he'd baited the admiral long enough. "It's a warning device. It follows an Arcani ship. Its autopilot is programmed to follow the planned course of its parent ship, at the same velocity, and a fixed distance behind. When its gravity detectors find an anomaly, which could be due to another ship chasing its parent craft, it goes to full speed, perhaps to ten light-years an hour, and broadcasts a warning. The parent craft then takes evasive action. This explains why the fourfold increase in detections wasn't accompanied by a fourfold increase in kills."

The admiral was silent. Emotions chased each other across his face. Finally he spoke. "Very well. You seem to have provided a satisfactory explanation for our losses. Apparently we were wrong about the enemy's having a secret weapon. And you've shown us how to use those nucleonic clocks to improve our tactics. Now we can turn the tables on them. Next month we'll see a big change in the loss rates on both sides. We may have called on you

for the wrong reasons, but at least we picked the right men to help us. You have our sincere thanks."

"We're glad we could be of help, Admiral," Fedeyev responded.

Then the admiral stood up. "Professor Fedeyev, Dr. Hanson, I'd like to see you again before you leave. The meeting's dismissed."

He left the room immediately, followed by most of the rest of his staff. Hanson, Griswold and Sokolnikov clustered around Fedeyev, who remained seated.

Fedeyev leaned back in his chair and sighed. "They bought it. I wasn't sure they would, for a while. Most of it was based on inference, and they're used to dealing only with hard facts."

"I see now what was going on," Sokolnikov stated, but I'm not sure I appreciate being told half-truths, and being used that way. You should have told us more of what you had in mind."

"I'm sorry for having misdirected you that way," Fedeyev replied, "but I couldn't have told you more. Until I actually had my hands on that Arcani warning device, I had no proof of anything. We'd have lost a lot of time arguing, if I could have convinced you at all."

"Well, it worked out, so we can't complain," Griswold said. "But tell me, what started you thinking that there wasn't really any secret weapon at all?"

"That the enemy success wasn't due to a technical advance? It took me a while to get to that point. I came out here realizing that I was totally ignorant of military matters, and that I'd have to pick up a lot in a hurry. I accepted everything I was told by the Navy, both officially and unofficially. But then I spotted a discrepancy. You tell me, what did the Arcani do with the bodies they took off the *Achernar?*"

"What? Why, they pickled them in alcohol, and put them in museums," Griswold replied, a look of astonishment on his face.

"How do you know? After all, we have no contact whatsoever with the Arcani culture."

"Why, everyone knows that," Griswold stated. "What else would they do with them?"

"Well, to start with, they wouldn't use alcohol as a preservative. Being chlorine-breathers, they'd probably use some chlorine compound. But anyway, when I first heard that story, I remembered what the chaplain had told me about burying the Arcani bodies off the captured ship. I don't know what the Arcani did with the crew of the *Achernar,* but it's at least conceivable to me that they gave them the equivalent of a military funeral, and buried them in the equivalent of a Government Issue casket. So I doubted the story. Then it occurred to me that maybe I should have been doubting a lot more than I had accepted so readily. Once I started doubting things, it was easy to con-

tinue, until I even doubted the existence of a secret weapon."

"However it happened, Victor," Hanson added, "congratulations anyway. I did manage to get part of the explanation, but I don't think I could have carried it beyond that. It's a very difficult job, to find a secret weapon that doesn't even exist."

"Wait a minute," Fedeyev protested. "The thing that made the job difficult wasn't that there was no secret weapon, but that there were *two* secret weapons.

"First of all, there was the Arcani warning device."

"O.K., maybe you could call that a secret weapon. It certainly was a secret. But it had nothing to do with our increased losses."

"That's right. But it prevented the Navy from realizing right away the nature of the secret weapon which *was* responsible for our losses."

"But there wasn't any."

"Not a piece of military hardware, no. But it was working there just the same. I mean the Law of Averages." Fedeyev grinned. "It was so secret even the Arcani didn't know they had it at the outset. They may not know it yet, and they'll really be surprised when we start it working in our favor." ■

In Times to Come

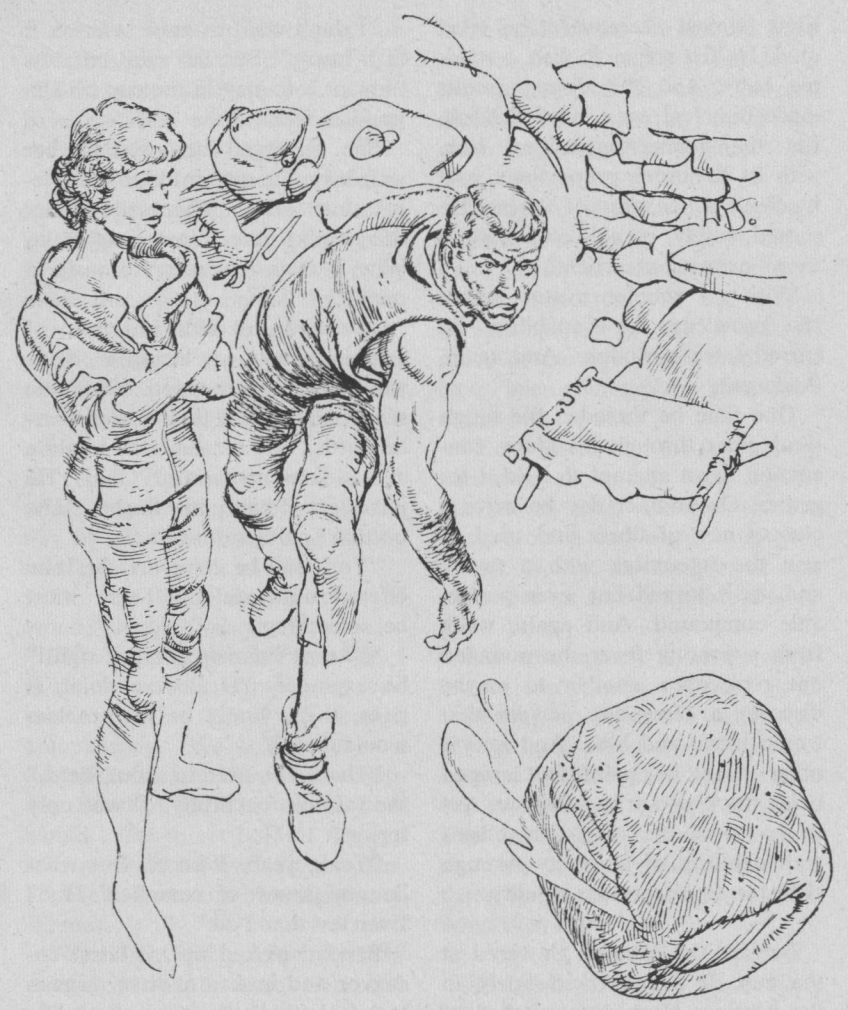
Nicholas van Rijn—and the Trader Team of Brains, Brawn, Beauty and Business, otherwise Muddlehead, Adzel, Chee and Falkayn—ride again! Courtesy of Poul Anderson.

This time the involvement is complex indeed—and the most complex part involves the computer-derived recognition of an immense and hitherto unrealized value of a rogue planet. A planet of no sun, wandering alone for twenty billion years or more in the eternal night between stars, with a temperature about five degrees above absolute zero—now passing briefly near a blue-white giant sun to return again to the Eternal Cold. Of what value could such a forever-frozen world be?

It was a giant computer that helped Falkayn find the answer. The complications came from the fact that the new idea made the planet worth trillions—and the computer, unfortunately, wasn't Falkayn's!

Plus the not-insignificant fact that when a blue-white giant sun's vicious nearby radiation boils off the entire cryosphere of a frozen rogue, the climate is, temporarily, best described as awe-inspiring.

The Trader Team had reason to call it "Satan's World"! And that's what Poul calls his long four-part novel, beginning next month—and for which Chesley Bonestell has done a magnificent astronomical color-plate cover. The cover painting will be available as special type-free reproductions, at $1.50 each. Take a look next month, and I think you'll want one! ■ *The Editor.*



Handyman

Persistence pays . . . and pays and pays!
It's just that sometimes it takes a lonnng *while to pay off!*

JACK WODHAMS
Illustrated by Leo Summers

First, almost secretively, he tried mud. He felt rather foolish, a mud-pie baby, and the dismal results made him feel even more childish. But the helmet aggravated him, with its ludicrous proportions, and it offended his sense of fitness. He should, surely, be able to fashion a more convenient article?

With no simpler means within his knowledge or capability, he stirred a fresh mixture. And again. And again.

One time he threaded the tough local grass through his gluey concoction in an attempt to hold it together. On another day he wove a clumsy nest of fibers and tried to seal the interstices with a messy and, as it turned out, ever permeable compound. And again, weak from a passing fever, he pounded one rock upon another to maybe discover a cementing powder that would blend and bind. And on yet other days he painfully scraped holes, looking for a substance yet to be tried, the magic ingredient with qualities of plasticity through cohesion to impervious rigidity . . .

Berrard de Potagier glowered at the cup. It had cracked finely in the heating. Now dark patches of moisture were spreading to darken the cup's rough gray surface.

"Leaking," Berrard grated. "Always leaks."

"If you drink the water quickly, it won't have time to leak," Linnette said reasonably.

"I don't want to have to drink it in a hurry," Berrard said irritably. "I want it to stay in the cup till I'm good and ready."

She shrugged and shifted her weight on the uncomfortable crudely-lashed seat. "There are other things that are more important. Why is it so necessary to make a cup?"

"Because I'm sick and tired of drinking out of my headgear, that's why!" Berrard snapped. "And the saucer thing, and that blasted plastic bottle." He turned back to glare at his latest creation. "Gah!" He poked at it with his finger. "The bottom's going soft again."

"You can't be doing it right," she offered unhelpfully. "There must be something . . ."

"I *know* I'm not doing it right!" he exploded. "If I were doing it right, there would be no problem would there?"

"There's no need to shout, Berd," she said reproachfully. "I was only trying . . ."

"Yeah, yeah, I know. But what do you know of ceramics? Huh? Even less than I do."

Berrard picked up his latest endeavor and looked at it in disgust. It left a shallow circle of puddle where it had stood. The vessel itself was half empty. "Useless. Absolutely useless."

With an oath, Berrard hurled the faulty container to join his other failures. He listened. "It doesn't even tinkle."

Linnette was tempted to say, "Oh well, back to the salad bowl," but said instead: "Perhaps you should have persisted with hollowing out the wooden ones, Berd."

"No," he said. "No, the tools are missing. Just gouging at it was no good. No proper finish. It needs to be smooth. And you know the color muck that comes out of the grain. Besides, it takes too long."

"No longer than your pottery ones," she pointed out. "That one you burnt through the center was all right till it split."

"Hah!" He sneered at himself. "Five days searing and boring, one day of vile-tasting use, and then—xixt! right down the middle."

"If you used another type of wood," she said, "maybe . . ."

"No," he growled, "that ax I made needs sharpening every two minutes." He spread his hands, complaining, "We haven't even a decent knife I could use for shaping. Survival kit," he said. "God, would I like to get hold of the guy who put that survival kit together. I'd like to have him here right now. I'd ram . . ."

"Yes," she said, cutting short the reiterated diatribe that, after five months, was getting wearisome, "but he's not so you can't. You should be grateful for the useful things that it did contain. Without the medicine and the food we probably wouldn't be alive today."

"Oh sure, sure, defend the vac. We'll erect a monument to the Unknown Mindless. *He* should have crashed in and tested it out for a few months. Not one can," Berrard declared, "not one tin can or one glass bottle. Edible sofpacs." He spat. "Brilliant."

Resigning herself to the repeated argument she said, "He couldn't know the circumstances of our particular misfortune. If the escape capsule had not got out of control, much of the equipment would not have been destroyed. You can't blame him for that."

"I can blame him for stowing the hardware aft smack bang against the power unit," Berrard stated. "Any trouble and *woomf!* up goes the lot. No sir, the designer of that outfit was an ante-frontal lobotomy job."

Linnette sighed. "There's nothing we can do about it now . . ."

"Twigs," Berrard went on. "Twigs instead of knives, forks and spoons. Would it have hurt to have had *some* metal cutlery? Oh, no. Rimmed plastic, unbreakable, haha. One little fire and *phut!* all that's left is a few slivers of tufbondedge. Huh!"

She tried to change the subject. "We were lucky to strike such an agreeable planet," she said. "We could so easily have done a lot worse."

His smile was wintrily bitter. "Oh, yes. We've been lucky to survive so far. We haven't caught lumps, bumps, twitches, spots, fe-

ver, cramps, nausea, paralysis or what all for at least two days now. Our immunity rating must be getting higher. And that's another thing—we've little over a hundred of the personalized correctives left between us. Not enough were supplied. Our food is running out and we're bound to have more trouble with the local stuff."

"We seem to be getting no ill-effect from the blue cabbagey. Or from the plumpear. And some others we're testing look promising."

He wriggled his features. "That mauve horror? You don't call the plumpear food, do you? It tastes like charred cow-pad. We'll have to find something better than that if we're not to live in a gourmet's hell. Lord knows it's bad enough now living on reconstituted rubbish."

"I'm doing the best I can," she said. "My workbox was smashed too, remember. As it is, we haven't the time and we'll just have to risk an increase in the fractional intake of likely-to-be-compatible substances."

"Oh, fine. And one of us eats mushroom soup and"—his fingers tossed imaginary dust—"blooey."

"The x-factor is a chance we have to take," she said calmly. "Face it, Berd, even if the marker was not scrunched and frazzled, we'd not be likely to see rescuers for a long, long time. The capsule was only meant as a basic camping outfit."

Berrard sagged. "Yeah. Yes, you're right." He gloomed and reflected. "If I only had something to cut the metal of the capsule. And had something to bend it with. Lin, it's so damned frustrating. My hammer just bounces off it. It's . . . It's so . . . unavailingly brutal."

She smiled philosophically. "We're not doing too badly are we? I mean, for inexperienced amateurs."

Berrard scowled. "We don't come from a prehistoric culture, yet we're living worse than primeval natives. With all my technical know-how, I still can't build a simple hut that will keep the wind and rain out. Hot knockers, what I wouldn't give for a IO-D epoxyglue."

"One day you will stop wishing for what you can no longer possibly have," Linnette said.

"But a cup, Lin." He stared at her. "An ordinary common cup. A thick mug even. I spent fifteen years specializing in radioelectronic circuitry—studying, sweating, choking on it. What good is it to me here? Why did nobody ever tell me how to *make* a wheel, a piece of paper, or a needle? It seems so ridiculous that I, a modern man, am incapable of making for myself such a stupid everyday item as a cup."

Linnette's smile broadened, and then she laughed. "Berd, I'm glad it was you. You're a trier. You'll make a cup that holds water one day."

"Huh." He struggled to stay sour. "Laughter, that's what hurts. To

know that a crummy caveman would bust a gut giggling at my efforts."

"Maybe the clay you are using is the wrong type, the wrong consistency," she said. "You might have more success if you tried to make glass."

"Oh ha-ha," he said sarcastically.

"No, seriously," she said. "If I remember rightly, it's made from sand and potash. You could at least make bricks from the clay, couldn't you? And . . ."

"Hold it, hold it, hold it!" he said. "Do you think I have a bulldozer, or a power shovel, here? Digging clay out of my little pit takes time. I'm ahead of you. I've thought of making a shelter with clay bricks—but I can't even make a cup!"

"You'll learn," she said amiably. "We're not going anywhere."

"Ah." This re-realization gave him pause. "Yes." Then another thought struck from his pensiveness. "I think glass also needs soda."

"Soda?"

"Yes, soda. I'm not sure what kind of soda. Frankly, I'm not even sure what soda looks like. They use it in some cleaning fluids, don't they? And I seem to recollect that my old dad used to take some soda preparation for his indigestion. And when I was a kid there used to be some stuff called soda pop." He cogitated. "How, or why, it is used in glass making I don't know. I only know that I wouldn't recognize it even if I were wading through it."

Berrard drooped again. "God, there are so many things. I didn't realize that there were so many things. I hardly know what any of the basic elements look like. Nearly every substance I can recall was a mixture of some kind—cloth, plastic, alloy, processed food, treated fabric, heated, pressured, blended and heaven knows what." He squirmed in despair. "I should have been a chemist, or an engineer."

Linnette's lips quirked. "It might have been better if you had been a physician," she said.

"Uh?" he said, surprised. "Heck, the medcab has all we need—what would we want with a doc?"

She eyed his crumpled clothes and unkempt beard and an immense warm sympathy sprang from her understanding of his worried crossness. "Berd," she said softly, "I'm going to have a baby . . ."

It was over seven years before other humans made chance contact with the castaways. A man can learn a great deal in that time.

"I can't get over it," Berrard de Potagier said. "I'd forgotten all about the pulser I knocked up. And it's still working?" He shook his head. "It must be all of four . . . aw, five years since I last adjusted the break duration of the cycle."

"It was very weak. We could easily have missed it. It had stretched to 1.16."

James Nyre did not feel very comfortable. He and navigator Ernfeld had been glad enough, as always, to keep ashore where hostility seemed comparatively minor. With little demur they had accepted the invitation to talk in Berrard's home in preference to the rather cramped dining-lounge-cum-chartroom on the ship. But now the newcomers began to feel awkward. Protectively insulated in container suits, they became aware of the incongruity of their garb in such simple surroundings. For health reasons it was very necessary, but it still seemed somehow absurd.

Berrard was brown, trim-bearded, placid-eyed. His clothes were coarse knitted, a loose jacket and pants very much like a sleeveless judo costume. Linnette wore a knee-length sack of similar material. She cradled a pop-eyed infant on her hip, and a four-year-old peered in amazed speculation from behind her skirt. The eldest child stood at her father's shoulder.

It was the kids that did it, Nyre thought. He hated like hell to frighten kids. And it would be unwise to try and win them with candy. "You, uh, seem to have acclimated very well," Nyre said.

"We have been very, very lucky," Berrard said. "We have very few correctives left, saved for desperation. It's something we could do with."

"Oh? You'll be able to last out do you think? You understand," Nyre explained, "that our accommodation is limited and that we're not equipped to handle passengers. It will be at least a year before a rescue ship can get back here. I'm sorry, but that's . . ."

"Rescue?" Berrard said. "Who wants to be rescued?"

"Uh? Well," Nyre blanked for a moment, "your signal *was* a distress call, wasn't it? I mean, you're a highly qualified technician. I imagine that you'll be very glad to get back to civilization again . . ."

"Good heavens no," Berrard said. "We wouldn't dream of it, would we, Lin? Not now. What, after all the trouble we've taken to assert our presence here?"

"Oh." Nyre was deflated, his armor suddenly rusty. "I naturally thought, uh . . ." He rallied. "You actually want to stay here?"

"It's peaceful," Berrard replied, "and a civilized attitude is not dependent on services and whatnot. Anyway, I have my own services. Look around you, have you ever seen a house like this one?"

The two guests looked. They had to admit that they had never seen a house like this one. It had a touch of ancient Grecian grandeur about it, but the design and composition were inimitable. Floor, walls, ceiling, tables, chairs, even a child's trolley, all seemed to be manufactured from the same basic matter, a hard, marbly substance that glowed even in its lightest

shade. Pleasant. A couple of thick knitted rugs were on the floor, there was an ornament or two, a few toys, but the room nevertheless had the spacious under-furnished elegance of a director's office.

"Ceramic," Berrard said, with a hint of pride. "Leastways, that's what I call it. This formula was my own discovery. Worked on it for over two years before I made a breakthrough. Been improving ever since. Molds well before it's cured. Can make tools, tableware—gearwheels even, from the stable mix. Practically anything. I'm still experimenting, of course. That chair you are sitting on is my new matt glaze. I'm not entirely satisfied with it."

"Oh?" Nyre looked around at his seat. "I thought it looked quite good," he said honestly.

"But not deep enough," Berrard said critically. "I hope it fits you," he added apologetically. "The layer is natural and has intrinsic malleability. It is fitted to my contours and will take a day or so to restress to suit you."

Nyre assured him that he was not discommoded by the shape.

"Ah, good," Berrard said. "It's great material to work with, once you have the knack. Perfect for stylistic construction. To start this house I took the floor plan on up from an integrated circuit in the transducer section of an F-type radiation processor. I haven't finished building it yet, as you can see," Berrard allowed modestly, "but I'm hoping eventually to build a number of dwellings to modified patterns and link them together to form one huge recept-and-relay. Naturally, I've only been able to construct the insulation casing. The channels will need to be filled with aluflo or somesuch, and that means we need a metals technologist."

Berrard coughed. "If you could mention it in your report and bring it to the attention of the Migration Placement Bureau? We'd prefer family men. I don't think a mediteam will have too great difficulty developing counteractive sera. Ah, and what we could do with is a library compac with full supplementary information about porcelain . . ."

Nyre was a bit put out. He had not expected the wildest and most enthusiastic of grateful rejoicings maybe, but . . . The eyes of the children bothered him. He cursed his bogey-man dress and slid down in his seat.

"It *is* unusual," the merchant skipper said, running his hand around the edge of the desk. It seemed to soothe his arm, which was aching a little from recent muni-shots. "It feels hard—yet it's soft and warm, just like the five-piece dining set I saw in Doraiac. Got your location number off the back."

Unter de Potagier smiled. "Everyone likes our formware. It is about our only export."

"Oh? Do you export much? Apart from Doraiac I've seen it nowhere else."

Unter chuckled. "We get an occasional caller like yourself. No regulars. That is, no *regular* regulars. There are so many directions, aren't there? And we are rather out of the way. Fortunately our needs from outside are not great." His lilting accent conveyed carefree humor. "There are less singular and more important cargoes to be obtained in other places we presume."

"I wouldn't say that. You're listed in the latest S.O.C. Spanfix, and they have your requirements as silklike fabrics, culture-magnums, jeeter units and spares, and so on, with plenty of leeway. Is that right?"

Unter grinned. "That's right."

"That's what I like to hear," the merchant skipper said, reaching to his pocket. "Here's my cargo inventory of available turnover stock. I'll trade the limit for anything you want."

He passed the catalog over and rubbed the desk again. He gazed around the expansively open and uncluttered show area. He liked what he saw. "You don't mass-produce this, do you?"

"Oh dear me, no," Unter said. "Each piece is fashioned individually by us to be perfected in use by the buyer."

"Ah." There was always a market for top quality. And, unless the skipper missed his guess, this quiet rustic planet produced craftsmanship that was to be compared to the traditional excellence associated with Ming, or Chippendale. Also, the material was unique. True, even the most primary of substances was subtly unique to its planet, but some things, as they say, are more unique than others.

The skipper browsed. "Is this a naturally occurring material, or one made up?"

Unter stopped mentally ticking likely items in the catalog. "Um? Oh, it's made up. My great-grandfather devised most of the formulas." He smiled again. "He was a very persistent old devil. But then, he was wrecked here and didn't have much else to do."

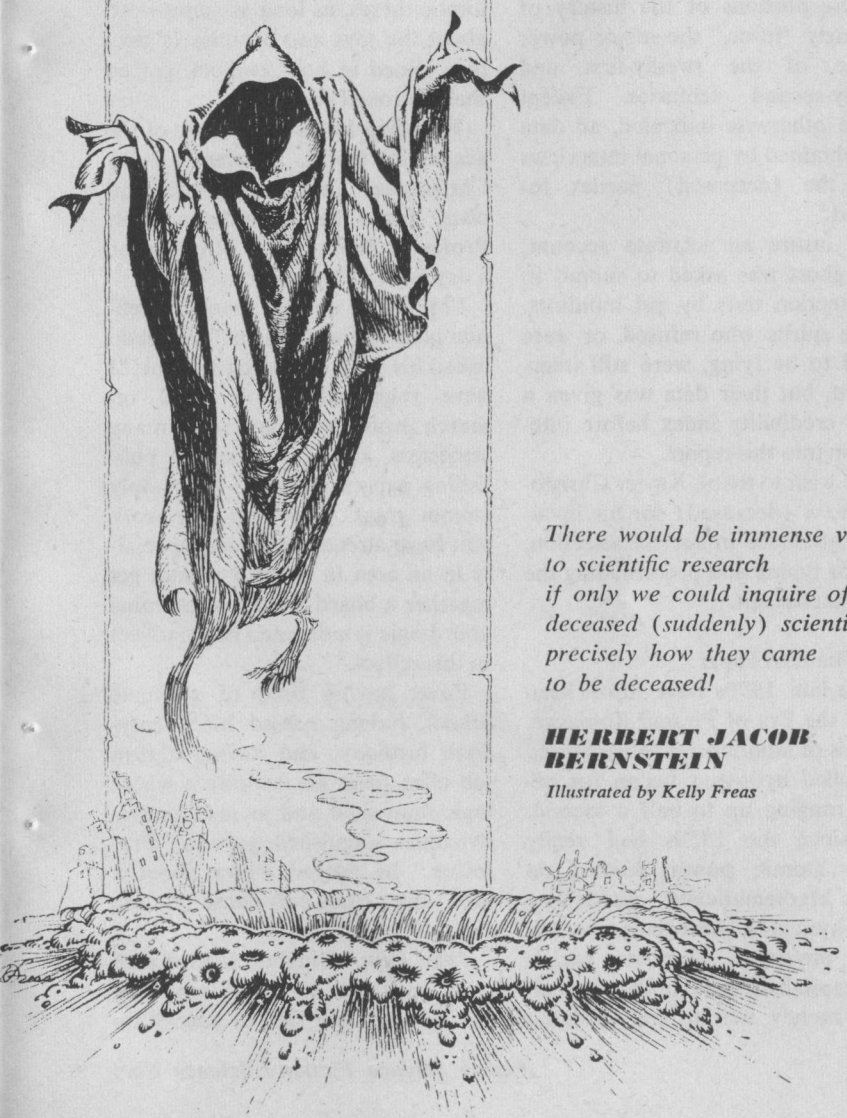
"Ah. I see." The skipper nodded, and his eye caught an odd jarring note. "Hullo," he said. He took a couple of paces. "What's this?" and his thumb wagged at what looked like a misshapen and lopsided vase that was defiantly centered upon a shelf all on its own.

"That?" the cheerful Unter said. He walked over and picked up the ugly pot. "This is great-grandfather's first non-leaking cup. It has the original family emblem on it, see, etched there?"

"I've noticed that, the tufted oval. It's your trademark."

"Yes. It's something great-grandfather called a coconut. He said that if there had been such things here formware would never have been invented . . ." ■

PHANTASMA PLASMA GORIA



There would be immense values to scientific research if only we could inquire of deceased (suddenly) scientists precisely how they came to be deceased!

HERBERT JACOB BERNSTEIN

Illustrated by Kelly Freas

Introduction.

In the first practical application of the postmortem psychic interaction theory of Melvin F. Roemven-Koesler[1], we have reconstructed the missing portions of the history of the early "fusor," the major power source of the twenty-first and twenty-second centuries. Except where otherwise indicated, all data was obtained by personal interviews with the (deceased) parties involved.[2]

To insure an accurate account, each ghost was asked to submit to lie-detection tests by psi monitors. Those spirits who refused, or were found to be lying, were still interviewed, but their data was given a lower credibility index before integration into this report.

We wish to thank Xavier Christopher Levi (deceased) for his invaluable guidance in subject selection, and for typing and proofreading the final manuscript.

1. The Levi Paper.

The late 1970s have justly been called the Era of Plasma Romance. Dozens of laboratories had achieved controlled hydrogen fusion for periods ranging up to half a second. Not since the 1950s had really cheap atomic power seemed so close. Mathematicians, physicians, metaphysicians, historians, beauticians, physicists, Marxists, socialists, capitalists, and philatelists all made money writing and speaking about the technicalities, prospects, and banalities of the bright tomorrow soon to dawn upon the world. Graduate students in a score of disciplines were certain of getting their degrees by propounding the most idiotic theses, as long as some word about the joys and beauties of protons joined in holy wedlock graced their Xeroxed pages.[3]

Knowing full well the state of the academic world, Xavier (Zave) Christopher Levi, embryonic logician,[4] faced his scientific advisor, Professor Zigmund G. Bingbon, on a day early in November 1978.

"Mr. Levi, do you have any definite plans for a thesis yet?" Bingbon asked his procrastinating student. "I have suggested twelve good research problems to you in as many semesters, and you persist in publishing papers on logic. We simply cannot grant a doctorate for work you have already released, especially in an area in which I cannot get together a board willing to examine you. Logic is a damned dead subject in this school."[5]

Zave, having tired of graduate school, having passed his twenty-sixth birthday, and having a firm job offer from an institution where logic flourished and magnetohydrodynamics languished, gave in. "Professor," he purred, "how about a nice long study of dense plasma fusion?"

"Mr. Levi," Bingbon replied with great restraint, "are you aware of the fact that the rate of energy re-

lease in a dense plasma sufficiently hot to unite protons is too high to be of any use in anything but a bomb? The theory of the hydrogen bomb has been very well worked out; I doubt that you can contribute anything new. But, if you would consider rarefied plasma—say global meta-stability of various new magnetic wells—then you would be contributing to the vital search for new power sources. Now I am working on . . ."

"Sorry to interrupt you, Professor," Zave interjected, "but there's more to dense plasma than bombs. Sure, I know you need very thin hot gases in power-source work. That keeps the number of fusions per second low enough to be controlled. A dense plasma would be very dangerous. But there are such systems in practical use right now—and they're quite safe." He stopped here, hoping he had the old man hooked.

Furious at being interrupted on the verge of expounding on his latest pet project, but curious about Zave's meaning, Bingbon bit. He asked the question Xavier was fishing for: "Mr. Levi, where does one find a bomb which one can use safely?"

"In the stars, Professor," Xavier Christopher Levi answered. "Our planet derives most of its current available energy from a stable dense plasma fusor we call Sol. The sun isn't likely to act like a bomb for many megayears.[6] I should like to investigate some properties of a generalized model of systems which maintain stable fusion of a dense medium in a 'small' fixed volume, substituting other constraints for the gravitational forces which hold stars together.[7]

"For example, I've done some preparatory work and reading on magnetoelectric constraints similar to those used in rarefied systems, and can prove the existence of a stable dense system only 3.5278 kilometers in diameter!"

Though his pride still hurt a little, and the thought of such a small fireball was unsettling his ulcer, Bingbon, realizing that getting this much MHD out of a future logician was a miracle, decided to accept the proposal. He and Levi spent a few more hours working out the details; then he signed the bottom of a blank thesis outline approval form, trusting Zave to put a proper outline above, and went home with a headache.

Zave honored that trust, and only modified things a little—just to insert some sections on logical metatheorems he felt applied mathematicians should learn "for the good of their souls." He then set to work on his study of an apparently useless variation on the stars.

Two months later, a much bewildered board of analysts, probabilists, and other applied mathematicians were confronted with a dissertation of the absurd length of

four thousand seven hundred and fifty-two pages, consisting largely of rigorous logical demonstrations (most generated by a computer) of the truth of theorems written in a new symbolic logic unfamiliar to everyone, accompanied by huge undecipherable sheets of computer plotter output resembling a terrain map of the moon, and purporting to discuss a problem in magnetohydrodynamics, a subject they had thought they understood.

Some on the board wanted to give Mr. Levi a hard time in his thesis defense for this unintelligible insult to their intelligence, but were quietly informed by Professor Bingbon that, if they did not like this one, Zave had a version (also computer generated) of fifteen times the length which explained everything in fuller detail, but which would take them several weeks just to read through once. So Xavier Christopher Levi passed, thus earning the title "Doctor of Philosophy." The longer version of the paper was consigned to oblivion[8]; and the 4.752 kilopage version—unwanted by every journal in the civilized world—was consigned to the semi-oblivion of a microfilm library in Michigan. Dr. Levi moved on to greater absurdities, and the institution he left behind tried to return to normal.

2. The Oxford Experiment, Primus.[9]

Dr. Lathram P. Bench-Chiens, FRS, director of the United Kingdom Fusion Power Effort, was jubilant. After three decades of fumbling, missed chances, and dead ends, Britain—early leader in the field, smarting at Russo-American success with "short burns"—would still be first to achieve continuing sustained hydrogen fusion. Visions of knighthood, life-peerage, and miles of adulatory prose in *Science Journal,* the *Sunday Times Supplement,* and even such foreign publications as *Scientific American,* kept distracting him from his most important guest, Robert Robert George, Prime Minister of England.

"You were saying, sir?" Bench-Chiens asked.

"Does this work affect your hearing?" the PM replied. "I inquired as to the nature of this demonstration you dragged me from London to Oxford to witness."

In truth, Robert Robert George had barged in uninvited that morning, but Bench-Chiens was loath to contradict him.[10] At least this question would give the director a chance to display his competence. The ones about dustmen's salaries, the staff's voting record, and the high price of the special flooring for the tab and computer rooms, had made him look woefully ignorant of his job.

"We are about to make history, Mr. Prime Minister. Never, in the course of . . ." he began.

"A simple direct explanation will do, Bench-Chiens."

"Certainly, sir. In precisely ten minutes, we shall initiate and maintain INDEFINITELY a thermonuclear reaction in a magnetically confined deuterium plasma."

"Quite, quite. Now be good enough to restate that in layman's terms."

Bench-Chiens was somewhat taken aback; he had thought he had been using layman's terms. The PM was either testing him or was even more uninformed than he had supposed.

"Prime Minister," the director ventured, "perhaps you would like to see our training films after the start-up. They explain things very well."

"Capital idea, but do give me a brief explanation now."

Resigned to it, Bench-Chiens brought to mind the crude description he had given his eight-year-old child, and simplified it for the PM.

"Sir, picture two special little balls bouncing around in a box. These balls, the nuclei of the deuterium—a heavy form of hydrogen—atoms, are both repelled and attracted to each other. When far apart they push apart a little, when moderately close they push apart very strongly, but when almost touching they pull together and stick. When they stick they give off a lot of energy—think of it as heat—the energy it would take to pull them apart again.

"The more balls there are, the faster they bounce around, and the longer they stay in the box, the more chance there is that a pair will get past the repulsive force and come close enough to stick. Indeed, if the box were full, or almost full, they would certainly all stick and give off more heat at one time than I should care to imagine. So for safety we use a small number of nuclei, moving very fast, held in the box for relatively long times.

"This is just the picture of a rarefied hot gas. Normally the nuclei are closely surrounded by a cloud which makes sticking more difficult; but in a gas this hot the nuclei are almost bare and the cloud is spread thinly throughout the box. We call a gas in this state a plasma . . ."

"I think I'm getting the idea," the PM said. "This mass of equipment makes a box out of some fancy fields of some sort, feeds in this plasma, starts it fusing, and then stokes the nuclear fire when it shows signs of going out."

"Excellent, sir, quite correct," Bench-Chiens exaggerated, realizing that it had been a test. Perhaps Robert Robert George was shopping about for new advisors. He hoped he had not seemed too patronizing. "We just have time to get into position for the start-up, sir."

They retired to the control room and watched while men in white laboratory coats assured one another that the fission reactor was ready to supply the power hungry magnets, well-shaping buses, com-

puters and control circuits; that transducers and dummy loads were ready to draw off the enormous power to be produced; that the cooling and vacuum systems were ready; that they looked presentable for the press. Then, suddenly, no more assurances were needed. The system was working, working perfectly.

In the ensuing bedlam, Bench-Chiens remembered to send out the press releases he had prepared, but somehow lost track of the PM. The PM, however, soon found him, and had some more annoying questions.

"Director," Robert Robert George asked, "how much power are you feeding into that thing?"

"Much less than to start it up, sir," the director answered. "Before the magnets go superconductive, over a thousand million watts are required, but now we feed in only two million watts for cooling, control, and special shaping fields."

"And how much power are you extracting?"

"Five to six hundred . . ."

"Million?"

"No, no, only five or six hundred thousand watts. But our studies have indicated that, without major modifications, we can achieve a full million watts, and, with some extensive changes in the transducers, extract almost two million. Impressive, is it not?"

"Quite. AND WHEN MIGHT WE EXPECT TO GET MORE POWER OUT THAN WE ARE PUTTING IN?"[11] Robert Robert George screamed.

"Uh . . ." Bench-Chiens replied, discovering that he had never really considered such a question. He had always assumed that once they had steady fusion, its use as a power source would follow automatically. Besides, was that not a problem for engineers to handle? He recovered his wits and suggested as much to the PM.

This seemed to calm the Prime Minister down, and he left on an amiable basis. He and the rest of the world were disappointed to learn that all their power problems weren't quite solved, but faith that a little tinkering would bring them through yet prevailed.

3. The Moscow Incident

By the fall of 1984, it had been confirmed that no existing fusor was going to provide a power gain. Actually, the Oxford installation showed promise of eventually generating several surplus kilowatts, but at an absurd cost. Two remedies were known, the first being impractical; the second dangerous.

Making use of "the economics of scale" was tried first. The cooling and control demands of a larger ball of plasma were known not to grow quite as fast as the power output. However, the techniques needed to handle the multi-gigawatt power flows of a rarefied plasma fireball over a hundred yards in diameter were not then within the

grasp of human technology,[12] and such sizes were needed to make the cost per watt competitive with even the most inefficient existing power sources. The use of denser plasmas was all that remained.

The Russian engineer, Harvey Leak, may be credited with the first successful dense plasma fusor. His experiment began and ended on December 12, 1984, in the Fusion Research Laboratories of Moscow University.

Mr. Leak conceived the brilliant idea of reducing the fusion rate in a dense plasma by introducing carefully measured impurities, atoms too heavy to fuse at the temperatures involved. Since a dense plasma does not require as delicate control as a thin one—it need not be confined as long to fuse—Harvey was able to achieve good power gains with modest power inputs and power flows, and avoid explosive energy release with various amounts and types of moderating impurities. Within a few hours, he had the fusor supplying all its own power with megawatts to spare.

Though pleased, Leak realized that he was treading dangerous ground. Some nuclei could work just as well to catalyze fusion as to moderate it. Carbon atoms made fusion more efficient in many stars. Before making any announcements, he decided to test out different moderators. For convenience, he rigged a small hopper by his desk, into which he could toss pellets of solids to be tested (gases were simply mixed with the deuterium).

He had worn out five pencils recording his remarkable results, when the MVD came in to arrest him as an English spy.[13] In the ensuing struggle the pencil stubs were brushed into the hopper, the feed mechanism activated, Moscow blown off the face of the earth by the world's first carbon cycle bomb, and the Russian automatic retaliation system triggered. World War III followed shortly thereafter.[14]

When analysis of the retaliation system records showed the first explosion to have been an inefficient ground-level explosion of a type of bomb known not to exist, an investigation was started. Though Moscow had no survivors, Mrs. Harvey Leak had been visiting her in-laws in Kiev on December 12th, and came through the war with only a touch of radiation sickness. She knew very little, but did recall her husband muttering about "moderation in purity." The scientific community quickly provided the proper interpretation, and the political community quickly outlawed experimentation with moderators in dense plasma fusion, as being too dangerous.[15] A new path to the fusor had to be found.

4. The Oxford Experiment, Secundus.[16]

Dr. Lathram P. Bench-Chiens, former Fellow of the Royal Society, adjunct assistant associate director

of the United Kingdom Fusion Power Effort, was desperate. April 1985 was upon him, and he still had no results. Robert Robert George, in trouble in the public opinion canvases, had sworn to keep reducing his position and salary all the way down to that of dustman if he did not get an efficient fusor going before the July elections; and the number of jobs for fusion research people was shrinking steadily. "At least," Bench-Chiens consoled himself, "the war removed the French, Russians, and Chinese from competition."

In a last spasm of effort, Bench-Chiens and his remaining staff had searched every remaining library for all publications having anything to do with plasma physics and magnetohydrodynamics. They had set their magnificent control computers to the demeaning task of searching these papers for anything new or different. The only good idea they had found thus far was the one outlawed after the Moscow Incident: the use of moderators in dense plasmas. No one was foolish enough to try that again.

April 1st was almost over, when an old 6600 signaled that it had been fed a microfilmed paper too long to handle. Bench-Chiens walked over thinking that several papers had been run together on the roll without spaces between, as had happened many times before. He put the roll in a reader, and was surprised to find the longest paper he had ever seen: the Levi paper. He couldn't understand the text, but the plotter output, which looked like terrain maps of the moon, impressed him greatly. He stared at them for several minutes before, with penetrating intuition, he grasped the entire idea and knew he had an answer to his problems.

This was a paper on dense plasma fusion; the valleys on the charts had to represent conditions of very low energy output, just what he needed. He spent the rest of the night working out the conditions which had to make sense. For safety's sake he sent one of his people off to interview X.C.Levi, but he could not resist trying the system out when his man failed to report back by the next Monday. He had just started the fusor when his man returned with Zave's reply. He never had time to find out what it was.

A fireball 3.5278 kilometers in diameter flared into brief existence. Oxford, Gloucester, Wilts, Berks, and Buckingham were gone. A fault formed, and half of northern England slid on molten limestone into the North Sea.[17] Kent shifted with the greatest majesty until the White Cliffs of Dover were blocking the port of Calais. The tidal waves finished damage the war had started in the coastal regions of Europe. Lathram P. Bench-Chiens (deceased) wondered what had gone wrong.

5. The Levi Fusor.

By the year 2000, research on hydrogen fusion power had ground to a halt. The lynching of the more prominent researchers was partly responsible. Other problems were absorbing surplus government funds then; the most prominent being the study of the logical foundations of science.

Xavier Christopher Levi, Senior Logician of the Main School of New New York, was thus surprised to run into a graduate student who WANTED to work on a problem in magnetohydrodynamics. Though he straightened the poor fool out, it did remind him of his own thesis, written so long before. As he fiddled with the little hydrogen tank of his cigarette lighter, he remembered that English nit who bothered him with silly questions in April 1985.

"Dr. Levi," the man had inquired, "you are the Xavier Christopher Levi who wrote a rather long thesis in MHD, are you not?"

"Guilty," he had replied.

"I happened to run across it the other day," the man had lied, "and found it rather interesting . . ."

"You READ it?"

"How else would I find it interesting?"

The man had obviously been a fool or a liar; but Zave had decided to humor him. "Go on."

"I shall come to the point promptly. I did not quite comprehend the meaning of the contour plots. Perhaps you would be good enough to enlighten me?"

"I think I know what you mean, the terrain maps of the moon. Right?"

"Quite," the man had said with obvious glee. "What do the valleys represent?"

"Valleys."

"No, no. I want to know what they are valleys in. The energy output of some system?"

"Only in gravitational potential energy. Those are simply terrain maps of the moon, an academic joke. You're only the third person to learn . . ." Zave had stopped when the man turned a shade of purple, and ran out of the office.

The man had returned once more, asking to use the phone for a transatlantic call. Zave had agreed—the school would pay for it—but the man had ripped the phone out when the operator told him she would get him a circuit in only four hours, since it was an emergency. Zave never learned who he was trying to reach in England, and he had never seen the man again. But then, very few Englishmen were ever seen again by anyone.

While thinking of that mad Englishman, on November 1, 2000, Xavier Christopher Levi accidentally turned his lighter into the fusor which was to be the prototype of the major power source of the next two centuries. It made Zave very, very rich, and very, very famous; but neither he nor any other person, dead or alive, knows yet how or why it works.[18]

FOOTNOTES

[1] See M. R. Roemven-Koesler, "On Hamlet's Father's Ghost," Bulletin of the Yukon Math. Soc., Vol. III, No. 2, Feb. 2565, pp. 263-284.

[2] Full transcripts of all interviews, with credibility ratings, have been filed with History Central; access restricted to registered Earth citizens, and those others authorized by Zigmund Gustav Bingbon (deceased), librarian.

[3] This mood paragraph was supplied by Charles E. Fellis (deceased), gratis, and, except for the second sentence, cannot be verified for basic credibility of content, since no living individual has been able to associate any meaning with the last two sentences; and the ghosts interviewed just laugh on reading the paragraph. The second sentence appears to be true on the basis of existing records.

[4] Terms such as "logician," "analyst," "probabilist," and "applied mathematician" refer to exponents of various cults of scholars in the ancient art of mathematics. The major divisions were along the lines of "pure" vs. "applied" math. The applied mathematician studied the applications of mathematics to other disciplines and mathematics, and the tools necessary to apply mathematics; but the pure mathematician studied the tools necessary to apply mathematics and the applications of mathematics to mathematics and to other disciplines.

[5] Any pomposity discerned in Bingbon's speech should be ascribed to the fact that English was not his native tongue.

[6] Levi was, of course, not aware of the demi-nova due to occur in 2347; but centuries are as good as megayears in such discussions.

[7] English was Levi's native tongue.

[8] The actual disposition of the long paper has not yet been discovered. Rumors that "Bingbon's john had the most peculiar rolls of paper" are still under investigation.

[9] We have borrowed freely from the data in History Central concerning the events of August 1983. This was necessary, since Bench-Chiens declined to discuss the matter.

[10] It appears that politicians had much more control over the behavior of physical scientists then than now. The decline in the price of massive hardware, caused by the entry of toy makers into the field and mass production to meet the demands of children may be, in part, responsible.

[11] This very question was later turned against Robert Robert George's government by the Tories; and would have certainly resulted in the defeat of Labor at the polls if not for the Oxford Experiment, Secundus (see section 4 of this paper).

[12] A certain lack of refinement in even current techniques might be inferred from the accidental melting of Pluto last year.

[13] They were actually after one Ivan Lukorivich, a close relative of the King of England. Harvey Leak was a loyal Russian, though descended from thirty generations of Kiev peasant stock.

[14] See A. K. Went, "Successes in Population Control," Dulcet Microbooks, Antwerp, 2552. Since Russian radar had been tracking some geese flying from China at the time, the major nuclear exchange was Sino-Soviet. The damage to the rest of the world was due largely to minor aiming errors.

[15] The ban is still in force, for no known reason.

[16] Lathram Peter Bench-Chiens (deceased) has filed suit for suppression of this section. Until litigation is settled readers are cautioned not to discuss this section under penalty of mind-wash and financial embarrassment.

[17] Plans to restore the area have been dropped, due to the protests of the fish farmers, and other residents of the area who are quite happy under cold water.

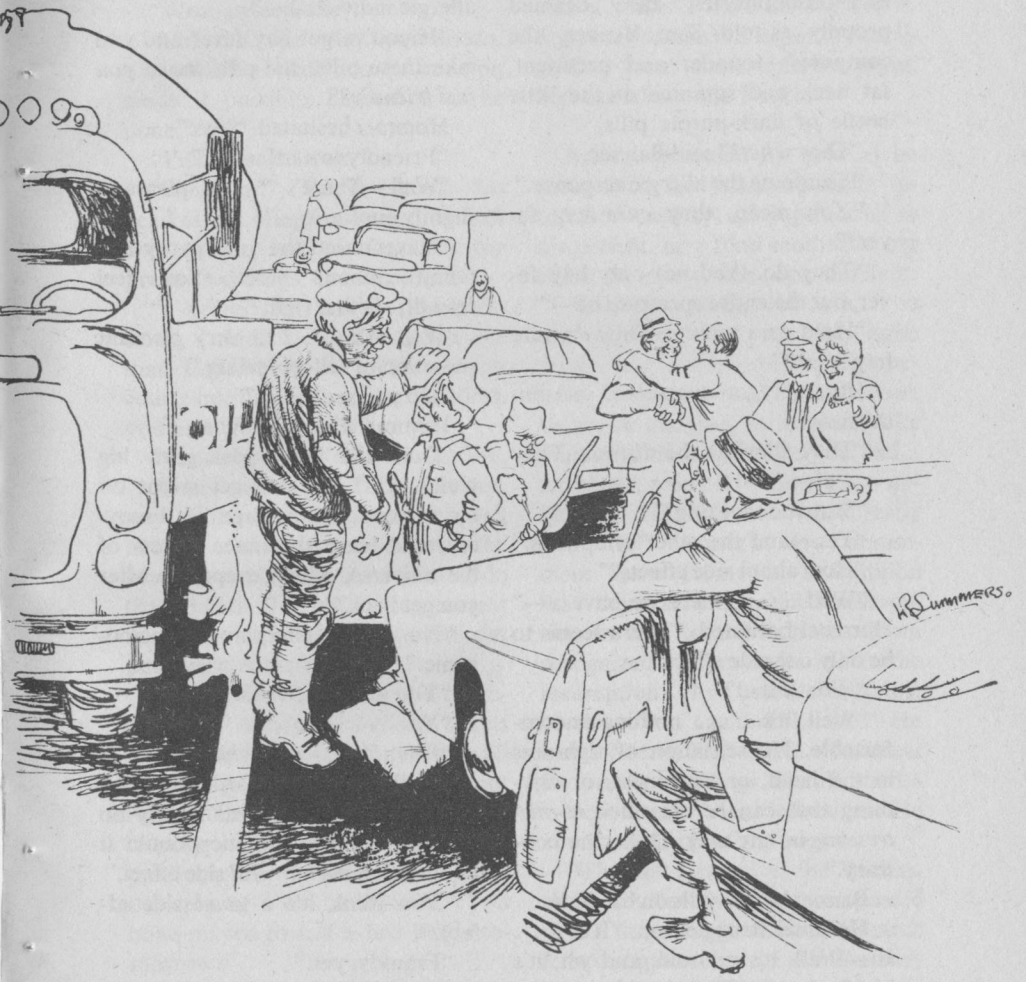
[18] Recent studies have shown that the inscriptions "Fill Here" and "Scripto" were not essential to proper functioning of the Levi fusor, though "To Zave With Love, Zelda (the Torch)" naturally was.

The Analytical Laboratory / January 1968

PLACE	TITLE	AUTHOR	POINTS
1.	Dragonrider (Conclusion)	*Anne McCaffrey*	1.48
2.	Such Stuff as Dreams	*Sterling E. Lanier*	2.57
3.	There Is a Tide	*R. C. FitzPatrick and Leigh Richmond*	2.88
4.	And Cauldron Bubble!	*Bruce Daniels*	3.77
5.	The System	*Ben Bova*	4.33

THE EDITOR

Is Everybody Happy?



It's kind of easy to overlook that there can be a little too much goodwill, happiness and tranquillity around . . .

CHRISTOPHER ANVIL

Illustrated by Leo Summers

Morton Hommel, Ph.D., Director of the Banner Value Drug & Vitamin Laboratories, Inc., beamed proudly as old Sam Banner, the company's founder and president, sat back and squinted at the little bottle of dark-purple pills.

"They *what?*" said Banner.

"Eliminate the allergic response."

"You mean, they *cure* hay fever?"

"They do. And not only hay fever, but the entire spectrum of—"

"Hold on a minute. They *do* cure hay fever?"

Hommel got control of his enthusiasm.

"They alleviate the *distress*. They . . . ah—"

"Stop the sneezing?"

"Yes—and the other symptoms."

"How about side effects?"

"Well . . . there we have a—" Hommel hesitated. "There seems to be only one side effect."

"What's that?"

"Well, it's . . . nothing uncomfortable. No sensation of tightness in the head, or sleepiness, or anything that can be classified as *distressing* in any way. Quite the contrary."

Banner set the pills on his desk.

Hommel struggled on. "It's . . . ah—Well, it's unusual, and yet, it's highly bene—That is, it's a *good* side effect."

"What is it?"

"There's an extremely pleasant sensation of . . . well . . . friendliness and fellow-feeling. Possibly, to some extent, this is a reaction from the distress experienced by the allergic individual—"

"If you've got hay fever and you take these pills, the pills *make you feel friendly?"*

Hommel hesitated. "Yes."

"Friendly toward *what?"*

"Well—There's a pleasant, slightly euphoric—"

"Never mind the gold paper and fancy ribbon, Mort. You feel friendly. Is that right?"

"Yes. It's a . . . very pleasant sensation of fellow feeling."

"Do you *see* things?"

Hommel blinked. "What—"

"Does the lamp post grow big violet eyes? Do you get swept off on a wonderful voyage of discovery, and learn the inner secrets of the universe, which evaporate after you get back?"

"No. It's definitely not hallucinogenic."

"You just feel *friendly*."

"Yes."

"Friendly towards *what?"*

"Well . . . it's hard to define. It's a sense of fellow-feeling. By no stretch of the imagination could it be considered a *harmful* side effect."

"You think it's a *good* side effect?"

"Frankly, yes."

"Then let's nail down what it does."

"I don't know how better to describe it than to say it's a sensation of *warm fellow-feeling and friendliness."*

"You've taken the pills, yourself?"

"Yes. And they relieved my hay fever completely. I'm sure if you'd care to try the—"

Banner said dryly, "I don't have hay fever. Now, since you've tried it yourself—"

"And we've thoroughly tested it. My report—"

"Your report read like a banquet with all the delicacies—cooked in the cans. Kind of hard to digest."

Hommel opened his mouth and shut it. "I don't know how else to express it. You feel *friendly*. We *need* more friendliness in the world."

"Suppose you drive somewhere, and take this pill so you won't have hay fever?"

"Your reactions to driving situations are perfectly normal. There's no falling off in reaction time, no sleepiness, no feeling of unreality. You do feel more friendly toward other drivers. You're more likely to be accommodating, and less likely, for instance, to try to beat them at the light. We find the drug makes the user, indirectly, a more careful driver. This isn't its purpose, of course; but I don't see how it could be considered a *harmful* side effect."

"This feeling of friendliness—Do you feel friendly toward your car, for instance? Or just toward other people?"

"Possibly it's correct to say that a man is incidentally more *careful* of his car. I suppose that might be interpreted as friendliness. But the inner sensation is a sense of *fellow-feeling*, for other human beings."

Banner sat back and scowled at the bottle of small dark-purple pills.

"If it were entirely up to me, Mort, these pills would go straight down the nearest drain. Unfortunately—"

Hommel was astonished. "Why should we try to suppress this?"

"The question is academic, because we can't. But bear in mind, we get paid for killing germs and easing pains. Uplifting human nature is not our line of work."

"But—"

"If we're going to stay in business, we can't ignore a money maker like this. But we're going to have to find out if we can get hay fever relief *without* incidentally making the customer feel friendly."

"But why eliminate a *good* side effect?"

"The customer isn't asking for it. The ideal drug does exactly what the customer buys it to do, *and nothing else*. He buys drugs to relieve an ache or kill a germ, not to have his head feel tight, to get sleepy, or to have green fur grow on his tongue."

"This is different."

"And, since we probably can't get rid of this side effect, we'll start work on an antidote."

Hommel felt staggered. *"Antidote?"*

"Right, Mort. An antidote. Just in case."

Despite Hommel's objections, Banner insisted. Being the boss, Banner got his way. The problem itself proved as interesting as the original problem, so that Hommel soon forgot his objections.

Meanwhile, the new drug appeared on the market, and Hommel exasperatedly read the label:

Nullergin-200

For Relief of Allergy Symptoms

Take one to three tablets per day as required, to relieve symptoms of hay fever, or allergic response to dust, cat hair, egg white, or other causative agent.

Nullergin-200 is a new formulation, designed to overcome symptoms of allergic response to a wide range of substances. Like all drugs, it should be used in moderation.

CAUTION: In some persons, Nullergin-200 has been found to apparently induce a sense of friendliness; discontinue use where this side effect is undesirable.

Where, Hommel asked himself, *would a sense of friendliness be "undesirable"?* Then he shrugged. The *main* thing was, this blessing for allergy sufferers was on the market.

The sales of Nullergin-200, with a minimum of advertising, picked up steadily. By hay-fever season, the cash registers were ringing all over the country. It was then that Banner called Hommel into his office.

"How's that antidote coming?"

"It's quite a complex problem. But we're making measurable progress."

"Measurable progress? Well, put all the man power on it you need, because we're getting into a measurable mess."

Hommel looked blank. "What do you mean?"

Banner had several newspapers on his desk, and tossed one over. "Look at the headline."

Hommel read:

ULTERIOR STRIKE SETTLED

Management Yields

After Long Struggle

Banner said, "Take a look at that picture."

Hommel frowned at a photograph of two men, the first grinning in triumph, the second smiling benevolently, with his arm around the other's shoulder. Behind them stood several rows of men, some smiling, some scowling, a few with handkerchiefs at their faces.

Hommel said blankly. "I see it. But—"

"Look at the part of the story that's circled."

Hommel spotted several paragraphs marked in heavy pencil:

> . . . Mr. Scharg explained that he wished the union well, and hoped the company would be able to offer a similar raise every year.
>
> Asked for his comment, Mr. Kraggenpaugh, the union representative, expressed contentment

with the contract "for the time being. If the management had accepted this offer earlier, it would have saved everyone trouble. This proves they could have done it all along."

Not available for comment was Maurice De Pugh, executive vice president, who earlier argued that accepting the union's demand would put the company out of business.

Mr. Scharg's sudden reversal took everyone by surprise. The question now raised is how Ulterior, in light of the latest drop in sales, can afford a pay raise it rejected last year, when it was making a profit.

Mr. Scharg's report to the upcoming stockholders' meeting is eagerly awaited.

Hommel frowned, and looked back at the photograph. The man smiling in friendship was identified as Mr. Scharg. The man grinning in triumph was Mr. Kraggenpaugh.

He studied the photograph more closely, and noticed that, of the men who had handkerchiefs raised, two apparently were blowing their noses, and one had his eyes shut, as if sneezing violently.

Banner said, "Kind of an unusual thing, Mort."

"It certainly is." Studying the photograph, Hommel could see a bulge in the pocket of Scharg's suit coat. It could be a pair of gloves. But who would carry gloves in hot weather? It could be a handkerchief. But Scharg didn't look as if pollen were bothering *him*.

Or it *could* be a pill bottle.

Banner said, "Mort, this stuff doesn't put a man into a stupor, does it?"

"No."

"What happens if he takes an overdose?"

"Well, the more he takes, the greater the . . . the effect."

"The more pills he takes, the friendlier he gets?"

Unwillingly, Hommel said, "Yes."

Banner handed across another paper.

Hommel was confronted by large headlines:

KIDNAP VICTIM SAFE!
Police Recover Youth
In High-Speed Chase
Father Hugs Kidnapper

A photograph showed a well-dressed man pumping the hand of a tough-looking individual handcuffed to an astonished policeman. Hommel glanced at the text:

". . . But this is the man who kidnapped your son!"

"I don't care," the boy's father told the police officer. "I just feel friendly toward *everyone*."

Hommel looked up. "We don't *know* he was using our product."

"Can you think of some *other* explanation?"

"No." Hommel looked puzzled.

"Neither can I. And here's something else I never heard of before." He handed Hommel a page torn out of a magazine.

Reluctantly, Hommel took it, to see an advertisement showing a cheerful overalled figure holding an electric drill, a section of an article about a high-speed passenger train, a small ad for a suction-plunger to clean out drains, and finally a paragraph circled in heavy pencil:

LONELY? NEED *FRIENDS?*

Our method brings Guaranteed Results. No need to exchange photos. This is not a pen-pal club. This method is New and Proven. You pick *who you want* for a friend *in advance.* Then take our Mystery Substance and *use* it! That's all. Now you have a friend! Can be used on anyone. Sex, age, social class, do not matter. Sound great? It *is* great! Full instructions included. Send $2.25 to Friendly Universe, Box 250, Dept. W3 . . .

Hommel looked up dizzily.

Banner pulled open a desk drawer, took out a small stamped package, opened it up, removed a stoppered vial from a cardboard tube, and unfolded a large sheet of paper labeled: "Now—A *Friendship* Essence—Here are your Instructions!"

Hommel swallowed hard, and read: "Now, an ancient mystery from the mysterious East, but guaranteed by Modern Science, makes it possible for anyone—*even you!* —to have friends! And it is so easy! . . . Contained in this vial is the Mysterious Miracle Essence compounded from an ancient formula . . . some say the mysterious vital essences of Earth, Air, Fire and Water are condensed into it by magically enchanted *strictly scientific equipment* . . . but we say only, it *works*, and it's *wonderful* . . . All that you need to do is buy a simple atomizer at any drugstore, and spray this Mystery Essence around the room before your chosen friend gets there. Or, you go where they are, and squirt it around when they aren't looking . . . The *Mystery Essence* will do the rest. It never fails! . . . There is no law against this. It is perfectly legal, and *you are doing them a favor* . . . The power of the Mystery Essence *will secretly protect* your chosen friend against *hay fever, cold, and poison ivy!* Refills available at $2.25 each from Friendly Universe, Box 250 . . ."

Hommel looked up in stupefaction. "Great, holy, leaping—"

Banner said, "You see, Mort, it *isn't* such a harmless side effect, is it?"

"I never imagined—" He stared at Banner. "Could *you* foresee all this?"

"Not the details. But if you should come in here with a little pill that cured headaches, and had no side effects, and nothing wrong with

it, except that if you hit it with a hammer it would blow out ten city blocks . . . well, no one might be able to foresee the *details*, but they could tell *something* would happen when it went on the market."

"Yes, but this was *friendliness*."

"Are you saying, Mort, that friendship isn't a power in the world?"

"No. But—"

"Then, you see, these pills *exert power*. Just as surely as if they were TNT."

Hommel sat back in bafflement. "I see it. But it doesn't seem right."

Banner nodded. "*If* these pills were used right, there'd be no great problem. *Some* people will use them just as they should. But I would bet you, Mort, that right this minute there are others mashing these pills into a fine powder, touching a match to the powder, and then sniffing the smoke to see what happens. If one of these people dives out a tenth-story window because he has turned into a bird, and another starts eating ground glass because he can't be hurt, who do you suppose will get blamed?"

Hommel only nodded his head.

"Right. Keep working on that antidote."

Hommel did as he was told. Fueled by a large proportion of Banner's profits, the "antidote" project forged ahead at a strenuous pace. But Nullergin-200 went faster.

As the hay-fever season ended, the common-cold season took over. It developed that Nullergin-200 eliminated most of the symptoms of an ordinary cold. Sales increased.

Hommel, more and more immersed in his work, paid little attention to the outside world. But it was impossible to ignore it completely.

On his way to work one morning, he nearly smashed into the car in front, which had stopped considerately in a long line of traffic to let a second car back out of an alley. The driver of the second car, in his friendly appreciation, walked back to thank his benefactor. As Hommel stared in disbelief, this first driver got out to shake hands, and the two beamed upon one another until some unregenerate ten cars back let go a long blast on his horn.

Farther on, two small children were playing in the middle of the street, and all the traffic laboriously detoured around their cardboard tent. A large oil truck, in front of Hommel, had to back and fill to get around, and finally came to a stop. The driver, a large, tough-looking man in a worn leather jacket, walked over to the two children, bent down, and rumpled their hair. He smiled at Hommel in pure friendship.

"You live for your kids. Right, Jack?"

Hommel stared at the truck driver's massive shoulders, and snarled, "*Right*."

When Hommel got to the plant, he was an hour late. He wasn't in a very friendly mood himself.

Banner at once called him to his office.

"How's that antidote coming?"

"Our program would go a good deal faster if we had less socializing and more work."

"Our own people are taking the drug, eh?"

Hommel nodded. "They say it cuts down the symptoms of the common cold. That may be true, but—"

There was a brief tap at the door, and Hommel glanced around. The door opened, and Banner's secretary looked in, to gush, "Oh, Mr. Banner, I just *had* to come in for a minute, to say how much I *do* enjoy working for you."

Banner looked at her coolly. "I appreciate that, Miss Hemple, but—"

"I just *love* every minute here. And I think you're just the *kindest* employer. There, I *had* to say it. Thank you *so* much, Mr. Banner, for everything."

The door shut, and Banner stared at it.

"Is that what you mean, Mort?"

"That's how it starts. It gets worse when everyone tells everyone else how he enjoys having him for a co-worker. You take half-a-dozen people, and the permuta—"

"The *what?*"

Hommel paused. "There are thirty different ways they can congratulate one another on being good co-workers. At *least* thirty different ways."

Banner said soberly, "I've heard of the world ending by disasters. It never occurred to me it might end in a handshake."

Hommel started to reply, but was interrupted again, this time by a woman's scream echoing down the hall outside.

Banner and Hommel were on their feet at once. Banner seized a heavy cane he used for occasional bouts of rheumatism, and they went through the outer office, and reached the hall door just as there was a louder scream.

Hommel threw the door open, to see Viola Manning, one of his assistants, rush past.

Right behind her came Peabody, Hommel's promising young research chemist. Peabody's eyes were lit up in a kind of greenish murky light. Both his hands were stretched out after Viola Manning.

Hommel shouted, "What *is* this? *Stop*!"

Peabody didn't stop.

Banner shot out his heavy cane, entangling Peabody's legs.

Peabody's arms flailed, he hurtled forward off balance, and hit the floor with a crash.

Banner recovered his cane, and watched Peabody alertly.

Peabody groaned, sat up, and felt cautiously of his nose and face. He staggered to his feet.

Hommel eyed him coldly. "And

just what the devil were *you* doing?"

"I . . . ah—"

From somewhere came a sound of sobbing, and a reassuring feminine voice giving words of comfort.

Peabody glanced around nervously. "Did I—"

Hommel said angrily, *"What were you doing?"*

"I . . . I was dissolving some powdered Nullergin-200 in ethyl alcohol, and I . . . it occurred to me to wonder what the physiological effect—"

"You *drank* it?"

Peabody stared at his toes. "Yes."

Banner said, "How much?"

"Just a little . . . a few millimeters . . . hardly any—"

Hommel said, "You were dissolving it in pure ethyl alcohol?"

"Yes, but I diluted it. I poured in some water, shook in a little . . . er . . . sucrose . . . and—"

Banner said, "How many pills did you grind up in this punch?"

"The . . . the dissolved Nullergin-200 couldn't have been the equivalent of a tenth of a pill."

Hommel said grimly, "Then what happened?"

"I . . . ah . . . Viola—She had just come in, and— All of sudden I saw her in a different light—" His face reddened. He said helplessly, "It was like friendship—only a lot more so."

Hommel said disgustedly, "Next time, stick a little closer to the planned experiment."

"Yes, Dr. Hommel. I will."

"Does Viola realize what happened?"

"I—No."

Banner said, "Did you drink up all of that stuff, or is there some left?"

"There's some left."

"Save it."

Hommel nodded. "And write down, as accurately as possible, the quantities you used. Then you'd better take a few minutes to decide what you'll say to Viola Manning."

Peabody nodded grimly.

Hommel said, "I'll try to explain to her that it was a . . . er . . . toxic effect. Possibly you can find some better explanation."

When Peabody had gone off, pale and shaken, Banner went back into his office, and Hommel had the job of explaining to Viola Manning.

That evening, when Hommel got back to his apartment, the daily paper told of a town in the midwest that had found the way to peace and friendship—through putting Nullergin-200 in the water supply.

When he got up the next morning, the news broadcast told of two daring bandits who, late the previous afternoon, had walked into a bank in a friendly town in the midwest, and cleaned it out. The bank guard explained, "I just felt too friendly to stop them."

What riveted Hommel's attention was the bank president's comment: "The trouble with those boys was just that they haven't been drinking

our water. I wonder if there's any way to spray the friendship medicine in the *air*?"

" 'Friendship medicine,' " muttered Hommel. Then he headed out into the morning traffic jam. This business of waiting out delays at intersections, while drivers politely waved each other ahead, was getting on his nerves.

Late in the week, Banner called Hommel to his office.

"How's the antidote coming, Mort?"

"Assuming there *is* an antidote, we might find it faster with . . . ah . . . fewer complications in interpersonal relationships."

"How's Viola Manning taking it?"

"She looks around with a start when the door opens."

"How about Peabody?"

"He's drowning himself in work," said Hommel.

"Good." Banner picked up a newspaper. "If you'd just glance over the items circled on the front page, Mort."

Hommel glanced over the front page, to notice to his horror that practically every news item was circled:

NO STRIKE, SAYS UNION
Accept Voluntary Pay Cut

RACE WAR ENDS
"We Love Each
Other" . . . Say
Rival Gang Chiefs

PEACE FORCE
ENDS STRIFE
"Friendship Bombs"
End Long-Drawn War

Guerrillas Emerge
From Jungle Hideout

COMMON COLD
LICKED BY
RESEARCHERS
Nullergin-200 Gives
Double Dose of Blessings

No Sniffles
No Snarls

URGE NULLERGIZATED
CITY WATER SUPPLY
Ends Colds, Strife
With Same Method

PETTIBO STORES
HEIRESS FOUND
Eloped With
Garbage Collector

Class No Obstacle
To True Friendship

IS PEACE
PACT REAL?
Soviets Claim
Treaty Sprayed
With Superdrug

Hommel looked up dazedly.

Banner said, "Things are picking up, Mort."

"But is it better, or worse?"

"Take a look at the folded page."

Hommel turned back to a page with the corner folded, to read:

INDUSTRIAL OUTPUT
DROPPING AGAIN
Productivity Per
Man-Hour Hits New
Low Again This Month

Hommel read the article, certain comments standing out boldly:

". . . Blamed on on-the-job socializing and increased hesitancy of supervisory personnel to force the pace. . . . 'After all, we're all one happy family,' says the superintendent of the Boswah Corporation's East Steelport plant . . . claimed it is possible to keep production lines moving but only by slowing them further. . . . 'There is a much nicer atmosphere around here,' comments one worker, sipping her coffee as the line idles by, 'It used to be hurry-hurry-hurry'. . . . Executives agree, 'Our competitors have the same problem. Why would we want to hurt *their* business by stepping up our productivity. They're basically very nice people.' . . . Dissenter is the crusty, hard-lining president of Kiersager Corporation, who insists, 'We will fire every one of these pooped-out friendship addicts that turns up for work. This mess of flabby hand-shakers is so much clotted blood in the arteries of commerce.' "

Hommel looked up. "Is it like this all over the country?"

"Can you think of anyone who doesn't want to avoid colds?"

"No. Everyone wants to avoid them," Hommel said.

"And how many people are there now who are against taking drugs on principle?"

"Not many."

Banner nodded. "This was bound to come along sooner or later. If people would only use the stuff in moderation, there'd be no problem. But they figure if two pills are good, four pills are twice as good."

Hommel said glumly, "At least it isn't habit-forming."

"No, but if you take two pills before breakfast long enough, you've got the habit whether the pills themselves are habit-forming or not. And if without the pills you snarl at people, and with the pills you feel friendly, which way will most people want to feel?"

"Friendly."

"Right. And if things get so exasperating they stop feeling friendly, they take *more* pills. And it's a little hard to regulate it, when the friendly authorities are using it themselves. Worse yet, supposing every factory on earth stopped making the pills tomorrow? First, the stuff is somewhat cumulative, and second, consider the uproar when it suddenly wore off. What we need is something so we can come out of this *slowly*."

Hommel stared at the paper. "But it's doing *some* good."

"So does a dose of castor oil. But one dose is enough. Keep hunting for that antidote."

Time passed, and more and more money and effort went into finding an antidote. Peabody, driven by a compounded sense of humiliation, seemed to think he could only justify his existence by finding the antidote, and was working day and night with every sign of being close on the trail of *something*.

Meanwhile, in case their attempt to find an antidote should prove useless, Hommel in desperation was following up an improbable project designed to produce some *natural* antidote. The drug overcame hay fever, the argument went, so maybe a stronger causative agent for hay fever might overcome the drug. Since anything seemed worth a try, some two hundred isolated acres of unsettled land were given over to ragweed culture. Some fields were studded with the housings of potent radiation sources, while others were sprayed with special chemicals. While a desperate watch was kept for promising mutations and hybrids, the mere sight of these fields, with dark-green monster ragweeds looming twenty feet tall, and others creeping mosslike along the ground, was enough to give chills to anyone who remembered when hay fever had been a real complaint.

At present, of course, only the stubbornly individualistic suffered from hay fever. These sneezed their way through life, observing with acid contempt the deterioration in quantity and quality of goods and services. Where others offered an eager handshake, this minority shoved its way past with a snarl.

Banner and Hommel, one summer afternoon, drove toward town to send a telegram. They cautiously detoured cars stopped by motorists who just wanted a little talk for friendship's sake, and stopped warily for traffic lights that didn't work, and were flagged down by friendly truckdrivers who wanted to share their cargoes.

Laden down with watermelons, hundred-pound boxes of nails, a five-gallon can of asphalt roof-coating, two crates of chickens, and a tin of frozen blueberries, they finally made it to the telegraph office, and stepped inside, to find a woman clerk chatting on the phone.

A tall thin man wearing a green eyeshade got up as they came in.

Banner said, "We've got a carload lot of chemicals we want to trace. We haven't been able to reach anyone by phone. What's the chance of a wire getting through?"

"Depends on who's on the other end." The man removed his eyeshade and glanced pointedly at the woman clerk. Her conversation was clearly audible:

". . . They're the nicest people. We just told them we couldn't pay it, and they said to forget it. The bank has lots of money anyway, and they didn't need it . . . Then Howard got his bill from the *hospital*, and that was two thousand seven hundred, and we were just *frightened*, what with the plant

closing and all—but that nice Mrs. What's-her-name in the office there said she'd just drop our record right out of the file. What does anyone need money *for,* anyway? Aren't we all friends? So then . . ."

The three men glanced at each other. Banner cleared his throat.

"Well, it won't hurt to try."

The telegrapher slid over a pad of forms and a pencil. "Speaking of lost cars, they're getting fairly common. As I understand it, the solution is to accept a carload lot of whatever happens to be lost in your neighborhood. Somebody somewhere else takes your carload lot which is lost in his territory." He added dryly, "It's the *friendly* way out. Saves the railroad a lot of trouble."

Banner tore a form off the pad. "A slight complication in the manufacturing process."

"Yes, I think that *is* starting to show up. Possibly you gentlemen can identify this for me." He reached under a counter, and produced a bottle labeled, "Count Sleek—The man's hair tonic that's friendly to your scalp. Invigorates. Refreshes. With RB37."

Hommel took the bottle curiously. The liquid inside appeared clear, save for a few black specks drifting around in it. He unscrewed the plastic cap, noted a little whitish crust on the rim, and what appeared to be small transparent grains of some kind on the thread. Frowning, he sniffed cautiously, but noticed no odor. He screwed the cap back on, and stood weighing the bottle in his hand. For its size, it felt heavy.

The man behind the counter said, "I've used that brand of hair tonic before. This stuff doesn't look right or smell right, and the bottle doesn't even *feel* right."

Frowning, Hommel took a piece of tissue paper from his pocket—put there in preparation for the approaching hay-fever season—folded the tissue, unscrewed the cap from the bottle, and poured a few drops of the liquid on the folded paper. The liquid, which had seemed watery in the bottle, looked oily on the paper. The wet paper promptly turned brownish.

Scowling, Hommel wiped the bottle with an edge of the folded tissue. The paper dissolved away, leaving, one beside the other, four curved blackened edges with a charred look. The large oily drop in the center of the paper sat there as the paper beneath turned black, then suddenly the paper shrank away in a thin film to expose the next layer.

From the tissue arose a sharp pungent odor.

Behind the counter, the telegrapher watched alertly.

"I've seen hair tonic I liked better."

Hommel cleared his throat. "My guess is, it's concentrated sulfuric acid."

Banner said, "They sold it in *that* bottle?"

"They did, I suppose a shipment of the wrong stuff reached the place where they make that—or maybe some chemical factory got a load of the wrong bottles. If enough people will just be obliging, practically anything can happen."

Banner and Hommel went soberly back outside.

"Are we," said Banner, "near even a partway-workable solution?"

"We're *near* half-a-dozen different solutions," said Hommel hauntedly. "But they're completely worthless until we arrive at something actually usable."

The rest of the month passed with slow breakdowns that roused little notice, because—who would be so unfriendly as to complain?

Hommel, sneezing violently during hay-fever season, but avoiding Nullergin-200 as he would avoid poison, was among those who did not feel friendly when he bought gasoline and got kerosene, and when he went to a store to purchase some staples, and found a can swollen out at both ends as if packed under high pressure.

"What's wrong," he asked. "Did they overload these cans?"

"It isn't that they put too much in the cans," said a clerk, in a friendly way, "it's just that everything inside is spoiled, and that makes gas."

That night, nothing else having worked yet, Hommel prayed long and earnestly for a solution.

The next day dawned with an impressive pollen count, and the rest of the week went by with Hommel progressively more miserable. He had scarcely walked into his air-conditioned office one day when Peabody, dark circles under his eyes, came in.

"Unless I'm completely insane, which is possible, I've got it."

Hommel stared at him, afraid to speak.

Peabody said, "I mean, the Nullergin-200 antidote."

Hommel said dizzily. "That's wonderful. Did—"

The phone rang. Hommel picked it up, and motioned Peabody to sit down.

An excited voice demanded, "Hello? Morton?"

"Speaking."

"This is Arthur Schmidt, out at the test plot. Look, Morton, we have a plant here that makes everyone sneeze . . . *Do you hear me?*"

Hommel stared at the phone. "What is the effect on . . . ah . . . disposition?"

"Terrible. With that first sneeze, believe me, all that friendly accommodating feeling evaporates."

"That's wonderful. Listen, you've isolated the particular plant that—"

"Yes, we know which one does it. It's quite a remarkable thing. A very ordinary, unprepossessing little plant, but it releases veritable clouds of extremely fine pollen. An unusual thing about this—it reproduces also, and I must say prolifically, not only by wind-borne pol-

len, but also by a kind of tumbleweed layering effect."

"By a—*what?*"

"And some of the other plants have evidently hybridized."

"Wait a minute. This thing reproduces *how?*"

"To put it plainly, parts of the stalk grow constricted when the plant reaches a height of approximately eight inches, and a blow or moderate wind causes it to break off. This plant has quite a lightweight structure, you see, Morton, and as a result of the construction of the stem, apparently it becomes partially dessicated—that is, dried out."

"I know what dessicated means," snapped Hommel. "Then what happens?"

"Then the . . . er . . . dried-out portion of stem and leaves is carried off a considerable distance, tumbling, rolling, being lifted up by the wind—"

"*Then* what?" The air-conditioner in the room was providing pure, pollen-free air, but Hommel could feel his nose tingle. "What happens when this thing goes tumbling—"

"Why, bits of the leaves break off, somewhat in the manner of— Possibly you're familiar with a plant commonly known as . . . ah . . . the 'lawyer plant,' I believe, or possibly it's called the . . . let's see . . . 'maternity plant,' which—Are you acquainted—"

"No. What does this have to do—"

"Why, esssentially the same mechanism, Morton. When the leaf finds a little moisture, a suitable bit of ground—it takes root, and grows. A new plant, you see."

Hommel had a mental image of the world covered with a rolling carpet of ragweed.

"Listen, if you break a piece of leaf off of this super-ragweed, *the piece of leaf grows into another super-ragweed?*"

The reply was cold. "Rather an imprecise way to express it, Dr. Hommel, but—Yes, *essentially,* that is correct."

Hommel got control of himself. "Excuse me, Dr. Schmidt. My excitement at this, ah, this extraordinary achievement— So timely, too — You understand—"

"Certainly, Morton, certainly. Forgive me if I seemed a trifle sharp. I misunderstood."

"Will you excuse me now? I want to inform Mr. Banner of the achievement."

"Banner? What does *he* know about it? Oh, he has money . . . but in a scientific sense, he is an ignoramus."

"Yes, of course. But when a piece of research particularly impresses him, he often provides more . . . ah . . . funds, to extend—"

"Yes, yes, Morton. I understand. Yes, I think he *should* know."

Hommel hung up. "My God! Little ragweeds, all over the place!" Despite the air-conditioning, Hommel sneezed.

"Dr. Hommel?" said Peabody blankly.

Hommel stared at him, then said abruptly, "You say you have the 'antidote.' You were looking for some chemical that would stimulate the functions the Nullergin-200 depressed?"

"That didn't work. I went back to another idea—something that would go right into the body and break up the Nullergin-200. Well, I've got it."

"What are the side effects?"

"That's one of the things that's taken me so long. So far as I can see, there are no noticeable side effects. You see, this is similar to an enzyme. A comparatively small amount will break down any quantity of Nullergin-200, given time. But, in the body, the enzyme is itself slowly broken down. Since only a comparatively small quantity needs to be used, the side effects are negligible, so far as I've been able to find out."

"And the decomposition products?"

"They're excreted."

"Is this enzyme hard to produce?"

"The process is partly biological. Temperature, pH—quite a number of factors need to be carefully controlled to get a good yield. But there's nothing particularly *hard* about it."

Hommel sat back. "Have you thought how we might use this?"

"Well, if for now we put it in the coating of the pills, the pills will still work—but the effect will wear off faster. And the more pills taken, the more quickly the following pills will wear off, because the Neutranull, as I call it, will accumulate. By varying the proportion of Neutranull to Nullergin, we determine, subject to individual variations, *the length of time a given daily dosage will be effective.*

"And," said Hommel excitedly, "since hay-fever season lasts only so long, *this is what we need.*"

A little work with pencil and paper, with Peabody providing the constants involved, suggested that varied proportions of Neutranull would eliminate the Nullergin-200, as slowly or rapidly as desired, and that the only way to get protection after a given time was to increase the dosage. If this was carried far enough, the effect of the Nullergin could be strung out for a long time—but as a result the Neutranull would build up to such a point that it would still make trouble during the next attack of hay fever.

"Well," said Hommel, "if anyone takes a reasonable dosage, he'll be all right. Good enough. Now, can we market this in time?"

Together, they went over the details. Then they went down to Banner's office.

Before the day was out, Banner Drugs was hard at work on the new process. But, as Banner pointed out, their problems were not solved.

"Even if we get this distributed without any trouble, Mort, there's

still Schmidt's improved ragweed. If that pollen is blowing around, how do we stop it?"

"Possibly, it was developed indoors, in a greenhouse," said Hommel grimly. "At any rate, there isn't much of anything I wouldn't be prepared to try to stop it."

"Luckily," said Banner, "we are now well enough known to get our suggestions listened to. Maybe we can get this genie back in the bottle. Get Schmidt on the phone—if you can get him on the phone—and have him come down here. If he drives at night, he may be able to make it without getting glued fast in friendship along the way."

Late the following afternoon, Banner and Hommel met with a tough-looking individual who arrived wearing his hat like a uniform cap, a suave personage who smiled easily and radiated power, and a bulky glum-looking man with a Russian name. There were also three technicians and a quantity of electronic equipment.

As Banner explained courteously to Schmidt, "This is in your honor, Dr. Schmidt. These people are here to learn about your . . . ah . . . epochal discovery. This is General Harmer, Mr. Hall, and Ambassador Kurenko. Your description of your discovery will be simultaneously broadcast and recorded as you give it. Thanks to your reputation, there, of course, is no doubt as to the reality of your achievement. Nevertheless, there are experts of various nationalities listening in, and they may want to ask some questions, which they can do over this hookup. Your words will be translated, incidentally, as you speak them."

Schmidt looked impressed. "May I ask, Mr. Banner, what is the advantage of having a military man here?"

"General Harmer is the President's personal representative. The President couldn't come himself."

"Ah—" said Schmidt. "I see. Excuse me. Well, gentlemen— Shall I begin?"

Banner glanced at the technicians, who nodded.

"Start whenever you want," said Banner, "and just tell us in whatever way you want."

"Well, then—I will begin with *method*. Knowing time was short, I decided upon a brute-force approach. Not so crude, perhaps, as adopted by the well-known innovator, Edison, but using the same general principle, developed more scientifically. I decided to try *every conceivable method and combination of methods*, possible in the space and time, and with the equipment available, sacrificing precise determination of the interrelations of the causative factors involved, in favor of—results."

Schmidt then proceeded to describe, in short clear language, a set of procedures designed to produce the maximum possible genetic vari-

ation in the shortest possible time. At the end, he concluded, "With such methods, success or failure depends on chance and the unknown. Our tools are still too crude, and our knowledge too imprecise to enable us to proceed on a basis of exact knowledge. However, the method that worked for Edison has also worked in this instance, as I shall demonstrate. We now have, gentlemen, a variant of the common ragweed that no drug on earth can resist. For the record, I here produce a sample of biologically-inactivated pollen." He removed a small, thick glass tube, about the size of a two-inch cut off a lead pencil. "Is anyone here subject to hay fever?"

Banner, Hall, Harmer, Kurenko, and the three technicians all shook their heads. Hommel reached into his side pocket, said, "I am," and shook three small old-style pills of Nullergin-200 into his hand. As Schmidt nodded, and began to pull the stopper out of the vial, Hommel, who knew Schmidt as a demon experimenter, at once took the pills. A warm feeling of friendship spread through him, reassuring him that the Nullergin-200 had taken effect.

"Ah," said Schmidt, "here we are. You see, the biologically inactive pollen, still—" He got the stopper out of the bottle, and instantly shoved it back in again.

A sensation like a double-pronged fork made of red-hot pepper moved up Hommel's nose. His vision blurred as a layer of burning dust seemed to coat his eyes. His ears itched. The inside of his mouth felt as if he had just eaten two large plates of overseasoned chili. The room rang with violent sneezes from Banner, Harmer, and everyone save Schmidt. Through a sea of tears, Hommel could see Schmidt stretched out on the floor, his face covered with red blotches.

Every breath Hommel drew was like a breath of finely-ground pepper. He sneezed until he ached so that he didn't dare to sneeze, while at the same time he *had* to sneeze. His throat constricted so that to draw a breath was like sucking a half-frozen drink through a flattened straw.

Something flashed across his wavering field of vision, and there was the crash of breaking glass.

For a brief instant, Hommel could see Banner, his heavy cane upraised, knocking out one window after another, in a room full of choking, gasping, strangling men.

Then Hommel drew in the wire-thin end of a breath of air so cool and uncontaminated that it seemed as sweet as fresh spring water to a man dying of thirst. Then everything whirled around him.

Hommel came to fitfully several times, and finally awoke in a pastel-green room, where several other pajama-clad occupants crowded around a big TV.

Banner, wearing a blue bathrobe, prodded Harmer and Kurenko to move apart, leaving a slot through which Hommel could see a stretch of barren lifeless landscape, across which there slowly came into view a small figure in some kind of dully-glinting suit, carrying a kind of wand in one hand. As this figure passed out of Hommel's range of vision, there appeared a large-wheeled slow-moving armored machine.

The whole scene looked so alien to Earth that Hommel said, "What *is* that—the surface of the Moon?"

"No," said Banner, "that's what's left of the ragweed test site. They're checking the radioactivity right now."

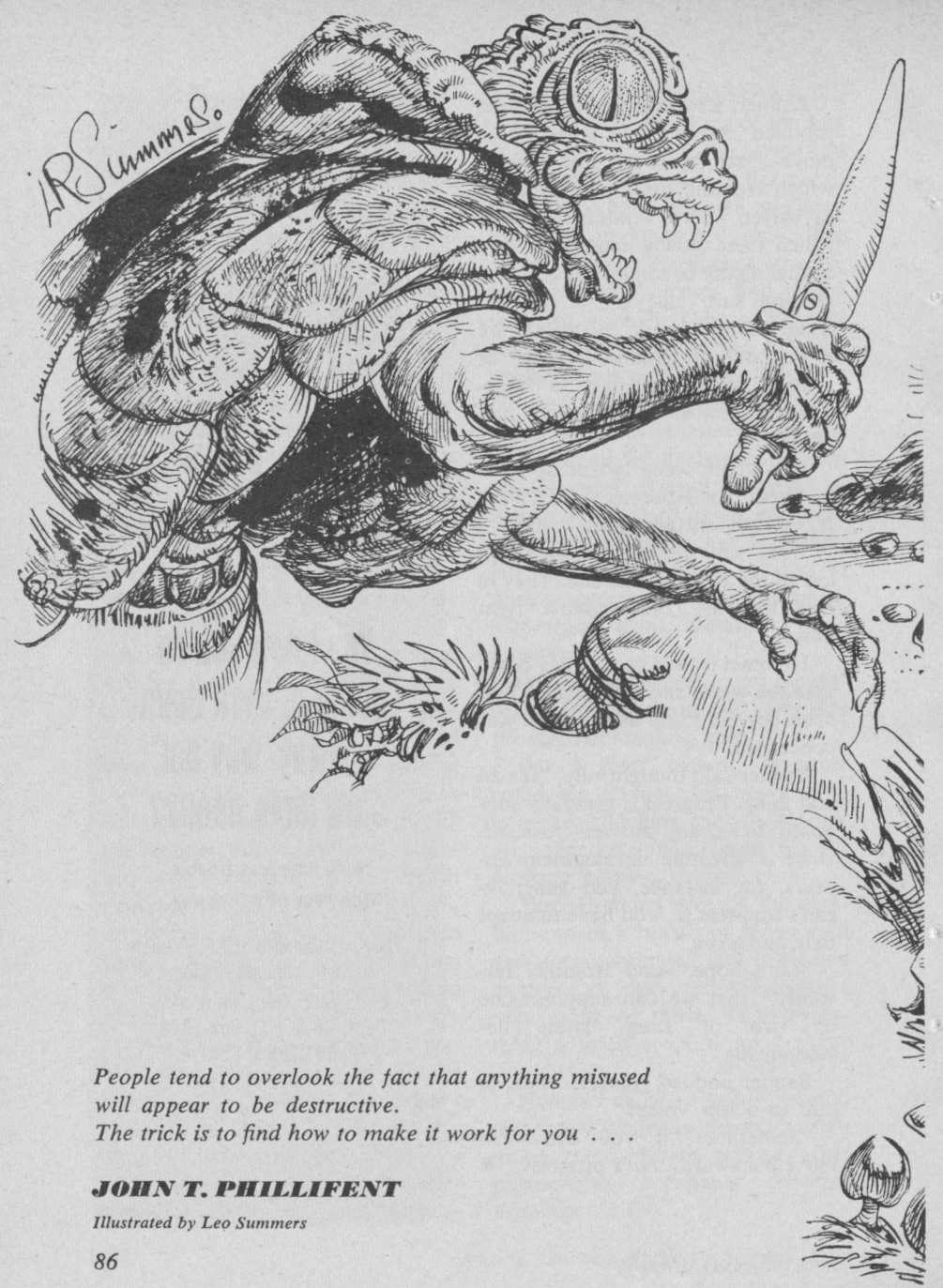
Hommel leaned back. They could take the whole site and throw it into orbit beyond Pluto as far as he was concerned.

Banner said thoughtfully, "It's an odd thing. Progress is generally supposed to mean, *moving forward.* Once a scientific development appears, for instance, you generally can't suppress it. You have to adapt to it, and go on."

"Let's hope," said Hommel fervently, "that we can suppress one or two of these latest developments."

Banner nodded gravely. Then he said in a low voice:

"Sometimes, if you can even move backward, *that's* progress." ■



People tend to overlook the fact that anything misused will appear to be destructive.
The trick is to find how to make it work for you . . .

JOHN T. PHILLIFENT

Illustrated by Leo Summers

Incorrigible

He closed the door quietly, turned and advanced three paces to the desk, stood erect but casual, and waited for the man there to finish reading the memo he held. One side of that desk was piled high with literature, with depositions, reports, eye-witness accounts, data of all kinds. Sector Commander-in-Chief Joseph Armer eyed the pile and knew that his future lay in it. As he stood now he was dressed in non-decorated fatigues. By the time the military machine had thoroughly chomped its way through that pile of data and the events it related to, he might not even be entitled to wear fatigues, nor any kind of military dress—or clothing of any kind.

The man at the desk laid aside the sheet of paper and looked up, sat back enough to avoid a crick in his neck, and for a while the two men just eyed each other. General Perris was old, worn lean by years rather than effort, and if his pale eyes looked tired it must have been for some other reason than active service. Armer had inquired, as far as he was able, about this man, had learned that Perris had made his way up the ladder and into the higher echelons of Space Service by the chair-borne route, merely by being heard to say "yes" and "no" at the right times, by the right people. But, also, that he was no fool.

Armer held the stare in silence up to within a microsecond of insolence, then said: "You sent for me, General?"

"I have been appointed to defend you, Commander. I intend to do it as best I can. What I would like, right now, is for you and me to have a long and informal talk about this business. Man to man, off the record."

"Whatever you say, sir." Armer guessed some reply was called for, and made it noncommittal.

Perris gestured. "Take a seat. I've been through this material. All the immediate facts are here, unless you want to dispute any of them? No? Very well, but what I want is the atmosphere, the people, the feelings, behind those facts. What I would like," and now Perris seemed to sigh in his tone, "would be for you to present me, here and now, with some good reason that I can take elsewhere and thus call off the whole offensive business. I never knew a court-martial to do anybody any good, and I have attended a few. All they ever achieve is the ruination of a good man and a flurry of rumors detrimental to the Service. It's a myth, of course, but a useful myth, that the Service acts as one man and with one voice. No doubts, no inner conflicts, that sort of thing. And a court-martial shatters that image. If it could be avoided . . ." Perris did sigh, this time. Armer waited for the old man to go on.

"Let me ask you the key question and get it out of the way. Did you actually do what is presented here 'Render technical and valuable in-

formation to a known and dangerous enemy of humanity.'?"

"Wrong voice, sir."

"Eh? Oh, see what you mean. You didn't actually do it, but you made it possible, caused it to be done. Yes?"

"I'll accept that, sir."

"Hm-m-m!" Perris shook his head at the disappearance of a frail hope. "You have a fondness for precise wordings, Commander?"

"I prefer not to be misunderstood. I think I ought to point out that I don't agree with you on courts-martial either, sir. I think you have it backwards."

Perris tightened all over, visibly.

Armer went on, "The Service, any military service, should speak and act with one voice so far as the image is concerned. And it can't do that unless the odd disagreement and difference can be sorted out promptly. And publicly."

"I see!" Perris was on the defensive now. Almost visibly the wheels buzzed in his mind, rechecking all the things he had heard about Armer: that he was a difficult man to push around, that he was hard to predict, ready to be unorthodox at the drop of a hat. A thinker. "You hope maybe to roll a few heads tomorrow?"

"No. But I welcome the chance to rub a few noses in an unpleasant fact. Which is that the Service is failing to make the best possible use of its available man power."

"Eh?" Perris stared, then shook his head again. "All right, Commander, it looks as if this is going to take a while. I have all day for it. Suppose you start filling in the background from some suitable point. Tell me about the Drekks."

Armer concealed his grin as he recognized the tone, the same intonation used by the psychiatrist to his patient, or a fond mother to her child; the one which says, in effect: "I will listen while you talk. You can say anything you like, quite safely, and I will pretend to sympathize and understand, and I won't laugh, or disagree, or anything like that. And that will make you feel a lot better, won't it? And *then,* maybe, we can find out what really goes on!" Armer's wry amusement came from the recognition that there is a concealed assumption in that tone which is seldom recognized by those who use it, the assumption: "I've heard everything, brother. You can't shake me!" He had, as Perris had noted, a fondness for precise wordings. He also had a critical ear for tonal inflections. He composed his face and began:

"The first I heard of the Drekks, sir, was when the buck was passed to me to get Vega Sector Research & Investigation out of a bollix they had run into. I had the same report you have there, plus what I was able to add to it during the term of my operation. Nothing very significant, just details. That would be the Commander Phelan docket."

"The chap who screamed for help? Yes, I've read it. He uses the phrase, 'a tiger by the tail,' I remember."

"I don't blame him. The Drekks tend to paralyze the faculties a bit." Armer thought back then began again. "A one-man scout discovered the Drekk culture, the hard way. It's a small star, well off the main routes and easy to miss because it's half hidden by a dust cloud. Seven planets, five of them far-out gas giants and no concern of ours, but the inner two are. You have the data there, but it won't hurt to repeat it. Two Earth-size and Earth-type planets, within the permissible parameters, chasing each other round the primary in a perfect Trojan formation. By some freak, which the cosmologists will eventually theorize away, one is almost all water, while the other is a sterile ball of dust and rock. And if that scout had gone right on by, we'd all be a lot happier. But he didn't.

"He went into orbit around Wet —we call one Wet, the other Dry, for convenience. He long-ranged the one major landmass with his detector-complex and got responses that indicated a low-level degree of intelligence. Very properly, he logged all that and transmitted it back to Sector Base, along with coordinates. He locked his ship in orbit, took the hopper, and went down to take a closer look. He made a verbal report all the way down to safe planetfall, and then to a cautious attempt at contact. And then nothing. The Drekks got him."

"I have it here." Perris riffled through the stack of material, brought out a sheet to study. "One landmass straddling the equator, roughly one thousand eight hundred by seven hundred fifty miles. Terrain rugged, subtropical type vegetation, constant and violent waves and surf action on rotation-edge of landmass; perpetual storms, heavy rainfall and high winds." He shook his head. "Not exactly a pleasant place to live, or to find life."

"No, sir. But that's why the Drekks are the way they are."

"Hm-m-m? Oh, I see what you mean. Environmental pressure."

"Yes, sir. They are as rugged as the terrain. And resourceful. That scout wasn't missed for some time. Six months or so before the word filtered back through channels, and Base sent a two-man fifty-ton breakdown ship to check up. I understand the betting, back there, was seventy-thirty that the scout was dead. It happens that way in the scout arm and no one loses any sleep over it, except the scouts. The breakdown ship found the scoutship still in orbit, checked it out clean. They radioed ground and got back a kind of reply they couldn't make head or tail of. So, they logged everything, sent back the details, and then went down on the trail of that reply. The 'breakdowners' are designed to land, of course."

"I did know that, Commander." Perris sounded testy. "I also know what happened. The Drekks took that ship, and the two men. They must have been half asleep!"

"Not necessarily, sir. You need to understand the Drekks. That's what I had to do, when I took over. There can be no doubt about it, they are explosive. They learn so fast it's like a chain reaction. The evidence indicates that before we ran into them they had nothing but a tribal federalism, some skills in agriculture and fishing, the beginnings of metallurgy, a hell of a lot of primitive weapons, and a fantastic survival potential. In the six or so months between capturing the scout and the breakdowner they showed a fair grasp of radio and electronics, glass-making, fuel cracking, basic electrical power handling and a toehold in ceramics. After they got the breakdowner they spread into heavy machinery skills, repair-technology, synthetics of many kinds, telemetering, optics, radar, television—and our language. They made those two men talk before they . . . eliminated them."

Perris stiffened again. "I know you think it's easy, Commander, for a man like me to sit back here and say it's all part of the game. I know it's not so easy when you happen to be one of the pawns, out there in the front line. It was a damnable situation, but it won't help to get emotional about it."

"I couldn't afford to get emotional, sir. The way I saw it, it wasn't just damnable, it was impossible! That's why Phelan threw his hand in and passed it back to me."

"You had a problem, of course." Perris put the document back thoughtfully. "Even a desperate situation. But I am still no nearer understanding why you did—what you did."

"For that you need the full picture, sir."

"I have all the facts. Correct me if I'm wrong, but the problem, as it was handed to you by Commander Phelan, was this way. He had tried twice more to establish some kind of relationship with the Drekks. For his pains he found that they are tall, bipedal, visibly reptilian, but humanoid; that they are ruthless, merciless and intractable in any terms we can apply; that they fight hard. In his words 'as if they had invented the art!' That's our side. On their side, they learned a great deal. New weaponry, new tactics, quite a lot about spaceships and propulsion systems that we would rather they had not learned. And much more. In fact, every time we make contact with the Drekks, we lose and they gain. In fact Phelan, very wisely, realized he was stuck, set up a temporary command post two lights away, left two orbital monitors to keep an eye on the enemy, and firmly refused to have anything more to do with them. The facts, Commander."

"They are all right, as far as they go." Armer agreed to that point with care. "But there's more. The Drekks don't stand still. A week before I took over they had managed, somehow, to talk down that scoutship that was still in orbit. From the account I had, they got it down on the ground safely before technics at Base managed to jury rig a remote destruct and blow the thing. Within three weeks of my taking over, the Drekks had put up a five-man ship, aimed for Dry. It was a total loss. Three weeks after that they did it again, made a landing, stayed four days, and got back home again safe and sound!"

Perris took a deep breath and let it out again slowly. "I know exactly how you must have felt, Commander. Explosive!"

"Exactly. Commander Phelan, who stayed on to render assistance, had the possible alternatives all laid out for me. There were only two that he could see. For one, we could drop a massive combat force and whip the Drekks into surrender, and then, maybe, talk sense to them. Only that would cost a lot of lives and a lot of equipment, plus the fact that we had no way of knowing if the Drekks could even comprehend peaceful coexistence. Every reason to doubt it, in fact. If that's true, then once we started we'd have to go on until we wiped them right out."

Armer let that hang a moment, then went on. "Also plus the fact that we could lose. The terrain is rugged. Jungle-type warfare can be tricky. And how do you fight a fanatical enemy who can copy and match all your tricks as fast as you display them? If we tried to eat the Drekks—and failed—they would eat us. And not just the combat effort, nor even the Sector. You'll read it somewhere in those reports that they have a well-developed science of breeding. They can and do control their numbers to the precise capacity of the environment. And they are reptilian in origin. So, we didn't dare start anything unless we were dead certain we could finish it."

Perris was pale. He looked his full age as he digested Armer's implications and extrapolation.

"I had read it," he admitted uneasily, "but it didn't come off the page the way you just said it. A tiger by the tail, indeed! And the only other alternative, of course, is to destroy the planet."

"Right. And you know why we can't do that. You know the Supreme Space Court ruling on that better than I do. The occasion has not yet arisen, but it's provided for. No such action can be put into effect without first the unanimous agreement of the entire Space Council, and then only if and when the offending planetary culture has been adequately warned—and can be shown to understand, beforehand. That last condition, alone, puts it out of sight. I can't think of

any way in which to deliver such information to the Drekks without tipping them off that we have them under observation. And that is one item of information I would rather they did *not* know."

Perris leaned back, made a pushing away gesture at the document pile as if to say: "All right, we're through with the data, now to cases." His weary old face showed signs of puzzlement.

"I've heard you, Commander. I've listened and tried to understand. I gladly concede that you were in a devilish position. I will even admit, but only within these four walls, that in your position I do not know what I would have done. But I do know what I would *not* have done—especially in view of your last remark, that you did not want the Drekks to know more than they already do. *That* I can understand. That you should then deliberately contrive to get information to the Drekks, that I do *not* understand. There's the charge, against you and Adolph Harger. That he conveyed useful information to the enemy, and that you made it possible for him to do so. Treason! And in these circumstances. I do not understand, at all." He hesitated a moment, then, "Tell me about that man, Harger. What did you hope to achieve?"

"I knew Harger from long ago, sir. At that time I had my first ship. I had the old *Heinlein,* a maintenance monitor. Harger was in the Service at that time. He was my Supplies and Materiel officer, a junior lieutenant. I got to know him very well indeed."

"I presume you also know that he was slung out of the Service on his ear, five years ago?"

"Oh yes, I knew. I could have predicted it. As I say, I got to know him. A good joe, good company, and a first-class brain."

"A thief, a swindler, con man, a blackguard!" Perris slapped his desk in sudden irritation. "I've a condensation of his dossier here. He has a record as long as your arm! A good joe?"

"This may take a bit of understanding, sir." Armer marshaled his thoughts carefully. "Harger is a type. Psychopathy takes many forms, many of them unspeakable, but Harger's is just antisocial. Quite genuinely, he does not know nor appreciate the difference between 'mine' and 'thine', and never has. He has learned to conform only where he can't do otherwise, but turn your back on him and anything of value, and he'll have it, even if it's nailed down. If you examine his record it shows him to be a thief, a hard-case swindler and rogue, robber, get-rich-quick merchant—only he isn't. He was slung out for unlawful appropriation and disposal of Service property. I imagine it's genuine. But in all the time he was with me he never stole a thing. I made it his job to get stuff, get it

promptly and efficiently, and he did it. And I took care of the paper work. He was the best S & M officer I ever had."

Perris pushed away from the desk, rose, and began pacing his side of the office. "To me," he said, "Harger is a crook, a disgrace to the uniform he once wore, a demonstrated blackguard. To you, you say, he is a pathological case. I won't argue. It makes no difference. What does matter, and what I still do not understand, is why you entered into some sort of deal with him. You did, didn't you?"

"Oh yes. In a way. I've no wish to deny that, sir. What matters is why. Why it had to be Harger. Why it was a stroke of good fortune that he happened to be handy in the first place. I just happened to find out that he was hanging around the Base, dodging around the fringes of legality. He and his beat-up old ship, picking up any old odds and ends he could lay hands on. That's his pattern, sir. He can't help it any more than he can help breathing. It's the way he's made. He's incorrigible."

Perris halted in his pacing and turned to glare. "The point is, you deliberately sought out Harger and made a deal with him, supplied information to him which he proceeded to *sell* to the Drekks."

"Not quite like that, no. If that's on the charge sheet, it's wrong!"

Perris wheeled, came back to his desk, set his palms on it and leaned forward, thrusting his face close. "Did you, or did you not, place certain information within the grasp of Adolph Harger, information which he had reason to believe would be of great value to the Drekks?"

"That's it, sir. I put it out where he could see and hear it. I told him, explained it to him, and he bit it."

"You *gave* it to him!"

"No, sir. I made it visible. I spoke to him about it in the tone of: 'This would be worth a fortune to the Drekks if only they knew . . .', and the rest was as inevitable as old age."

"You knew he would jump at it!"

"Of course. I keep telling you, I know him."

"You amaze me, Commander." Perris pushed away from his desk and began the pacing again. "My purpose here is to examine any possible kind of defense for your actions—a mitigating circumstance, even. But you don't seem to have grasped the fact that you're in trouble. You're treating this like some kind of charade. Your whole attitude— Do you deny that your whole object was to send Harger hot-foot to the Drekks?"

"I didn't *send* him. I knew he would go. I made it easy for him. But I didn't send him."

"A fine distinction. May it ease your conscience, knowing as you do what the Drekks have done so far with all the humans who have fallen into their clutches!"

Armer wanted to grin at the fine

melodramatic phrase, but he stifled the impulse. "Harger knew all that as surely as I did. The whole Base knew it. But he still went. That's part of him, too. He can't resist a challenge. He has long since graduated out of the petty thievery stage. And, knowing him, it would not surprise me if he manages to get out of the deal with a whole skin. I told you, sir, in his own field he's good!"

Again Perris halted his pacing, came back to his desk, riffled through the paperwork. Armer saw that there was a fine sheen of sweat on that old face, and he wondered at it. Given time and persistence a man can learn to control his facial expressions so well that they become atrophied. Armer had known men like that, men who couldn't register anger, excitement, fear, or even amusement, on their faces. But they still *had* emotions, and if you overloaded them too much, such men broke—into utterly unpredictable pieces.

"It will interest you to know," Perris muttered, "that Harger did manage to do just that. This report came in since you were . . . ah . . . relieved of your post. He has returned to Base with a substantial fortune in gems and bio-spices. He is also, naturally, under arrest on a charge similar to yours. He has been questioned. His account is substantially the same as yours."

"I'm glad to hear it," Amer said.

"Glad?" Perris seemed to strangle on the word. "It's your neck, man! The documented testimony from Base Security would have been damnable enough. It's all here. Eye-witness evidence of your semi-clandestine meetings with Harger, the literature you obviously showed him, his abrupt departure from there and equally abrupt and unexpected arrival in the Drekk system. All that, even without what you've just confided in me, off the record and inadmissible, is enough to hang you. But now we have Harger's own testimony, and it pulls the last remaining shreds away. In fact, Harger may be able to plead for considerations, may be able to swing some of the onus on your back. And he can claim to have brought back valuable first-hand information about the Drekks. By his word they are every bit as hard-driving, ruthless and . . ."

"Incorrigible, sir?"

"You like that word, Commander?" Perris stared curiously.

"I do. I like words that fit. This one does, if you take it to mean anything that can't be corrected, put right, adjusted. There's an old saying, what you can't cure you have to endure. I don't hold with that. In my book, if a thing is the way it is, find a use for it. The Drekks can't be cured, no more than Harger can. But they can be used."

"Used?" Perris was shrill. "You talk as if they were expendable! You certainly used Harger in that fashion, and that will add dark

shades to your prospects. You sent him to his death, in everything but the final fact."

"I didn't send him," Armer repeated patiently. "I used him. I knew he would go. He couldn't resist it. I didn't give a damn whether he got back or not, that was his lookout. But, seeing that he *did* get back, I assume you also know by now just what it was that I 'leaked' for him to snap up and sell."

"It's here, somewhere." Perris attacked the document pile again. "I did read it, briefly. Something to do with the Scarsdale-Jensen process for desalination, wasn't it?" The bony old fingers froze to stillness as Perris heard what he had just said. He let himself down into his seat carefully and stared at Armer. "My God! Desalination!" Collecting himself he attacked the pile again, got the relevant paper, scanned the first few lines fearfully, then put his eyes on Armer once more.

"When you leak, you really leak, don't you? Desalination! I can just imagine what a godsend this will be to the Drekks!"

"Oh yes." Armer bobbed his head in agreement. "What with the perpetual storms, the gigantic waves and surf, the spray-mist, one of their chronic headaches is getting a supply of really clean and fresh drinking water. And the same for all those manufacturing processes which call for it. The Scar-Jen process was something they just had to jump at."

Perris looked haunted now, his face gleaming with perspiration. "How can you sit there and gloat?" he demanded. "With every word you dig the hole deeper for yourself. Any idea of trying to defend this—it's ludicrous!"

"There's more, sir, if you read on. At the tail end, among the 'notable side-effects addenda' I think."

Perris was too paralyzed to comprehend. Armer shrugged.

"I'll summarize it for you, then. The Scarsdale-Jensen process is old, developed during the latter part of the Twentieth Century struggle to beat pollution and overproduction, and it's remarkable only in the sense that the originators went at the problem from the reverse end. Other desalination systems went for extracting the undesirable impurities by various methods, like distillation, ion-exchange, osmosis, that kind of thing. Scarsdale and Jensen went for the water, did some water-chemistry, confirmed an old theory that water is not just H_2O but is, in fact, a polymer on the same formula, with hydrogen bonds, and then tackled the problem from that angle. They worked out the applicable depolymerization technique. They learned how to extract pure water. They also reaped a small bonus in energy-output, which is another story. But they stumbled on a freak matter-transmission effect, too."

"Eh?" Perris came alive, peered at the paper in his hand, then back at Armer. "Matter transmission? What are you talking about? If we have matter transmission, why haven't I heard about it?"

"Why?" Armer grinned sourly. "Scarsdale and Jensen thought just what you are probably thinking now—until they went into it. Like so many of the 'miracle breakthrough' notions, this one has built-in snags. For a start, it takes a hell of an investment in energy, and only a percentage is recovered from the receiving end. But the main snag lies in how you define matter. You can say matter is a pattern of energies, and the system will transmit that just like radio, and over the same order of distance. A pattern. An energy pattern. Not this, for instance"—he put his finger on the desk intercom—"nor this"—he moved his finger to touch the gleaming titanium paperweight in the form of a combat cruiser—"nor anything like it."

"Why not?" Perris was hooked.

"Because those things are not just energy patterns. They are shapes and arrangements, assemblages of parts in an orderly, three-dimensional mechanical-physical array. And they are made up of complex molecules, too. If I could put that intercom through a grinder, reduce it to monomolecular dust, then the Scar-Jen system would be able to take, and send, some of the simpler molecules. As dust. And then only the simpler ones. Yes, sure, a molecule is an energy pattern. You can scan it, and transmit it. But only the simple ones. If you tried to transmit, say, hemoglobin, or pepsin, or a protein, you'd first have to break it down into simpler fractions—which is easy. And then put the bits back together again at the far end—which is impossible. It has taken life a long time to learn how to assemble bits like that. We can't do it. So, the 'matter transmitter' effect does just that. Matter. Molecular matter. And it has to be simple molecules, too, otherwise you get analysis. In fact the process is used, in a small way, for analysis. And purification."

Perris gulped and said, "You mean that this process can transmit only dust, powder, or liquid?"

"Right. And only simple powders and liquids. You try taking complex molecules apart for scanning and you get big bang trouble. Water happens to be ideal for the purpose, but you try naming three or four other substances that would be worth the trouble and cost."

Perris said: "Let's stick to the facts. You gave this to the Drekks. Desalination, *and* a working technique for radio-transmission of pure water . . ." Once again he ground to a halt as his own words made a pattern in his mind. He managed to look horrified. "You," he said, in a choked whisper, "have given them the way to colonize their other planet. Dry and sterile, you said it

was. But not for long. Not with this technique."

"That's right." Armer nodded approvingly. "I had to bait the hook good, you see. Knowing them, I figure they will go flat out on this. They'll build transmitters on Wet, receivers on Dry, and give them about three years, they'll have a toehold colony on Dry, all set to expand at a fantastic rate. Also, on the side, they will gain a bit of land on Wet, as they drop the sea level. Not a lot, but something. You see, that technique can be expanded until it shifts water on the order of tens of millions of gallons per day, if you don't stop to count the cost in energy. And they won't."

Perris got to his feet again, unsteadily. He looked at Armer as if he were facing some loathsome disease. "You must be out of your mind," he said, in simple defeat. "I shall apply to the Trial President to have me taken off this case. There's nothing I can do for you. By your own account, and on all the evidence, the Drekks are a deadly menace even as they stand, on their one severely handicapped world. You have made it possible for them to expand and colonize their sister planet, multiplying the menace. You know what this means? No, not for you or Harger. You two are finished, as good as dead. I mean for the future. Do you realize you leave me no other course than to report this to the Space Council and demand urgent crash-priority authorization to destroy that planet? I dare say that would have been the only possible answer in the long run anyway, but you have made it absolutely inevitable now."

He spread his hands on the desk and leaned forward. "Or was that your intention all along? You've made it plain that you don't think twice about using people."

"No, sir." Armer could relax now. "I count myself expendable, in the interests of workability . . ."

"Workability?" Perris almost spat it. "You have a fine choice of words, Commander. Incorrigible, expendable, workable. Let me offer you one more. Incredible! I have heard some crazy schemes . . ."

"If you'll let me explain just one thing more, sir. In that pile of paper you'll find the full planetary data on Wet. Phelan, very properly, had it extracted and codified for me, in the event it would be decided to use the planet-buster bombs. I looked it over. Wet is slightly smaller than Earth. In many ways it is almost a dead ringer for Venus. And that reminded me of something that also has to do with the Scar-Jen process. I know about it because, as I told you, I was on the *Heinlein* at the time she was detailed to take part in the project."

"What project?" Perris, seated again, sounded patient.

"The project was to link Mars and Venus in a transmitter-receiver couple, using the Scar-Jen side effect. Mars has always been short of

water, and Venus could certainly bear to lose some. So the idea was put up, and all sorts of political shenanigans had to be gone through, but eventually it was all agreed, and the trials were scheduled. *Heinlein*, as I say, was in on it, as part of the hardware."

Perris scowled now. "This is fiction, Commander. Surely. I never heard of any such deal between Mars and Venus!"

"You didn't, no. It was all hushed up, allowed to slide into limbo. You see, the whole thing would have worked fine, was actually started, until some smart boy came along to point out the trap. Panic buttons were pushed. The joker has to do with planetary formation. I looked it all up, all over again, just to make sure. It's like this: When a planet is larger than a certain critical mass, the internal gravitic pressure is great enough to collapse the heart-rocks into a denser state, and the planet has a small, massive core. The critical mass is calculable. Earth has a small core, for instance. But the Moon doesn't. Nor does Mars. Not massive enough. But when you take Venus you are right on the critical limits. Venus does have a small core, is *only just* massive enough to maintain those internal pressures needed to collapse the rocky center. So, you see, if they went ahead with the project to remove a few hundreds of millions of tons of mass—and water is heavy—they would tip the balance the other way. The core would un-collapse, would, in fact, explode with enough energy release to rip the surface apart in chunks. So they decided to forget the whole idea.

"But I was there. I knew about it. And when I looked over the planetary data for Wet, I knew we had another one."

He leveled a steady stare on Perris. "I figure it will take the Drekks something less than three years to achieve imbalance. Then Wet will blow itself apart, and all that will be left will be the struggling new colony on Dry. A toehold, but with no back up. And we'll see what they make of that! I'd say they have an outside chance of surviving. Too much water can be tough, but too little can be a damn sight worse. And maybe they will have learned, by then, that we are not the simple pushovers they now think we are. Maybe they will learn a little sense."

He sighed, shook his head. "On the other hand, maybe not. Maybe they are incorrigible. Sir . . . !"

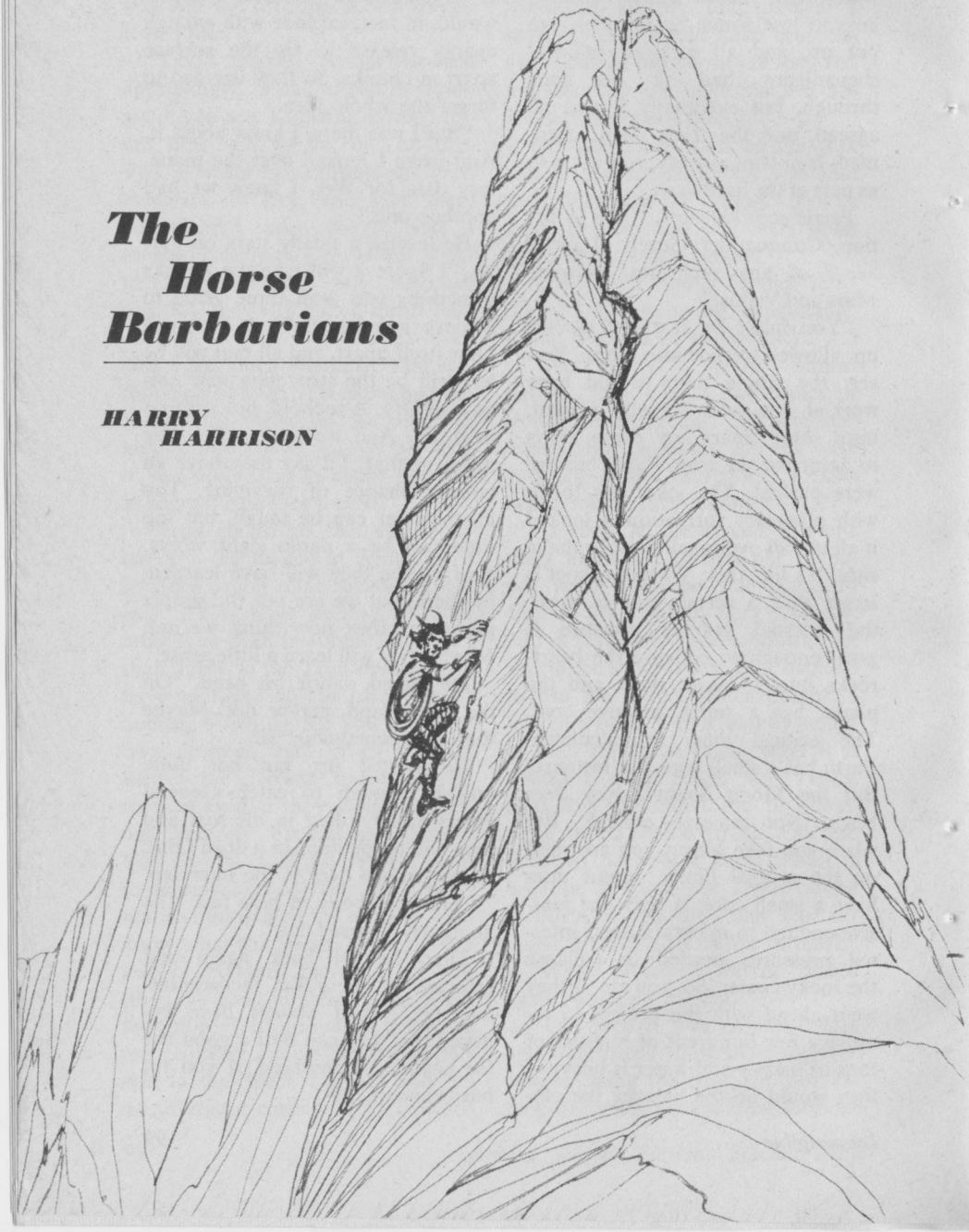
He started up, but not quite quickly enough to catch General Perris as he wilted in his seat and then slid to the floor in a dead faint. Armer leaned over to the intercom.

"Get somebody in here fast. The general has passed out!"

Then he sat back again and grinned. "I guess I'm incorrigible, too, General. I always have believed that you can find a good use for anyone or anything, if you try hard enough." ■

The Horse Barbarians

HARRY HARRISON



CONCLUSION

Jason dinAlt was a little slow getting the point through his head.
He tried on Pyrrus, and lost. He and his Pyrran friends
tried on Felicity, and it misfired.
You can't fight a fighting breed into changing their ways.
You have to subvert them . . .

Illustrated by Kelly Freas

SYNOPSIS

JASON DIN ALT knows that the city dwellers on Pyrrus are doomed if they do not leave their planet. Their continuing hatred has generated an endless—and escalating—war with the telepathic life forms that inhabit this world. The Pyrrans, after centuries of battling for their lives in the doubled gravity, are undoubtedly the galaxy's fastest and best warriors. JASON convinces them that they should try to open a mining colony on the planet FELICITY, despite the deadly and barbaric nomads who rule there now. A small expedition is mounted, but JASON is kidnapped by the nomads as soon as the spaceship lands. He is taken to TEMUCHIN, warlord of all the nomads, who interviews him briefly—then orders him killed.

JASON manages to escape and returns to the landing site, but finds the spaceship gone. He is attacked by nomads, but is saved by META in the ship's launch. She takes him to the mountains where the spaceship and the other Pyrrans are hidden. JASON now has a plan to gain control of this high plateau where they must dig mines.

The Pyrrans will disguise themselves as another tribe of nomads and, led by KERK, they will beat the tribesmen at their own game. They will be better barbarians, better warriors—and KERK will eventually take over TEMUCHIN's position as warlord. While they are doing this RHES will go to the lowlands, below the continent-wide cliff that separates the nomads from the more civilized cultures, and will organize a trading expedition. When

KERK has gained control, the trading expedition will board ship and land on the northern coast. They will be permitted to land and will start a settlement, that will eventually cover the mining operations.

JASON goes to the plains ahead of the others, with META and the boy GRIF. He is disguised as a jongleur, a minstrel who travels from tribe to tribe with entertainment and news. TEMUCHIN hears about him and the Pyrran tribe, and orders the disguised JASON before him. After a first clash of personalities they reach an agreement. Then TEMUCHIN asks JASON how much he knows about gunpowder. What does this mean? What can TEMUCHIN, an illiterate, iron-age barbarian, know about gunpowder? Does he suspect that Jason is an off-worlder? Is it a trap?

TEMUCHIN reveals that the lowland people have gunpowder, and that he knows a way to get down the kilometers-high cliff. JASON admits that his tribe, the Pyrrans, has ancient knowledge and he, too, knows a bit about gunpowder. A small expedition is mounted, and they are let down the cliff, one by one, by a hand-cranked windlass. After a pitched battle with lowland soldiers, ten barrels of gunpowder are captured and brought back. JASON, wounded and exhausted, manages to make a grenade bomb with the gunpowder and demonstrates it for TEMUCHIN. The warlord has consolidated his rule of all the plateau tribes; only the weasel clans in the hills still resist him. With the aid of the bombs he hopes to be able to overcome the resistance by destroying their defenses, then wipe out his last enemies.

The bomb demonstration is interrupted by the arrival of KERK and the rest of the Pyrrans disguised as the Pyrran tribe. It is hatred at first sight for KERK and TEMUCHIN, though they do agree on an uneasy armistice if the Pyrrans will join the warlord's forces. It is agreed. A well-planned attack is launched against the weasel tribes.

After a series of heroic rides and attacks, the invading forces reach a mountain pass called The Slash, the only access to the enemy's stronghold. The Slash is so well defended that it has never been taken before, but this time the bombs reduce the strong points and the attack sweeps forward. It looks like certain victory for TEMUCHIN's forces—until an artificial landslide seals the pass completely. All the careful planning is worthless since the campaign has obviously been lost.

Part 3

XIV

"I do not like it," Kerk said. "I do not think that it can be done."

"Kindly keep your doubts to yourself," Jason whispered as they

came up to Temuchin. "I'll have enough of a job selling him this in any case. If you can't help, at least stand there and nod your head once in a while as if you agreed with me."

"Madness," Kerk grumbled.

"Greetings, oh warlord," Jason intoned. "I have come bringing aid that will turn this moment of disaster into victory."

If Temuchin heard, he gave no sign. He sat on a boulder with his hands over the pommel of his sword, which stood upright on the ground before him, looking straight ahead at the sealed pass that had stopped his dream of conquest. The last rays of the setting sun lit up the sheer, vertical faces of the towers of rock that formed the gate.

"The pass is now a trap," Jason said. "If we try to climb the rubble blocking it, or clear it away, we will be shot down by the men concealed behind it. Long before we can have forced passage the reinforcements will have arrived. However, there is one thing that can be done. If we were to stand on the top of the higher spire of rock, on the left there, we could drop the gunpowder bombs down on the enemy, keeping them at bay until your soldiers had climbed the rockfall."

Temuchin's eyes went slowly up the smooth fall of rock to the summit high above. "That stone can not be climbed," he said, without turning his head.

Kerk nodded and opened his mouth to agree, then made an oofing sound instead as Jason planted an elbow in the pit of his stomach.

"You are right. Most men cannot climb that rock. But we Pyrrans are mountain men and can climb that tower with ease. Do we have your permission?"

The warlord turned deliberately and examined Jason, as though he were more than a little mad. "Begin then, I will watch."

"It must be done during daylight, and we will need to see in order to throw the bombs. Then there is special equipment in our saddlebags that we must make ready. Therefore, the climb will begin at dawn and by the afternoon The Slash will be yours."

They could feel Temuchin's eyes burning into their backs as they returned to the others. Kerk was baffled.

"What equipment are you talking about? None of this makes sense."

"Only because you have never been exposed to accepted rock climbing techniques. The piece of equipment I will need first is your radio, because I have to call the ship and have the other equipment made. If they work hard, it can be done and delivered before dawn. See that our men set up camp as far from the others as possible. We want to be able to slip away without being noticed."

While the others unrolled the fur sleeping bags and dug the fire pits,

Jason used the radio. The *moropes* were arranged in a rough circle while he crouched in the center behind the concealing bulk of their bodies. The duty officer aboard the *Pugnacious* sent a messenger to awaken and call in all the men, then copied down Jason's instructions. There were no complaints, or excuses, since a war emergency is a normal part of Pyrran life, and delivery of the equipment was promised for well before dawn. Jason listened to a repeat of his instructions, then signed off. He ate some of the hot stew and left orders to be awakened when the completion call came through. It had been a long day, he was on the verge of exhaustion, and tomorrow promised to be even worse. Settling down in his sleeping bag, boots and all, he pulled a flap of fur over his face to keep the ice from forming in his nostrils and fell instantly to sleep.

"Go away," Jason muttered, and tried to pull away from the clutching hand that was crushing his already well-crushed arm.

"Get up," Kerk said. "The call came through ten minutes ago. The launch is leaving now with the cargo and we must ride to meet it. The *moropes* are already saddled." Jason groaned at the thought and sat up. All of the heat was instantly sucked from his body and he began to shiver.

"M-medikit-t—" he rattled. "Give me a good jolt of stimulants and pain killers because I have a feeling that it is going to be a very long day."

"Wait here," Kerk said. "I will meet the launch myself."

"I would like to, but I can't. I have to check the items before the launch returns to the ship. Everything must be perfect."

They carried him to his *morope* and put him into the saddle. Kerk took his reins and led the beast while Jason dozed, clutching the pommel so he would not fall. They trotted through the pre-dawn darkness and by the time they had reached the appointed spot the medication had taken hold and Jason felt remotely human.

"The launch is touching down," Kerk said, holding the radio to his ear. There was the faintest rumble on the eastern horizon, a sound that would never be heard back at the camp.

"Do you have the flashlight?" Jason asked.

"Of course, wasn't that part of the instructions?" Jason could imagine the big man scowling into the darkness. It was inconceivable for a Pyrran to forget instructions. "It has a photon store of 18,000 lumen-hours, and at full output can put out 1,200 LF."

"Throttle it down, we won't need a tenth of that. The verticapsule is phototropic and has been set to home on any point light source twice as radiant as the brightest star—"

"Capsule launched, on this radio bearing, distance approximately ten kilometers."

"Right. It does about 120 an hour wide open so you can turn the light on now on the same bearing. Give it something to look for."

"Wait, the pilot's saying something, take the light."

Jason took the finger-sized tube and switched it on, turning the intensity ring until a narrow beam of light spiked away into the darkness. He pointed it in the direction of the grounded launch.

"The pilot reports that they had some trouble making a stain take on the nylon rope. It's on now, but they can't guarantee that it will be waterproof, and it is very blotchy."

"The blotchier the better. Just as long as it resembles leather from a distance. And I'm not expecting any rain. Did you hear that—?"

A rising hum sounded from the sky and they could make out a faint red light dropping down towards them. A moment later the beam glinted from the silvery hull of the verticapsule and Jason turned down the light's intensity. There was a faint whistle of jets as the meter-long shape came into sight, dropping straight down, slowing as its radar altimeter sensed the ground. When it was low enough Kerk reached up and threw the landing switch, and it settled with a dying hum to the ground. Jason flipped open the cargo hatch and drew out the coil of brown rope.

"Perfect," he said, handing it to Kerk. He burrowed deeper and produced a steel hammer that had been hand forged from a single lump of metal. It balanced nicely in his palm: the leather wrappings on the handle gave it a good grip. It had been acid etched and rubbed with dirt to simulate age.

"What is this?" Kerk asked, pulling a metal spike out of the compartment and turning it over in the light.

"A piton, a solid one. Half of them should be like that, and half with carabiner clips—like this one." He held up a similar spike that had a hole drilled in its broad end, through which a ring-like clip had been passed.

"These things mean nothing to me," Kerk said.

"They don't have to." Jason emptied the cargo compartment while he spoke. "I'm climbing the spire and I know how to use them. I only wish that I could take along some of the more modern climbing equipment, but that would give me away at once—and besides we don't have any in the ship. There are explosive piton setters that will drive a spike into the hardest rock, and instant adhesive pitons that set in less than a second and the join is tougher than the rock around it. But I'm not using any of them. But I have had this rope wrapped around one of those monofilaments of grown ceramic fiber—the ones we use instead of barbed wire—with a break-

ing strength of more than 2,000 kilos. What I have here will get me up the spire, so I'll just climb until I run out of handholds, then I'll stop and drive in a piton and climb on it. For overhangs, or any other place where I need a rope, I'll use the ones with the rings. And these are for use close to the ground." He held up a crude looking piton, marred by hand-forged hammer blows and pitted with age. "All of these are made from bar steel stock, which is a little rare in this part of the world. So the ones Temuchin and his men will see have been made into artificial antiques. Everything's here. You can tell the launch to take the verticapsule back."

The jets blew sand in their faces as the capsule rose and vanished. Jason held the light while Kerk tied the plaited leather rope to the end of the stained nylon line, then stowed this in the backpack, along with the rest of the equipment that Jason would use during the climb. Behind them, as they rode back to the encampment, the first light of dawn touched the horizon.

When the Pyrrans marched up The Slash they saw that a desperate battle had been fought during the night. The dam of rubble and rock still sealed the neck of the valley—only now it was sprinkled darkly with corpses. Soldiers slept on the ground, out of bowshot of the enemy above, many of them wounded. A blood-stained nomad, with the totem of the lizard clan on his helm, sat impassively while a fellow clansman cut at the bone shaft of the arrow that had penetrated his arm.

"What happened here?" Jason asked him.

"We attacked at night," the wounded soldier said. "We could not be quiet because the rocks slipped and rolled away while we climbed, and many were hurt in this way. When we were close to the top the weasels threw bundles of burning grass on our heads and they were above us on the cliff top in the darkness. We could not fight back and only those who were not high on the rocks lived to come down again. It was very bad."

"But very good for us," Kerk said as they moved on. "Temuchin will have lost prestige with this defeat, and we will gain it when we climb the rock. If we can—"

"Don't start the doubting act again," Jason said. "Just stand by at the base here and pretend that you know exactly what is going on."

Jason took off his heavy outer clothing and shivered. Well, he would warm up quickly enough as soon as he started his ascent. From below, the tower looked as unclimbable as the side of a spaceship. He was tying the piton hammer's thong around his wrist when Ahankk walked up, his face working as he tried to both sneer and look dubious at the same time.

"I have been told that you are so

stupid you think you can climb straight up rock."

"That is not all you have been told," Jason said, slipping his arms through the pack straps and settling it on his back. "Lord Temuchin told you to come here to see what happens. So get comfortable and rest your legs for the moment when you must run to your master with the glad news of my success."

Kerk looked up dubiously at the vertical face of rock, then down at Jason. "Let me climb," he said. "I am stronger than you and in far better condition."

"That you are," Jason agreed. "And as soon as I get to the top I'll throw down the rope and you can climb up with all the bombs. But you can't go first. Rock climbing is a skilled sport, and you are not going to learn it in a few minutes. Thanks for the offer, but I'm the only one who can do this job. So here we go. I would appreciate a lift so I can get a grip on that small ledge right over your head."

There was no nonsense about climbing up onto the Pyrran's shoulders. Kerk just bent and seized Jason by the ankles and lifted him straight up into the air. Jason walked his hands up the stone face as he rose and grabbed onto the narrow ledge while Kerk steadied his feet. Then his toes scrabbled and caught on a protruding hump and the climb had begun.

Jason was at least ten meters above the ground before he had to drive his first piton. A good bit of ledge, wide enough to lie down on, was well beyond the reach of his outstretched fingertips. The rock surface here was interlaced with cracks, so he picked a transverse one at the right height before him.

The first piton was one of the disguised ones: he jammed it into the crack. Four sharp blows with the hammer wedged it in solidly. Slowly and carefully—it had been a good ten years since he had done any real climbing—he stepped out and eased his weight onto the piton. It held. He straightened his leg, sliding up the rough surface of the rock until he could reach the ledge. Then he pulled himself up to a sitting position and, breathing heavily, looked down at the upturned faces below.

All of the soldiers were looking at him now, and even Temuchin had appeared to watch the climb. The enemy was surely taking an interest in what was happening, but the swell of the rock-face cut them off from sight and arrowshot. They could come to the edge of the canyon's wall, but they could not reach him unless they climbed the tower as well.

The rock was cold and he had better keep moving.

There was no way to estimate the height accurately, but he thought he must be at least as high as the rim of the canyon. He had his toes jammed into a wide crack, and was trying to drive a piton at an awk-

ward angle off to one side, when he heard the shouting below.

He bent as much as he could and called down, "What? I can't hear what you are saying." As he did this an arrow cracked into the rock at the place where his head had been and spun away and fell.

Jason almost fell after it, only keeping his grip by a convulsive clutch at the ribbed surface of the rock. When he turned his head he saw a weasel tribesman hanging from a leather strap that was tied tightly about his body. He had a second arrow notched and ready to fire. The men holding the other end of the strap were out of sight on the rim of The Slash, but by lowering the bowman below the bulging outcropping they had put him within bowshot of Jason.

The warrior carefully drew the arrow back to the point of his jaw and took aim. The hammer was tied by its thong to Jason's wrist so he would not lose it, but he still clutched the piton in his left hand. With a reflexive motion he hurled it at the bowman. The blunt end caught him in the shoulder. It did not injure him, but it deflected his aim enough so that the second arrow missed as well. He pulled a third from his belt and notched it to the bowstring.

Down below the soldiers were also shooting their bows, but the range was long and the overhead aim difficult. One arrow pierced the bowman's thigh, but he ignored it.

Jason let go of the hammer and took out a piton. It was tempered steel, well weighted and needle sharp. And he had had one try already so he knew the range. Taking the pointed end in his fingertips he drew well back beyond his head, then threw it with all the strength of his arm.

The point caught the bowman in the side of the neck and sank deep. He let go of his bow, scratched for the weapon with his fingers, shuddered and died. His body vanished from sight as the others pulled him up.

Someone had quieted the men below and he heard Kerk's voice cutting through the sudden silence.

"Hold on and brace yourself!" he shouted.

Jason looked down slowly and saw that the Pyrran had moved back from the base of the cliff and was holding one of their bombs, bent over and lighting it. Frantically, Jason kicked his toes in farther and, making fists of both hands, he jammed them deep into a vertical crack in the stone face.

Below him, the soldiers retreated from the base of the cliff. The foreshortened figure of Kerk reached back and back, until his knuckles appeared to be touching the ground. Then, in a single, spasmodic contraction of all his muscles, he hurled the bomb almost straight up into the air.

For a heartstopping instant Jason thought it was coming right at him

—then he realized it was going off to one side. It seemed to slow as it reached the summit of its arc, before it disappeared behind the curve of rock. Jason pushed hard against the cold stone.

The boom of the explosion was transmitted to him through the stone, a shuddering vibration. Fragments of rock and bodies blew out into space behind him and he knew his flank was safe. Kerk would be ready if the same trick were tried again. Yet there was still a feeling of unease . . .

"Kerk!" Jason shouted. "The piton!" He spoke in Pyrran. "What happened to the piton I dropped? If Temuchin should see it—"

One glimpse would be enough to reveal that they were off-worlders. The nomads were familiar enough with the appearance of alien artifacts.

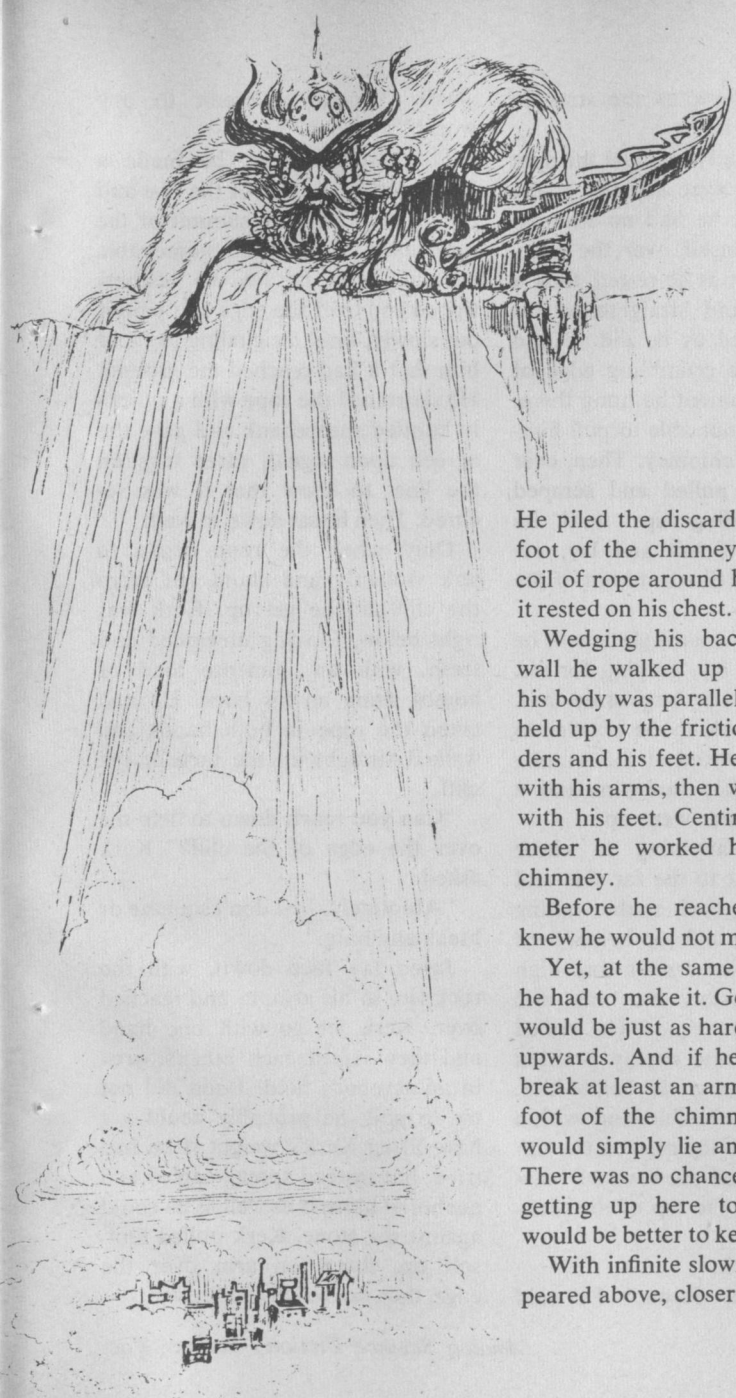
One, two thudding heartbeats of time Jason waited, before Kerk called back to him.

"All . . . right . . . I saw it drop . . . picked it up while they were all looking at you. Are you hurt?"

"Fine," Jason whispered, then drew a deep breath. "Fine!" he shouted. "I'm going on now."

After this it was just work. Twice Jason had to sling a loop of rope through the carabiner of a piton and sit in it to rest. His strength was giving out and he had used the most potent stimulants in the medikit by the time he reached the foot of a chimney that went right to the top of the tower. It looked to be about ten meters high and the two faces appeared to be parallel all the way up.

"One last try," he said, spitting on his hands and instantly regretting it as the saliva chilled and froze. He brushed the ice from his palms and took off the pack. The less weight the better, even the hammer had to be left behind now.



He piled the discarded items at the foot of the chimney and slung the coil of rope around his neck so that it rested on his chest.

Wedging his back against one wall he walked up the other until his body was parallel to the ground, held up by the friction of his shoulders and his feet. He pushed higher with his arms, then walked upwards with his feet. Centimeter by centimeter he worked his way up the chimney.

Before he reached the top he knew he would not make it.

Yet, at the same time he knew he had to make it. Going back down would be just as hard as keeping on upwards. And if he fell he would break at least an arm or a leg at the foot of the chimney. Where he would simply lie and die of thirst. There was no chance of anyone else getting up here to help him. It would be better to keep on.

With infinite slowness the sky appeared above, closer and closer, and

slower and slower as the strength ebbed from his limbs.

When he finally reached the spot where his toes were actually at the lip of the rock he had no strength left to pull himself over the edge. For a few seconds he rested, took a deep breath and straightened his legs. He twisted as he did so and clutched at the crumbling edge of rock. For a moment he hung there, neither falling nor able to pull himself out of the chimney. Then, ever so slowly, he pulled and scraped with bloody fingertips until he dragged himself out and lay, exhausted, on the tilted summit of the pinnacle.

The top was amazingly small, he saw that as he lay, gasping for air. No bigger than a large-sized bed. When he was able to, he crawled to the edge and waved at the waiting men below. They saw him and a spontaneous cheer went up.

Was there anything to cheer about? He went to the far side and looked, moving back as the waiting bowmen on the cliff top below fired at him. Only two arrows rose high enough to possibly hit him, and these were badly aimed. He looked again and saw the enemy position spread out like a model below him. Everything was visible and within easy range, both the men on the rim of The Slash and the rows of bowmen protecting the top of the rockslide.

He had done it.

"Good man, Jason," he said aloud. "You're a credit to any world."

Sitting crosslegged, he made a large loop in the end of the line and passed it around the summit of the rock itself, making an unmovable anchor. Then he let the leather-tipped end over the edge and paid it out slowly, until a signaling tug told him that it had reached the ground. He shortened the rope with a quickly knotted sheepshank and gave the agreed upon signal, three tugs on the line, to show that it was secured. Then he sat down to wait.

Only when the rope began to jerk violently and stand out from the cliff did he get up. Kerk was right below, looking unwinded and fresh, with an immense load of bombs slung on his back. He had taken the rope in both hands and walked straight up the face of the cliff.

"Can you reach down to help me over the edge of the cliff?" Kerk asked.

"Absolutely. Just don't squeeze or break anything."

Jason lay face down, with the rock rim in his armpit, and reached over. Kerk let go with one hand and they seized each other's wrist in an acrobat's hold. Jason did not try to pull, he probably could not have lifted Kerk's weight if he had tried, but instead spread-eagled and anchored himself as well as he could against the stone. Kerk pulled himself up, threw an arm over the edge, then heaved his body over.

"Very good," he said, looking down at the enemy below. "They do not stand a chance. I have extra microgrenades that we can use. Shall we begin?"

"You're letting me throw out the first bomb of the season, how nice."

As the explosions roared and rumbled into a continuous thunder, the army of Temuchin shouted a victorious echo and started up the rocky slope. The battle was decided and would soon be won, and after it the war would be won as well.

Jason sat down and watched Kerk happily bombing the natives below.

This part of the plan was complete. If the next step worked as well, the Pyrrans would have their mines and their planet. *Their* last battle would be won.

Jason sincerely hoped so. He was getting very tired.

XV

Strike like lightning, magic thunder
Slew the weasels, cleansed the mountains
Piled high, the thumbs of conquest,
Reached above a tall man's head.
Then the word of strangers coming
To his land, reached Lord Temuchin.
With sword and bow and fearless army
Rode he out to slay invaders . . .
from "The Song of Temuchin"

Jason dinAlt reined his *morope* to a stop at the top of the broad slope, and searched for a path down through the tumbled boulders. The wind, funneled up through this single gap in the high cliffs, struck him full in the face, damp and cold. Far below the ocean was gray steel, flecked with the spray-blown tops of waves. The sky was dark, cloud covered from horizon to horizon, and somewhere out to sea thunder rumbled heavily.

A faintly marked path was visible, threading away down the rock-covered slope; Jason spurred his mount forward. Once he had started down he saw that the path was well-worn and old. The nomads must come here regularly, for salt perhaps. An aerial survey from the spaceship had shown that this was the only spot for thousands of kilometers where there was a break in the palisade of cliffs. As he descended the air became a little warmer, but the dampness after the dust-dry plateau cut into him. A final turn brought him out in a circular bay, with great cliffs rising on both sides, and a beach of black sand below. Two small boats were drawn up on the shore with yellow cloth tents set up beside them. Farther out in the bay a squat two-master, with a smoke-stained funnel aft, lay with furled sails, swinging at anchor. Jason's approach was seen and, from the knot of men around the boats, a tall figure emerged and strode purposefully across the sand. Jason halted the *morope* and slid down to meet him.

"That's a great outfit you're wearing, Rhes," he said as he shook the other man's hand.

"No more exotic than yours," the Pyrran said, smiling and running his fingers through the purple ruffles that covered his chest. He wore crotch-high boots of yellow suede and a polished helmet with a golden spike. It was most impressive. "This is what the well-dressed Master Merchant of Ammh wears," he added.

"From the reports I hear that you made out very well in the lowlands."

"I've never enjoyed myself more. Ammh is basically an agrarian society that is working very hard to enter a primitive machine age. The classes are completely separate, with the merchant and the military at the top, along with a small priest class to keep the peasants quiet. I had the capital to enter the merchant class and I made the most of it. The operation is going so well that it is self-financing now. I have a warehouse in Camar, the seaport closest to the barrier mountains, and I have just been waiting for the word to sail north. Would you care for a glass of wine?"

"And some food—your best."

They had reached the open-sided tent which contained a trestle table loaded with bottles and cuts of smoked meat. Rhes picked up a long-necked green bottle and handed it to Jason. "Try this," he said. "A six-year-old vintage, very good. I'll get a knife to cut the seal."

"Don't bother," Jason said, cracking the neck off the bottle with a sharp blow against the edge of the table. He drank deeply from the golden wine that bubbled out, then wiped his mouth on the back of his sleeve. "I'm a barbarian, remember? This will convince your guards of my roughshod character." He nodded towards the soldiers who stood about, frowning and fingering their weapons.

"You've developed some vile habits," Rhes said, wiping the broken neck of the bottle with a cloth before he poured a glassful for himself. "What's the plan?"

Jason chewed hungrily at a fatty chop. "Temuchin is on the way here with an army. Not a big one, most of the tribes went home after the weasels were wiped out. But all of them first swore fealty to him and agreed to join him whenever he ordered. When he heard about your landing here he called in the nearest tribes and started his march. He's about a day away now, but Kerk and the Pyrrans are camped right across his trail. We should join up tonight. I rode on here alone just to check the setup before contact is made."

"Does everything meet your approval?"

"Just about. I would keep your armed thugs close by, but don't make it look so obvious. Let a couple of them lounge around and stuff the rest into a tent. Do you have the trade goods we talked about?"

"Everything. Knives, steel arrowheads, wooden shafts for arrows, iron pots, plus a lot more. Sugar, salt, some spices. They should find something they like out of this lot."

"That's our hope." Jason looked unhappily at the empty bottle, then tossed it away.

"Would you like another one?" Rhes asked.

"Yes, but I'm not going to take it. No contact with the enemy—not yet. I'll get back to the camp so I can be there when we have to meet with Temuchin. This is the one that counts. We have to get the tribes on our side, start peaceful trade, and squeeze the warlord out into the cold. Keep a bottle on ice until I get back."

By the time Jason's mount had climbed up to the high plains again the sky was lower and darker, and the wind threw a fine shrapnel of sleet against the back of his neck. He crouched low and used his spurs to move the *morope* at its best speed. By late afternoon he came up to the Pyrran camp just as they were starting to move out.

"You're just in time," Kerk said, riding over to join him. "I have the ship's launch up high in a satellite orbit, tracking Temuchin's force. Earlier this afternoon he turned off the direct route to the beach and headed for Hell's Doorway. He'll probably stop there for the night."

"I never thought of him as being much of a religious man."

"I am sure that he isn't," Kerk said. "But he is a good enough leader to keep his men happy. This pit, or whatever it is, appears to be one of the few holy places they have. Supposed to be a backdoor leading directly to hell. Temuchin will make a sacrifice there."

"It's as good a place as any to meet him. Let's ride."

The dark afternoon blended imperceptibly into evening as the sky pressed down and the wind hurled granular blizzard snow at them. It collected in the folds of their clothing and on the *moropes'* fur until they were all streaked and coated with it. It was almost fully dark before they came to the *camachs* of Temuchin's followers. There were welcome shouts of greetings from all sides as they rode towards the large *camach* where the chieftains were meeting. Kerk and Jason dismounted and were pushed by the guards at the entrance flap. The circle of men turned to look as they came in. Temuchin glared pure hatred at them.

"Who is this that dares come uninvited to Temuchin's meeting of his captains?"

Kerk drew himself up and gave as well as he had received. "Who is this Temuchin who would bar Kerk of the Pyrrans, conqueror of The Slash, from a meeting of the chiefs of the plains?"

The battle was joined and everyone there knew it. The absolute silence was broken only by the rustle

of wind-driven snow against the outside of the *camach*.

Temuchin was the first warlord to have brought all of the tribes together under one banner. Yet he ruled nothing without the agreement of his tribal chieftains. Some of them were already displeased with the severity of his orders and would have preferred a new warlord—or no warlord at all. They followed the contest with close attention.

"You fought well at The Slash," Temuchin said. "As did all here. We greet you and you may now leave. What we do here today does not concern that battle nor you."

"Why?" Kerk asked with icy calmness, seating himself at the same time. "What are you trying to conceal from me?"

"You accuse me—" Temuchin was white with anger, his hand on his sword.

"I accuse no one." Kerk yawned broadly. "You seem to accuse yourself. You meet in secret, you refuse a chieftain entrance, you attempt insult rather than speaking the truth. I ask you again what you conceal?"

"It is a matter of small importance. Some lowlanders have arrived on our shores, to invade, to build cities. We will destroy them."

"Why? They are harmless traders," Kerk said.

"Why?" Temuchin was burning with anger now and could not stand still; he paced back and forth. "Have you never heard of 'The Song of the Freemen'?"

"As well as you have—or better. The song says to destroy the buildings of those who will trap us. Are there buildings to be destroyed?"

"No, but they will come next. Already the lowlanders have put up tents—"

One of the chieftains broke in, singing a line from "The Song of the Freemen."

" 'Knowing no home, other than our tents.' "

Temuchin controlled his rage and ignored the interruption. The words of the song were against him, but he knew where the truth lay.

"These traders are like the point of the sword that makes but a scratch. They are in tents and they trade today—but soon they will be ashore with bigger tents, then buildings in order to trade better. First the tip of the sword, then the entire blade to run us through and destroy us. They must be wiped out now."

What Temuchin said was absolutely true. It was very important that the other chieftains should not realize that. Kerk was silent for an instant and Jason stepped into the gap.

" 'The Song of Freemen' must be our guide in this matter. This is the song that tells us—"

"Why are you here, jongleur?" Temuchin said in a voice of stern command. "I see no other jongleurs or common soldiers. You may leave."

Jason opened his mouth, but could think of nothing to say. Te-

muchin was unarguably right. Jason, he thought, you should have kept your big mouth shut. He bowed to the warlord, and as he did he whispered to Kerk.

"I'll be close by and I'll listen in on the dentiphone. If I can help in any way, I will tell you."

Kerk did not turn around, but he murmured agreement and his voice was transmitted clearly to the tiny radio in Jason's mouth. After this there was nothing Jason could do except leave.

Bad luck. He had hoped to be in on the showdown. As he pushed through the flap one of the guards bent to lace it behind him. The other one dropped his lance.

Jason looked at it, surprised, even as the man reached out with both hands and grabbed him by the wrists. What was this? Jason twisted upwards with his forearms, against the other's thumbs, to break the simple hold, while at the same time aiming a knee at the man's groin as a note of disapproval. But before he could free himself or connect, the guard behind him slipped a leather strap over his head and jerked it tight about his throat.

Jason could neither fight nor cry out. He writhed and struggled ineffectively as he quickly slipped into black unconsciousness.

XVI

Someone was grinding snow into Jason's face, forcing it into his nostrils and mouth, effectively dragging him back to consciousness. He coughed and spluttered, pushing himself away from the offending hands. When he had wiped the snow from his eyes he looked around, blinking.

He was kneeling between two of Temuchin's men. Their swords were drawn and ready, and one of them held a guttering torch. It illuminated a small patch of drifted snow and the black lip of a chasm. Red-lit snowflakes rushed by him and vanished into this pit of darkness.

"Do you know this man?" a voice asked, and Jason recognized it as Temuchin's. Two men appeared out of the night and stood before him.

"I do, great Lord Temuchin," the second man said. "It is the otherworld man from the great flying thing, the one who was captured and escaped."

Jason looked closer at the muffled face and, as the torch flared up, he recognized the sharp nose and sadistic smile of Oraiel, the jongleur.

"I never saw this person before: he is a liar," Jason said, ignoring the hoarseness of his voice and the pain in his throat when he spoke.

"I remember him when he was captured, great lord, and later he attacked and beat me. You saw him yourself there."

"Yes, I did." Temuchin stepped forward and looked down at Jason's upturned face, his own cold and impassive. "Of course. He is the one. That is why he looked familiar."

"What are these lies—" Jason said, struggling to his feet.

Temuchin seized him by the forearms in an implacable grip, pushing him backwards until his heels were on the crumbling edge of the abyss.

"Tell the truth now, whoever you are. You stand at the edge of Hell's Doorway and in one moment you shall be hurled down it. You cannot escape. But I might let you go if you tell me the truth."

As he talked Temuchin bent Jason's body back, farther and farther over the blackness, until only the grip on his wrists prevented him from falling. Jason could not see the warlord's face; it was a black outline against the torches. Yet he knew there was no hope of mercy there. This was the end. The best he could do now was to protect the Pyrrans.

"Release me and I shall tell you the truth. I am from another world. I came here, alone, to help you. I found the jongleur, Jason, and he was dying, so I took his name. He had been gone from his people many years and they no longer remembered him. And I have helped you. Release me and I will help you more."

A weak voice, filled with static, buzzed in his head. *Jason, is that you? Kerk here. Where are you?* The dentiphone was still operating—he had a chance.

"Why are you here?" Temuchin asked. "Are you helping the lowlanders to bring their cities to our lands?"

"Release me. Do not drop me now into Hell's Doorway and I will tell you."

Temuchin hesitated a long moment before he spoke again.

"You are a liar, everything you say is a lie. I do not know what to believe." His head turned and for an instant the torchlight lit the humorless smile on his lips.

"I release you," he said, and opened his hands.

Jason clawed at empty air, tried to twist so he could clutch at the cliff's edge, but he could do nothing. He fell into the blackness.

A rush of air.

A blow on his shoulder, his back. Then he was scraping along the side of the cliff, struggling to keep his face and hands away from the abrasive dirt and stone. The cliffside tore at the leather of his garments as he plummeted down the outward-slanting surface.

Then it ended and he fell free in the blackness once again. Falling for an unmeasurable moment of time, seconds or minutes—forever—until a crushing impact enfolded him.

He did not die, and that surprised him very much. He wiped the substance from his face and realized that it was snow. A snowbank, a drift, here at the bottom of Hell's Doorway. A snowbank in hell and he had fallen into it.

"Where there's life there's still hope, Jason," he told himself unconvincingly. What hope was there

at the bottom of this inaccessible pit? Kerk and the Pyrrans would get him out, that was a morale-building hope. Yet, even as he thought this, his tongue contacted a jagged end of metal in his mouth. With restored fear he groped out the crushed remains of the dentiphone. Some time during the fall, unknowingly, he had ground it between his teeth and destroyed it.

"You're on your own again, Jason," he said aloud, and did not enjoy in the slightest the tiny sound of his voice in the immense blackness. What were his assets? He floundered about in the drift until he could reach back for his medikit. It was gone. Well, his wallet was still on his belt, though his knife was gone from his boot. His fingers searched through the assorted junk in the wallet until they touched an unfamiliar tube. What? The photon store flashlight, of course. Dropped in here and forgotten since the night they had picked up the climbing equipment.

But was it broken? The way his luck was running it probably was. He switched it on and groaned aloud when nothing happened. Then he turned the intensity ring and the brilliant beam slashed through the darkness. Light! Even though his situation was not materially changed, Jason felt a lift in his morale. He broadened the beam and flashed it around his prison. The air was still and the snowflakes fell silently through the light and vanished. Snow covered the flat valley floor below and piled in drifts against the walls. Black rock rose up on both sides, pushed out above his head where a ledge of rock projected. The sky was invisible, cut off by the jutting rock. He must have slid down that rocky angle and been shot off like a projectile into this snowbank. Pure chance had saved him.

There was a moaning cry and something black plunged down from above and through the beam of light, striking the valley bottom no more than ten meters from Jason.

The vertical rocks there were coated with only a thin layer of snow and the man had struck full across them. His eyes were open and staring: a trickle of blood ran from the gaping mouth. It was his betrayer, the jongleur Oraiel.

"What's this? Temuchin eliminating eye witnesses? That's not like him." The mouth still gaped open but Oraiel had finished forever with speaking.

Jason floundered out of his drift and started across the floor of the narrow valley. The ground was smooth in the center, smooth and very flat. He did not consider why until there was an ominous creaking beneath his feet. Even as he tried to throw himself backwards the ice broke, splintering and cracking in every direction, and he fell into the dark waters beneath.

The sudden shock of the frigid

water almost drove the air from his lungs, but he clamped his mouth shut, sinking his teeth hard into his lower lip. At the same time his fingers tightened convulsively on the flashlight. Without this he would not be able to find the opening in the ice again.

Almost at the same instant his feet touched the rocky bottom, the water was not deep, and he kicked upward. The light shone on a mirror above as he rose and his hand went out to press, palm to palm, against his imaged hand. It was ice, solid and unbroken above him. Only when he felt his fingers being dragged across its surface did he realize that he was being pulled swiftly along by a current. The hole in the ice must already be far behind him.

If Jason dinAlt had been prone to despair, this was the moment when he would have died. Trapped beneath the ice at the bottom of this inaccessible valley, this was indeed the time to give up. He never considered it. He held the burning lungful of air; he tried to swim to the side where he could get some footing, perhaps press up through the ice; he waved the light upwards looking for a break.

The current was too swift, it threw him numbingly against the rocks, then hurtled him back into the swift-flowing current. He pointed downstream and kicked to stay in the center, looking down at the smooth rocks that flew by an arm's length beneath his face.

Although the water was cold, it numbed his skin and carried him along with it. It was the fire in his lungs that could not be ignored. Logically he knew that he had enough oxygen in his body cells and his bloodstream to live for many minutes. The breathing reflex in his chest was not interested in logic. *Dying* it screamed. *Air, breathe,* until he could deny it no longer. Numbly he drifted upwards to the mirrored surface and broke through into blackness and sucked in a shuddering, life-giving breath.

It took a long time for the reality of what had occurred to penetrate his numbed senses. He dragged himself to a dark, stony shore and lay half in and half out of the water like some form of beached marine life. Moving seemed completely out of the question, but as the shuddering cold bit deep he realized it was either that or die here. And where was *here?* With pained slowness he pulled himself clear of the water and moved the light up the rocky wall, across the rock above and back down the rock to the water again. No snow? The meaning of this forced through his chilled and sluggish synapses.

"A cave—"

It was obvious enough by hindsight. The narrow valley, Hell's Doorway, must have been cut by water, slowly eroded out through the centuries by the small stream. It had no visible outlet because it plunged underground—and it had taken him

with it. That meant he wasn't finished yet. The water had to have an outlet, and, if it did, he would find it. For a moment he considered the fact that it might sink lower and lower into the rock strata and vanish, but he swiftly rejected this defeatist idea.

"Carry on!" he shouted aloud as he stumbled to his feet, and the echoes called back: "On—On——"

"Good idea, on, onwards. Just what I shall do."

He shivered and squelched forward through the fine sand at the edge of the water, and the next thing he saw were the footprints emerging from the stream and going on ahead of him.

Was someone else here? The footprints were sharp and clear, obviously recently made. There must be an entrance to these caverns that was well known. All he had to do was follow the footprints and he would be out. And as long as he kept walking he would not freeze in his sodden clothing. The cave air was cool, but not as cold as the plateau outside.

When the trail left the sand beside the stream and ventured into an adjoining cavern it became more difficult to follow, but not impossible. Small stalagmites growing from the limestone floor had been kicked down, and there were occasional marks gouged into the soft stone of the walls. The tunnels branched and one went back to the water where it ended abruptly at a rocky bank. The shore was gone and the water filled the cave here, coming close to the smooth ceiling. Jason retraced his steps and picked up the trail again at the next branch.

It was a long walk.

Jason rested once and fell asleep without realizing it. He awoke, shivering uncontrollably, and forced himself to go on. As far as he knew the watch concealed in his belt buckle was still operating, but he never looked at it. Somehow the measuring of time could not be considered in these endless, timeless caverns.

Walking down one of them, no different from all the others, he found the man he had been following. He was sleeping on the cave floor ahead, a barbarian, in furs very much like Jason's.

"Hello," he called in the inbetween tongue, then fell silent as he came closer. The sleep was for eternity and the man had been dead a very long time.

Years, centuries perhaps, in these dry, cold, and bacteria-free caverns, there was no way to tell. His flesh and skin were brown and mummified, leather lips shriveled back from yellow teeth. One outstretched hand lay, pointing ahead, a knife just beyond the splayed fingers. When Jason picked it up he saw that it was tarnished only by the thinnest patina of rust.

What Jason did next was not easy, but it was essential for survival. With

careful motions he removed the fur outer garments from the corpse. It crackled and rustled when he was forced to move the stiff limbs, but made no other protest. When he had the furs he moved further down the cavern, stripped himself bare and donned the dry clothes. There was no repugnance; this was survival.

He stretched his own clothes out to dry, bunched the fur under his head, turned the light to a dim yellow glow—he could not bear the thought of total darkness—and fell instantly into a troubled sleep.

XVII

"They say that if everything is the same for a long time, you can't tell how long the time is because everything is the same. So I wonder how long I have been down here." He trudged a few steps more and considered it. "A long, long time I guess."

The cavern branched ahead and he made a careful mark with the knife, at shoulder height, before taking the right-hand turning. This tunnel deadended at the water, a familiar occurrence, and he knelt and drank his stomach full before turning back. At the junction he scratched the slash that meant *water* and turned down the other branch.

"One thousand, eight hundred and three— One thousand, eight hundred and four—" He had to count every third step of his left foot now because the number was so large. It was also meaningless, but it gave him something to say and he found the sound of his voice to be less trying than the everlasting silence.

At least his stomach had stopped hurting. The rumblings and cramps had been very annoying in the beginning, but that had passed. There was always enough water to drink, and he should have thought of measuring the time by the number of notches he took in his belt.

"I've seen you before, you evil crossway you." He spat dryly in the direction of the three marks on the wall at the junction. Then he scratched a fourth below them with the knife. He would not be coming back here again. Now he knew the right sequence of turns to take in the maze ahead.

He hoped.

"Cuglio, he only has one sphere—Fletter, has two but very queer—Harmill—" He pondered as he marched. Just what was it that Harmill had? It escaped him now. He had been singing all the old marching songs that he remembered, but for some reason he was beginning to forget the words.

Some reason! Hah. He laughed dirtily at himself. The reason was obvious. He was getting very hungry and very tired. A human body can live a long time with water and without food. But how long can it go on walking?

"Time to rest?" he asked himself.

"Time to rest," he answered himself.

In a little while. This tunnel was slanted downwards and there was the smell of water ahead. He was getting very good with his nose lately. Many times there was sand next to the water on which he could sleep, and this was far better than the bare rock. There was very little flesh over his bones now and they pressed through and hurt.

Good. There was sand here, a luxurious wide band of it. The water was wider and must be deeper, almost a pool. It still tasted the same. He squirmed out a hollow in the unmarked sand, turned the flashlight out, put it into his pouch and went to sleep.

He used to leave it on when he slept, but this did not seem to make any difference any more.

As always, he slept briefly, woke up, then slept again. But there was something wrong. With his eyes open he lay staring up into the velvety darkness. Then he turned to look at the water.

Far out. Deep down. Faint, ever so faint, was a shimmer of blue light.

For a long time he lay there, thinking about it. He was tired and weak, starved, probably feverish. Which meant he was probably imagining it. The dying man's fantasy, the mirage for the thirsty. He closed his eyes and dozed, yet when he looked again the light was still there. What could it mean?

"I should do something about this," he said, and turned his flashlight on. In the greater light the glow in the water was gone. He stood the flashlight up in the sand and took out his knife. The tip was still sharp. He raked it along the inside of his arm, drawing a shallow slice that oozed thick drops of blood.

"That hurts!" he said. Then, "That's better."

The sudden pain had jarred him from his lethargy, released adrenalin into his bloodstream and forced him into unaccustomed alertness.

"If there's light down there, it must be an exit to the outside. It has to be. And if it is, it may be my only chance to get out of this trap. Now. While I still think I can make it."

After that he shut up and took breath after breath, filling his lungs again and again until his head began to swim with hyperventilation. Then, with a last breath, he turned the light to full intensity and put the end in his mouth so that he could direct it forwards by tilting his head. One, two, hands together and dive.

The water was a cold shock, but he had expected that. He dove deep and swam as hard as he could towards the spot where he had seen the light. The water was wonderfully transparent. Rock, just solid rock on the other side of the pool. Perhaps lower then. The water soaked into his clothes and helped pull him down. Almost to the bottom where a ledge cut across the pool and below it the current quickened and

moved outwards. Headfirst, pushing against the rock above, he went under, bumped along a short channel and was in the clear again.

Above him now was more light, far above, inaccessible. He kicked and stroked, but it seemed to come no closer. The flashlight fell from his mouth and spun down to oblivion. Higher, higher. Though he was going towards the light it seemed to be getting darker. In a panic he thrashed his arms, although they seemed to be pushing against mercury or some medium far thicker than water. One hand struck something hard and round. He seized it and pulled, and his head was thrust above the surface of the water.

For the first minute all he could do was hang from the tree root and suck in great, rasping breaths of air. When his head began to clear he saw that he was at the edge of a pond almost completely surrounded by trees and undergrowth. Behind him the pool ended at the base of a towering cliff that stretched upwards until it vanished in the haze and clouds above. This was the outlet of the underground stream from the plateau.

He was in the lowlands.

Pulling himself out of the water was an effort, and when he was out he just lay on the grass and steamed, until some small fraction of his strength had returned. The sight of some berries on the nearby bushes finally stirred him into motion. There were not many of them, which was probably for the best, since even these few caused racking stomach pains after he had wolfed them down. He lay on the grass then, his face stained with purple juice, and wondered what to do next. He slept, without wanting to, and when he awoke his head was clearer.

"Defense. Every man's hand turned against the other. The first local who sees me will probably try to brain me just to get these antique furs that I'm wearing. Defense."

His knife had vanished along with his flashlight, so a sharp fragment of split rock had to do. A straight sapling was raw material and he worried it off close to the ground with the chip of stone. Taking off the branches was easier, and within the hour he had a rough but usable quarterstaff. It served first as a walking stick as he hobbled eastwards on a forest path that appeared to go in the right direction.

Towards evening, when his head was starting to swim again, he met a stranger on the path. A tall, erect man in semimilitary uniform, armed with a bow and a very efficient looking halberd. The man snapped some questions at Jason in an unknown language, in answer to which Jason simply shrugged and made mumbling noises. He tried to appear innocent and weak, which was easy enough to do. With his drawn skin, tangled beard and filthy furs he certainly couldn't have looked very

ominous or appetizing. The stranger must have thought so too, since he did not use his bow and came forward with his halberd only indifferently at the defense.

Jason knew that he had only one good—or half-hearted—blow in him, and he had to make it count. This efficient looking young man would eat him alive if he missed.

"Umble, umble—" Jason muttered, and shrank back, both hands on the length of stick.

"Frmblebrmble!" the man said, shaking his halberd menacingly as he came close.

Jason pushed down with his right hand, pivoting the quarterstaff with his left so that the end whipped up. Then he lunged it forward into the other's midriff in the region of the solar plexus ganglion. The stranger let out a single mighty whoosh of air and folded, unmoving, to the ground.

"My fortunes change!" Jason chortled as he fell on the other's bulging purse. Food perhaps? Saliva dampened his mouth as he tore it open.

XVIII

Rhes was in his inner office, finishing up with his bookkeeping, when he heard the loud shouts in the courtyard. It sounded as though someone were trying to force their way in. He ignored it; the other two Pyrrans had gone, and he had a lot of work to finish up before he left. His guard, Riclan, was a good man and knew how to take care of himself. He would turn any unwanted visitors away. The shouting stopped suddenly, and a moment later there was a noise that sounded suspiciously like Riclan's armor and weapons falling onto the cobbles.

For two days Rhes had not slept, and there was still much to be done before he went away for good. His temper was, therefore, not of the best. It is very unhealthy to be around a Pyrran when he feels this way. When the door opened he stood and prepared to destroy the interloper. Preferably with his bare hands so that he could hear the bones crunch. A man with an ugly black beard, wearing the uniform of a free-lance soldier, entered, and Rhes flexed his fingers and stepped forward.

"What's the trouble? You look ready to kill me," the soldier said in fluent Pyrran.

"Jason!" Rhes was across the room and pounding his friend on the back with excitement.

"Easy," Jason said, escaping the embrace and dropping onto the couch. "A Pyrran greeting can maim, and I haven't been feeling that good lately—"

"We thought you were dead! What happened?"

"I'll be happy to explain, but would prefer to do it over food and drink. And I would like to hear a report myself. The last time I heard about Felicitation politics was just

before I was pushed off a cliff. How does the trade go?"

"It doesn't," Rhes said glumly, taking meat and bread from a locker and fishing a cobwebbed bottle of wine from its straw bed. "After you were killed—or we thought you were killed—everything came to pieces. Kerk heard you on his dentiphone and almost destroyed his *morope* getting there. But he was too late, you had gone over the edge of Hell's Doorway. There was some jongleur who had betrayed you, and he tried to accuse Kerk of being an off-worlder as well. Kerk kicked him off the cliff before he could say very much. Temuchin was apparently just as angry as Kerk and the whole thing almost blew up right there. But you were gone and that was that. Kerk felt the most he could do for you was to try and complete your plans."

"Did you?"

"I'm sorry to report that we failed. Temuchin convinced most of the tribal leaders that they should fight not trade. Kerk aided us, but it was a lost cause. I eventually had to retreat back here. I'm closing out this operation, leaving it in good enough shape for my assistants to carry on, and the Pyrran 'tribe' is on its way back to the ship. This plan is over, and if we can't come up with another one we have agreed to return to Pyrrus."

"You can't!" Jason said in the loudest mumble he could manage around the mouthful of food.

"We have no choice. Now tell me, please—how did you get here? We had men down in Hell's Doorway later the same night. They found no trace of you at all, though there were plenty of other corpses and skeletons. They thought you must have gone through the ice and that your body had been swept away."

"Indeed swept away, but not as a body. I hit a snowbank when I landed and I would have been waiting for you, cold but alive, if I had not fallen through the ice as you guessed. The stream leads to a series of caverns. I had a light and more patience than I realized. It was nasty, but I finally came out below the cliffs in this country. I knocked a number of citizens on the head and had an adventurous trip to reach you here."

"A lucky arrival. Tomorrow would have been too late. The ship's launch is to pick me up just after dark and I have a ten kilometer row to reach the rendezvous point."

"Well, you've got a second oar now. I'm ready to go anytime after I get this food and drink under my belt."

"I'll radio about your arrival so that word can be relayed to Kerk and the others."

They left quietly, in one of Rhes's own boats, and reached the rocky offshore islet before the sun touched the horizon. Rhes chopped a hole in the boat's planking and they put in some heavy rocks. It sank nicely,

and after that all they could do was wait, and admire the guano deposits, and listen to the cries of the disturbed seabirds, until the launch picked them up.

The flight was a brief one after the pilot, Clon, had nodded recognition at Jason—which was about all the enthusiastic Pyrran welcome he expected. When they arrived the *off* watch was asleep and the *on* watch at their duty stations, so Jason saw no one. He preferred it this way since he was still tired from his journey. The Pyrran tribesmen should arrive some time the following day and socializing could wait until then.

His cabin was just as he had left it, with the expensive library leering at him metallically from one corner. What had ever prompted him to buy it in the first place? A complete waste of money. He kicked at it as he passed, but his foot only skidded off the polished metal ovoid.

"Useless," he said, and stabbed the *on* button. "What good are you, after all?"

"Is that a question?" the library intoned. "If so restate and indicate the precise meaning of *good* in this context."

"Big mouth. All talk now—but where were you when I needed you?"

"I am where I am placed. I answer whatever questions are asked of me. Your question is, therefore, meaningless."

"Don't insult your superiors, machine. That is a definite order."

"Yes, sir."

"That's better. I maketh and I can breaketh just as well."

Jason dialed a strong drink from the wall dispenser and flopped into the armchair. The library flickered its little lights and hummed electronically to itself. He drank deep, then addressed the machine.

"I'll bet you don't think much of my plan to lick the natives and open the mine?"

"I do not know your plan, therefore I cannot give a judged opinion."

"Well, I'm not asking you. I bet you think that you could think of a better plan yourself?"

"In which area?"

"In the area of changing a culture, that's where. But I'm not asking."

"Culture changing references will be found under history and anthropology. If you are not asking I withdraw the reference."

Jason sipped and brooded, and finally spoke.

"Well I am asking. Tell me about cultures."

Jason pressed the *off* button and settled back in his chair. The lights went out on the library and the hum faded into silence.

So it could be done after all. The answer had been right there in the history books all the time, if he had only had the brains to look. There were no excuses for the stupidity of

his actions. He should have consulted the library and he had not. Yet—it still might be possible to make amends.

He paced the room, hitting his fist into the palm of his hand. The pieces might still be put back together if he played it right. He doubted if he could convince the Pyrrans that the new plan would succeed, or even that it was a good idea. They would probably be completely against it. Then he would have to work without them. He looked at his watch. The launch was not due to leave for the first pickup of Kerk and the others for at least another hour. Time enough to get ready. Write a friendly note to Meta and be deliberately vague about his plans. Then have Clon drop him off near Temuchin's camp. The unimaginative pilot would do as he was told without asking questions.

Yes, it could be done, and by the stars he was going to do it.

XIX

Lord was he, of all the mountains
Ruled the plains and all the valleys.
Nothing passed, without his knowledge,
Many died with his displeasure.

Temuchin sprang suddenly into the camach, his drawn sword ready in his hand.

"Reveal yourself," he cried. "My guard lies outside, struck down. Reveal yourself, spy, so that I may kill you."

A hooded figure stepped from the darkness into the flickering light of the oil lamp and Temuchin raised his sword. Jason threw back the fur so his face could be seen.

"You!" Temuchin said in a hollow voice, and the sword slipped from his fingers to the ground. "You cannot be here. I killed you with these hands. Are you ghost or demon?"

"I have returned to help you, Temuchin. To open an entire new world to your conquest."

"A demon, that you must be, and instead of dying you returned home through Hell's Doorway and gained new strength. A demon of a thousand guises, that explains how you could trick and betray so many people. The jongleur thought you were an off-worlder. The Pyrrans thought you were one of their tribe. I thought you a loyal comrade who would help me—"

"That's a fine theory. You believe what you want, then listen to what I have to tell you."

"NO! If I listen I am damned." He grabbed up the sword. Jason talked fast.

"There are caves opening from the valley you call Hell's Doorway. They don't go to hell—but they lead down to the lowlands. I went there, and returned by boat to tell you this. I can show you the way.

You can lead an army through those caves and invade the lowlands. You rule here now—and you can rule there as well—a new continent to conquer. And you are the only man who could possibly do it."

Temuchin lowered the sword slowly and his eyes blazed in the firelight. When he spoke his voice was hushed, as though he were speaking only to himself.

"You must be a demon, and I cannot kill that which is already dead. I could drive you from me, but I cannot drive your words from my head. You know, as no living man knows, that I am empty. I rule these plains and that is the end of it. What pleasure in ruling? No wars, no conquests, no joy of seeing one's enemy fall and marching on. Alone, by day and night I have dreamt about those rich meadows and towns below the cliffs. How even gunpowder and great armies could not stand against my warriors. How we would surprise them, flank them, besiege their cities. Conquer."

"Yes, you could have all that, Temuchin. Lord of all this world."

In the silence, the lamp sputtered, tossing their shadows to and fro. When Temuchin spoke again there was resolve in his voice.

"I will have that, even though I know the price. You want me, demon, to take me to your hell below the mountains. But you shall not have me until I have conquered all."

"I'm no demon, Temuchin—"

"Do not mock me. I know the truth. What the jongleurs sing is true, though I never believed it before. You have tempted me, I have accepted, I am damned. Tell me the hour and manner of my death."

"I can't tell you that."

"Of course not. You are bound as I am bound."

"I didn't mean it that way."

"I know how it was meant. By accepting all I lose all. There is no other way. But I will have it like that. I will win first. That is true, demon, you will allow that?"

"Of course you will win, and—"

"Tell me no more. I have changed my mind. I do not wish to know the manner of my end." He shook his shoulders as though to remove some unseen weight, then thrust his sword back into the slings at his waist.

"All right, believe what you will. Just give me some good men and I'll open up the passage to the lowlands. A rope ladder will get us into the valley. I'll mark the route and take them through the caves to prove that it can be done. Then the next time we do it the army will follow. Will they go—down there?"

Temuchin laughed. "They have sworn to follow me to hell if I order it and now, so they will. They will follow."

"Good. Shall we shake on that?"

"Of course! I will take the world and win eternity in hell, so I have no fear of your cold dead flesh now, my demon."

He crushed Jason's hand in his and, despite himself, Jason could not help but admire the giant courage of the man.

XX

"Let me talk to him, please," Meta asked.

Kerk waved her away and clutched the microphone, almost swallowing it in his giant hand.

"Listen to me now, Jason," he said coldly, "we are not with you in this adventure. You will not explain your purpose and you will gain nothing except destruction. If Temuchin controls the lowlands too, we will never replace him and open the mines. Rhes has returned to Ammh and is organizing resistance to your invasion. Some here have voted to join him. I am going to ask you for the last time: Stop what you are doing before it is too late."

When Jason's voice sounded from the radio it had a curious flat quality, whether the fault of the transmission or that of the speaker it was hard to say.

"Kerk, I hear what you say and, believe me, I understand it. But it is too late now to turn back. Most of the army has gone through the caves and we've captured a number of *moropes* from the villages. Nothing I say could stop Temuchin now. This thing will have to be seen through to its conclusion. The lowlanders may win, though I doubt it. Temuchin is going to rule, above and below the cliffs, and in the end this will all be for the best."

"No!" Meta shouted, pulling at the microphone. "Jason, listen to me, you cannot do this. You came to us and helped us, and we believed in you. You showed us that life is not only kill and be killed. We know now that the war on Pyrrus was wrong because you showed us, and we only came to this planet because you asked us to. Now it seems, I think, it is as though you were betraying us. You have tried to teach us how not to kill and, believe me, we have tried to learn. Yet what you are doing now is worse than anything we ever did on Pyrrus. There, at least, we were fighting for our lives. You don't have that excuse. You have shown that monster, Temuchin, a way to make new wars and to kill more people. How can you justify that?"

Static rustled hoarsely in the speaker while they waited the long moments for Jason to speak. When he did he sounded suddenly very tired.

"Meta . . . I'm sorry. I wish I could tell you, but it is too late. They're looking for me and I have to hide this radio before they get here. What I'm doing is right. Try to believe that. Someone a long time ago said that you can not make an omelet without breaking eggs. Meaning you cannot bring about social change without hurting someone. People are being hurt and are

dying because of me and don't think I'm not aware of it. But . . . listen, I can't talk any more, they're right outside." His voice dropped to a whisper. "Meta, if I never see you again, just remember one thing. It's an old fashioned word, but it is in a lot of languages. The library can translate it for you and give you the meaning.

"This is better by radio. I doubt if I could say it right to your face. You're stronger than I am, Meta, and your reflexes are a lot better, but you are still a woman. And, hell, I want to say that I . . . love you. Good luck. Signing off."

The speaker clicked and the room was silent.

"What was that word he used?" Kerk asked.

"I think I know," she answered, and she turned her face away so he could not see it.

"Hello Control," a voice shouted. "Radio room here. A subspace message coming in from Pyrrus with an emergency classification."

"Put it through," Kerk ordered.

There was the rustle of interstellar static, then the familiar drumbeat warble of the jump-space carrier wave. Superimposed on top of it was the quick, worried voice of a Pyrran.

"Attention, all stations within zeta radius. Emergency message for planet Felicity, ship's receiver *Pugnacious*, code Ama Rona Pi, 290-633-087. Message follows. Kerk, anyone there. Trouble hit. All the quadrants. We've shortened the perimeter, abandoned most of the city. Don't know if we can hold. Brucco says this is something new and that conventional weapons won't stop it. We can use the fire power of your ship. If you can return, come at once. Message ends."

The radio room had put the subspace message through to all compartments of the ship and, in the horrified silence that followed its ending, running footsteps sounded from both connecting passageways. As the first men burst in, Kerk came to life and shouted his commands.

"All men to stations. We blast as soon as we're secured. Call in the outside guards. Release all the prisoners. We're leaving."

There was absolutely no doubt about that. It was inconceivable that any Pyrran could have acted otherwise. Their home, their city, was on the verge of destruction, perhaps already gone. They ran to their posts.

"Rhes," Meta said. "He's with the army. How can we reach him?"

Kerk thought for a moment, then shook his head. "We cannot, that is the only answer. We'll leave the launch for him, on the same island where we make the contacts. Record a broadcast telling him what has happened and set it on automatic to broadcast every hour. When he gets back to a radio he will pick it. The launch will be locked so no one else can get in.

There is medicine in it, even a jump-space communicator. He will be all right."

"He won't like it—"

"It's the best we can do. Now we have to ready for blast off."

They worked as a team, driven by a common urge. Back. Return to Pyrrus. Their city was in danger. The ship lifted at 17G's, and Meta would have used more power if the structure of the ship could have withstood it. Their course through jump-space was the quickest, and the most dangerous, that could be computed. There were no complaints about the time the journey took: they accepted this period with stoic resignation. But weapons were readied and there was little or no conversation. Each Pyrran held, locked within him, the knowledge that their world and their life faced extinction, and these things cannot be discussed.

Hours before the *Pugnacious* was scheduled to break out of jump-space, every man and woman aboard was armed and waiting. Even nine-year-old Grif was there, a Pyrran like all the others.

From the eye-hurting otherness of jump-space, to the black of interstellar space, to the high atmosphere of Pyrrus the ship sped. Downward in a screaming ballistic orbit, where the hull heated to just below its melting point and the coolers labored against the overtaxing load. Their bodies reacted, sweat dripped from their faces and soaked their clothes, but the Pyrrans were unaware of the heat. The picture from the bow pick-up was put on every screen in the ship. Jungle flashed by, then a high column of smoke climbed up on the distant horizon. Diving swiftly, like a striking bird of prey, the ship swooped down.

The jungle now occupied the city. A circular mound, covered with plants and tough growth, was the only trace of the once impregnable perimeter wall. As they came low they could see thornlike creepers bursting through the windows of the buildings. Animals moved slowly through the streets that had once been crowded with people, while a clawhawk perched on the tower of the central warehouse, the masonry crumbling under its weight.

As they flew on they could see that the smoke was coming from the crushed ruin of their spaceship. It appeared to have been caught on the ground at the spaceport, and was held down by a now blackened net of giant vines.

There were no signs of activity anywhere in the ruined city. Just the beasts and plants of deathworld, now strangely quiet and sluggish with their enemy gone, the motivations of hatred that had enraged them for so long now vanished. They stirred and reared when the ship passed over, quickened to life again as the raw emo-

tions of the surviving Pyrrans impressed upon them.

"They can't all be dead," Teca said in a choked voice. "Keep looking."

"I am quartering the entire area," Meta told him.

Kerk found the destruction almost impossible to look at, and when he spoke his voice was low as though he were talking only to himself.

"We knew that it had to end like this—sometime. We faced that and tried to make a new start on a new planet. But, knowing something will happen and seeing it before your eyes, those are two different things. We ate there, in that . . . ruin, slept in that one. Our friends and comrades were here, our entire life. And now it is gone."

"Go down!" Clon said, thinking nothing, feeling hatred. "Attack. We can still fight."

"There is nothing left to fight for," Teca told him, speaking with an immense weariness. "As Kerk said, it is gone."

A hull pickup detected the sound of gunfire, and they rocketed towards it with momentary hope. But it was just an automatic gun, still actuating itself in a repeating pattern. Soon it would be out of ammunition and would be still like the rest of the ruined city.

The radio light had been blinking for some time before someone noticed it. The call was on the wavelength of Rhes's headquarters, not the one the city had used. Kerk reached over slowly and switched the set to receive.

"Naxa here, can you hear me? Come in *Pugnacious*."

"Kerk here. We are over the city. We are . . . too late. Can you give me a report."

"Too late by days," Naxa snorted. "They wouldn't listen to us. We said we could get them out, give them a place to go to, but they wouldn't listen. Just like they wanted to die in the city. Once the perimeter went down the survivors holed up in one of the buildings and it sounded like everything on this planet hit them at once. We couldn't take it, standing by I mean. Everyone volunteered. We took the best men and all the armored ground cars from the mine. Went in there. Got out the kids, they made the kids go, some of the women. The wounded, just the ones who were unconscious. The rest stayed. We just got out before the end. Don't ask me what it was like. Then it was all over, the fighting, and after a bit everything quieted down like you see it now. Whole planet quieted down. When we could, me and some of the other talkers went to see. Had to climb a mountain of bodies of every creature born. Found the right spot. The ones that stayed behind, they're all dead. Died fighting. Only thing we could bring back then was a bunch of records that Brucco left."

"They would not have had it any other way," Kerk said. "Let us know where the survivors are and we will go there at once."

Naxa gave the coordinates and said, "What're you going to do?"

"We'll contact you again. Over and out."

"What *are* we going to do now?" Teca asked. "There's nothing left for us here."

"There's nothing for us on Felicity either. As long as Temuchin rules we cannot open the mines," Kerk answered.

"Go back. Kill Temuchin," Teca said, his power holster humming. He wanted revenge, to kill something.

"We can't do that," Kerk said. Patiently, because he knew the torture the man was feeling. "We will discuss this later. We must first see to the survivors."

"We have lost everywhere," Meta said, voicing the words that everyone was thinking.

Silence followed.

XXI

The four guards ran into the room half carrying Jason, then hurled him to the floor. He rolled over and got to his knees.

"Get out," Temuchin ordered his men, and kicked Jason hard on the side of his head, knocking him down again. When Jason sat up there was a livid bruise covering the side of his face.

"I suppose that there is a reason for this," he said quietly.

Temuchin opened and closed his great hands in silent fury, but said nothing. He stamped the length of the ornate room, his trailing prick-spurs scratching deep gouges in the inlaid marble of the floor. At the far end he stood for a moment, looking out of the high windows and across the city below. Then he reached up suddenly and pulled at the tapestry drapes, tearing them down in a sudden spasm of effort. The iron bar that supported them fell as well, but he caught it before it touched the floor and hurled it through the many-paned window. There was the crashing fall of breaking glass far below.

"I have lost " he shouted, almost an animal howl of pain.

"You've won," Jason told him. "Why are you doing this?"

"Let us not pretend any more," Temuchin answered, turning to face him, a frozen calm replacing the anger. "You knew what would happen."

"I knew that you would win—and you have. The armies fell before you and the people fled. Your horde has overrun the land and your captains rule in every city. While you rule here in Eolasair, lord of the entire world."

"Do not play with me, demon. I knew this would happen. I just did not think that it would happen so quickly. You could have allowed me more time—"

"Why?" Jason asked, climbing to his feet. Now that Temuchin had realized the truth there was no longer any point in concealment. "You said that by accepting you would lose."

"I did. Of course." Temuchin straightened his back and looked, unseeingly, from the window. "I just had not realized how much I would lose. I was a fool. I thought that only my own life was at stake. I did not realize that my people, our life, would die as well." He turned on Jason. "Give it back to them. Take me, but let them return."

"I cannot."

"You will not!" Temuchin shouted, rushing on Jason, grabbing him up by the neck and shaking him like an empty goatskin. "Change it—I command you." He loosened his grip slightly so that Jason could gasp in air and speak.

"I cannot—and I would not even if I could. In winning you lost, and that is just the way I want it. The life you knew has ended and I would not have it any other way."

"You knew this all along," Temuchin said, almost gently, releasing his grasp. "This was my fate and you knew it. You let it happen. Why?"

"For a number of reasons."

"Tell me one."

"Mankind can do very well without your way of life. We have had enough killing and bloody murder in our history. Live your life out, Temuchin, and die peacefully. You are the last of your kind and the galaxy will be a better place for your ending."

"Is that the only reason?"

"There are others. I want the off-worlders to dig their mines on your plains. They can do that now."

"In winning I lost. There must be a word for this kind of happening."

"There is. It was a Pyrrhic victory. I wish I could say that I am sorry for you, but I'm not. You're a tiger in a pit, Temuchin. I can admire your muscles and your temper and I know that you used to be lord of the jungle. But now I'm glad that you are trapped." Without looking towards the door Jason took a short step in its direction.

"There is no escape, demon," Temuchin said.

"Why? I cannot harm you—or help you any more."

"Nor can I kill you. A demon, being dead already, cannot be killed. But the human flesh you wear can be tortured. That I shall do. Your torture will last as long as I live. This is a small return for all that I have lost—but it is all that I have to offer. We have much to look forward to, demon—"

Jason did not hear the rest as he bolted through the door, head down and running as fast as he could. The two guards at the far end of the hall heard his pounding feet and turned, lowering their spears. He did not slow or attempt to avoid them, but fell instead and slid, feet

first, under their spears and cannoning into them. They fell in a tangle and, for one instant, Jason was held by the arm. But he chopped with the edge of his hand, breaking the restraining wrist, and was free. Scrambling to his feet he hurled himself down the stairwell, jumping eight, ten steps at a time, risking a fall with every leap. Then he hit the ground floor and ran through the unguarded front entrance into the courtyard.

"Seize him!" Temuchin shouted from above. "I want him brought to me."

Jason pelted towards the nearest entrance, veering off as it filled suddenly with guards. There were armed men everywhere, at every exit. He ran towards the wall. It was high and topped with gilded spear heads, but he had to get over it. Footsteps sounded loudly behind him as he sprang upwards, his fingers closing over the edge of the wall. Good! He heaved himself up, to throw his legs over, climb between the spear heads and drop to the other side to vanish into the city—

The hands locked about his ankle, the weight holding him back. He kicked and felt his boot crush a face, but he could not free himself. Then other hands caught his flailing leg and still more, pulling him back, down, into the courtyard.

"Bring him to me," Temuchin's voice sounded over the crowd of men. "He is mine."

XXII

Rhes was waiting, a tiny figure beside the launch as the *Pugnacious* dropped down from the sky. It was a full-jet, 20G landing. Meta was not wasting any time. Rhes picked his way through the fused and smoking sand as the port opened to receive him.

"Tell us everything, quickly," Meta said.

"There's little enough to tell. Temuchin won his war, as we knew he would, taking every city with one blow after another. The people here, even the armies, could not stand against him. I fled after the last battle, with all the others, since I did not wish to see my thumbs hanging from some barbarian banner. That was when I got your message. You must tell me what happened on Pyrrus."

"The end," Kerk said. "The city, everyone there, is gone."

Rhes knew that there were no words that he could say. He was silent a moment, then Meta caught his eye and he continued.

"Jason has . . . or had . . . a radio, and soon after I reached the launch I picked up a message from him. I could not answer him and his message was never completed. I did not have the recorder on, but I can remember it clearly enough. He said that the mines could be opened soon, that we had won. The Pyrrans have won, that is exactly what he said. He started to add

something else, but the broadcast was suddenly broken off. That must have been when they came for him. I have heard more about it since that time."

"What do you mean?" Meta asked quickly.

"Temuchin has made his capital in Eolasair, the largest city in Ammh. He has Jason there in . . . in a cage, hung in front of the palace. He was first tortured, now he is being starved to death."

"Why? For what reason?"

"It is a nomad belief, that a demon in human form cannot be killed. He is immune to normal weapons. But, if he is starved long enough, the human disguise will wither and the demon's original form will be revealed. I don't know if Temuchin believes this nonsense or not, but this is just what he is doing. Jason has been hanging in that cage for over fifteen days now."

"We must go to him," Meta said, leaping to her feet. "We must free him."

"We will do that," Kerk told her. "But we must do it the right way. Rhes, can you get us clothes and *moropes?*"

"Of course. How many will you need?"

"We cannot force our way in, not against the ruler of an entire planet. Just two of us will go. You will come to show the way. I will go to see what can be done."

"And I will come, too," Meta said, and Kerk nodded agreement.

"The three of us then. At once. We don't know how long he can live under these conditions."

"They give him a cup of water every day," Rhes said, avoiding Meta's eyes. "Take the ship up, I'll show you which way to go. It does not matter any more if the people in the city here know we are from off-planet."

This was before noon. By drugging the *moropes* and loading them into the cargo bay a good deal of riding time was saved. The city of Eolasair was built on a river among rolling hills, with a forest nearby. They landed the ship as close as they could without being seen, and had the *moropes* on the way as soon as they could be revived. By late afternoon they entered the city, and Rhes threw a boy a small coin to show them the way to the palace. He wore his merchant's clothes, while Kerk had put on his full armor and weapons. Meta, veiled as was the local custom, clutched her hands tightly on the saddle as they forced their way through the crowded streets.

Only before the palace was there empty space. The courtyard was floored with gold-veined marble, polished and shining. A squad of troops guarded it, their bearded, nomad faces incongruous above the looted armor. But their weapons were in order and they were as deadly as they had been on the high plains. Worse perhaps, their tem-

pers were not improved by the warm climate.

A chain had been passed between the tops of two of the tall columns that flanked the courtyard and from it, hanging a good two meters above the ground, was suspended a cage of thick bars. It had no door and had been built around the prisoner.

"Jason!" Meta said, looking up at the slumped figure. He did not move and there was no way of telling if he was alive or dead.

"I will take care of this," Kerk said, and jumped from his *morope*.

"Wait!" Rhes called after him. "What are you going to do? Getting yourself killed won't help Jason."

Kerk was not listening. He had lost too much and felt too much pain recently to be in a reasoning mood. Now, all of his hatred was turned against one man.

"Temuchin!" he roared. "Come out of your gilt hiding place. Come out you coward and face me, Kerk of Pyrrus. Show yourself—*coward.*"

Ahankk, who was the guard officer, came running with his sword drawn, but Kerk backhanded him offhandedly, his attention still fixed on the palace. Ahankk dropped and rolled over and over and remained there, unconscious or dead. Surely dead, with his head at an angle like that.

"Temuchin, coward, come out!" Kerk shouted again. When the stunned soldiers touched their weapons he turned on them, snarling.

"Dogs—would you attack me? A high chief, Kerk of Pyrrus, victor of The Slash?" They fell back before his burning anger, and he turned to the palace as the front entrance was thrown wide. Temuchin strode out.

"You dare too much," he said, his cold anger matching Kerk's.

"You dare," Kerk told him. "You break tribal law. You take a man of my tribe and torture him for no reason. You are a coward, Temuchin, and I name you that before your men."

Temuchin's sword flashed in the sunlight as he drew it, a fine tempered length of razor-sharp steel.

"You have said enough, Pyrran. I could have you killed on the spot, but I want that pleasure for myself. I wanted to kill you the moment I first saw you—and I should have. Because of you and this creature which calls itself Jason I have lost everything."

"You have lost nothing—yet," Kerk answered and his sword pointed straight at the warlord's throat. "But now you lose your life, for I shall kill you."

Temuchin brought his sword down in a blow that would have cut a man in two—but it rang off Kerk's blade. They battled then, furiously, with no science and no art. A barbarian sword fight, just slash and parry, with eventual victory going to the strongest.

The clang of their steel rang in the silence of the courtyard, the on-

ly other sound the rasping of their breath as they fought. Neither would give way, and they were well matched. Kerk was the older man, but he was the stronger. Temuchin had a lifetime of sword fighting and battles behind him and was absolutely without fear.

It went on like that, a rapid exchange that was broken suddenly by a sharp twang as Temuchin's sword snapped in two. He threw himself backwards, out of the way of Kerk's slash, so that, instead of gutting him, it cut a red gash in his thigh, a minor wound. He sprawled at full length, slow blood seeping into the golden silk he wore, as Kerk raised his sword in both hands for the last, unavoidable blow.

"Archers!" Temuchin shouted. He would not submit to death this easily.

Kerk laughed and hurled his sword away. "You do not escape that easily, ruling coward. I prefer to kill you with my bare hands."

Temuchin shouted wordless hatred and sprang to his feet. They leaped at each other with the passion of animals and closed in struggling combat.

There were no blows exchanged. Instead Kerk closed his great hands around the other's neck and tightened. Temuchin clutched his opponent in the same way, but the muscles in Kerk's neck were steel ropes: he could not affect them. Kerk tightened his grip.

For the first time Temuchin showed some emotion other than unthinking anger. His eyes widened and he writhed in the clutch of the closing fingers. He pulled at Kerk's wrists, but to no avail. The Pyrran's grip tightened like that of a machine, and just as implacable.

Temuchin twisted about, got his hand in the back of his belt and pulled out a dagger.

"Kerk! He has a knife!" Rhes shouted, as Temuchin whipped it around and plunged it full into Kerk's side under the lower edge of his breastplate.

His hand came away and the hilt of the dagger remained there.

Kerk bellowed in anger—but he did not release his grip. Instead he moved his thumbs up under Temuchin's chin and pushed back. For a long moment the warlord writhed, his boot tips almost free of the ground and his eyes starting from their sockets.

Then there was a sharp snap and his body went limp.

Kerk released his grip and the great Temuchin, First Lord of the high plateau and of the lowlands, fell in a dead huddle at his feet.

Meta rushed up to him, to the spreading red stain on his side.

"Leave it," Kerk ordered. "It plugs the hole. Mostly in the muscle, and, if it has punctured some guts, we can sew it up later. Get Jason down."

The guards made no motion to interfere when Rhes pulled away

one of their halberds and, hooking it in the bottom of the cage, pulled it crashing to the ground. Jason rolled limply with the impact. His eyes were set in black hollows and his skin was drawn tautly over the bone of his face. Through his rags of clothing red burns and scars could be seen on his skin.

"Is he—" Meta said, but could not go on. Rhes clutched two of the bars, tensed his muscles, and slowly bent apart the thick metal to make an opening.

Jason opened one bloodshot eye and looked up at them.

"Took your time about getting here," he said, and let it drop shut again.

XXIII

"No more right now," Jason said, waving away the glass and straw that Meta held out to him. He sat up on his bunk aboard the *Pugnacious,* washed, medicated, his wounds dressed, and with a glucose drip plugged into his arm. Kerk sat across from him, a bulge on one side where he had been bandaged. Teca had taken out a bit of punctured intestine and tied up a few blood vessels. Kerk preferred to ignore it completely.

"Tell us," he said. "I've plugged this microphone into the annunciator system, and everyone is waiting to hear. To be frank, we still don't know what happened. Other than the fact that both you and Temuchin think that he lost by winning. It is very strange."

Meta leaned over and touched Jason's forehead with a folded cloth. He smiled and put his fingers against her wrist before he spoke.

"It was history. I went to the library to find out the answer, later than I should have—but not too late after all. The library read a lot of books to me and very quickly convinced me that a culture cannot be changed from the outside. It can be suppressed or destroyed—but it cannot be changed. And that's just what we were trying to do. Have you ever heard of the Goths and the Hunnish tribes of Old Earth?"

They shook their heads *no* and this time he accepted the drink to dampen his throat.

"These were a bunch of backwoods barbarians who lived in the forest, enjoyed drinking, killing and their own brand of independence, and fought the Roman legions every time they came along. The tribes were always beaten—and do you think they learned a lesson from it? Of course not. They just gathered up the survivors and went deeper in the woods to fight another day, their culture and their hatred intact. Their culture was changed only when they *won.* Eventually they moved in on the Romans, captured Rome and learned all the joys of civilized life. They weren't barbarians any more. The ancient Chinese used to work the same trick, for centuries. They weren't very

good fighters, but they were great absorbers. They were overrun and licked time and time again—and sucked the victors down into their own culture and life.

"I learned this lesson and just arranged things so that it would happen here as well. Temuchin was an ambitious man and could not resist the temptation of new worlds to conquer. So he invaded the lowlands when I showed him the way."

"By winning he lost," Kerk said.

"Exactly. The world is his now. He has captured the cities and he wants their wealth. So he has to occupy them to obtain it. His best officers become administrators of the new realm and wallow in unaccustomed luxury. They like it here. They might even stay. They are still nomads at heart—but what about the next generation? If Temuchin and his chiefs are living in cities and enjoying the sybaritic pleasures thereof—how can he expect to enforce the no-cities law back on the plateau? It begins to look sort of foolish after a while. Any decent barbarian isn't going to stay up there in the cold when he can come down here and share the loot. Wine is stronger than *achadh* and they even have some distilleries here. The nomad way of life is doomed. Temuchin realized that, though he could not put it into words. He just knew that by winning he had left behind and destroyed the way of life that had enabled him to win in the first place. That's why he called me a demon and strung me up."

"Poor Temuchin," Meta said, with sudden insight. "His ambition doomed him and he finally realized it. Though he was the conqueror he was the one who lost the most."

"His way of life and his life itself," Jason said. "He was a great man."

Kerk grunted. "Don't tell me that you're sorry I killed him?"

"Not at all. He attained everything he ever wanted, then he died. Not many men can say that."

"Turn off the communicator," Meta said. "And you may go, Kerk."

The big Pyrran opened his mouth to protest, then smiled instead, turned and went out.

"What are you going to do now?" Meta asked, as soon as the door was closed.

"Sleep for a month, eat steaks, and grow strong."

"I do not mean that. I mean where will you go? Will you stay here with us?"

She was working hard to express her emotions using a vocabulary that was not equipped for this form of communication.

"Does that matter to you?"

"It matters, in a way that is very new." Her forehead creased and she almost stammered with the effort to put her feelings into words. "When I am with you, I want to tell you different things. Do you know what is the nicest thing that

we can say in Pyrran?" He shook his head. "We say 'you fight very well.' That is not what I want to say to you."

Jason spoke nine languages and he knew exactly what it was he wanted to say, but he would not. Or could not. He turned away instead.

"No, look at me," Meta said, taking his head in both hands and gently turning his face towards hers.

"I have looked up the word *love,* just as you told me to do. At first it was not clear because it was only words. But, when I thought about you, the meaning became clear at once."

Their faces were close, her wide clear eyes looking unflinchingly into his.

"I love you," she said. "I think that I will always love you. You must never leave me."

The direct simplicity of her emotions rose like a flooded river against the shored up dikes and levees of his conditioned defenses, the mechanisms that he had built up through the years. He was a loner. The universe helps those who help themselves. I can take care of myself and . . . I . . . don't . . . need . . . anyone—

"Dear stars above, how I do love you, too," he said, pulling her to him, his face pressing into her neck and hair.

"You will never leave me again," she said. A statement, not a question.

"And you will never leave me again. There, the shortest and best marriage ceremony on record. May you break my arm if I ever look at another girl."

"Please. Do not talk about violence now."

"I apologize. That was the old unreconstructed me talking. I think that we must both bring gentleness into our lives. That is what you, I, and our pack of growling Pyrrans need the most. That's what we all need. Not humility, no one needs that. Just a little civilizing. I think that we can survive with it now. The mines should be opening here soon, and the way the tribes are moving to the lowlands it looks like you Pyrrans will have the plateau to yourselves."

"Yes, that will be good. It can be our new world." She hesitated a moment as she weighed his words. "We Pyrrans will stay here—but what about you? I would not like to leave my people again, but I will go if you go."

"You won't have to. I'm staying right here. I'm a member of the tribe—remember? Pyrrans are rude, opinionated and irascible, we know that. But I am, too. So perhaps I've found a home at last."

"With me, always with me."

"Of course."

They kissed, laughed, embraced, while the wall speaker blared unheard above them.

"Three volunteers with shovels wanted at once for *morope* stable duty. Their names are—" ■

local effect

Some other culture's minor accident could have some remarkably upsetting local effects on theoretical development!

D. L. HUGHES

Illustrated by Leo Summers

When studying Galactic science, one finds many systems of thought so odd that it is difficult to understand how sentient beings could have come to create them. None so odd, however, as that which arose on the third planet of the star Sol, where an isolated human culture based an entire system of cosmological science upon the side effects of a derelict space drive. Consider, then, this oddity, as seen through the eyes of Firefoal of Swaylone . . .

The central planet of the empire of Swaylone was a world of parks and open spaces, studded with green forests. Large trees towered upwards, to spread their foliage in the bright sunlight. Through one of these forests strolled Firefoal, idly kicking the giant fungi which grew upon the great tree boles, gleaming with dull luminescence in the dimness. The mission was completed, he told himself, and he was no longer beating through space, no longer isolated from the cool winds which stirred on planetary surfaces. Around him were the sounds of the forest, as unseen creatures stirred and whispered.

Emerging from the forest, he looked over the grassy plain, towards the rising sun as it came up over the hills in the distance. Dawn was breaking into morning, with the wind rippling in the grass and bringing to him the scent of pollen and flowers. Nothing moved in that plain except the rippling grass, and Firefoal felt the strain easing out of him, being absorbed by the stillness. For a time he could forget the darkness of space, could dwell instead upon the warmth of the sun and the humming of insects.

He lay down and let time vanish as the sun rose over him. Memories of the starkbeasts faded and became dim shadows. Odd and twisted scientific systems, which he had grappled with in mind-twisting effort for the Epistemological Corps, also faded and became nothing.

The only reality was the sun and the warmth and the humming insects as they swarmed over the little flowers which grew on the grass.

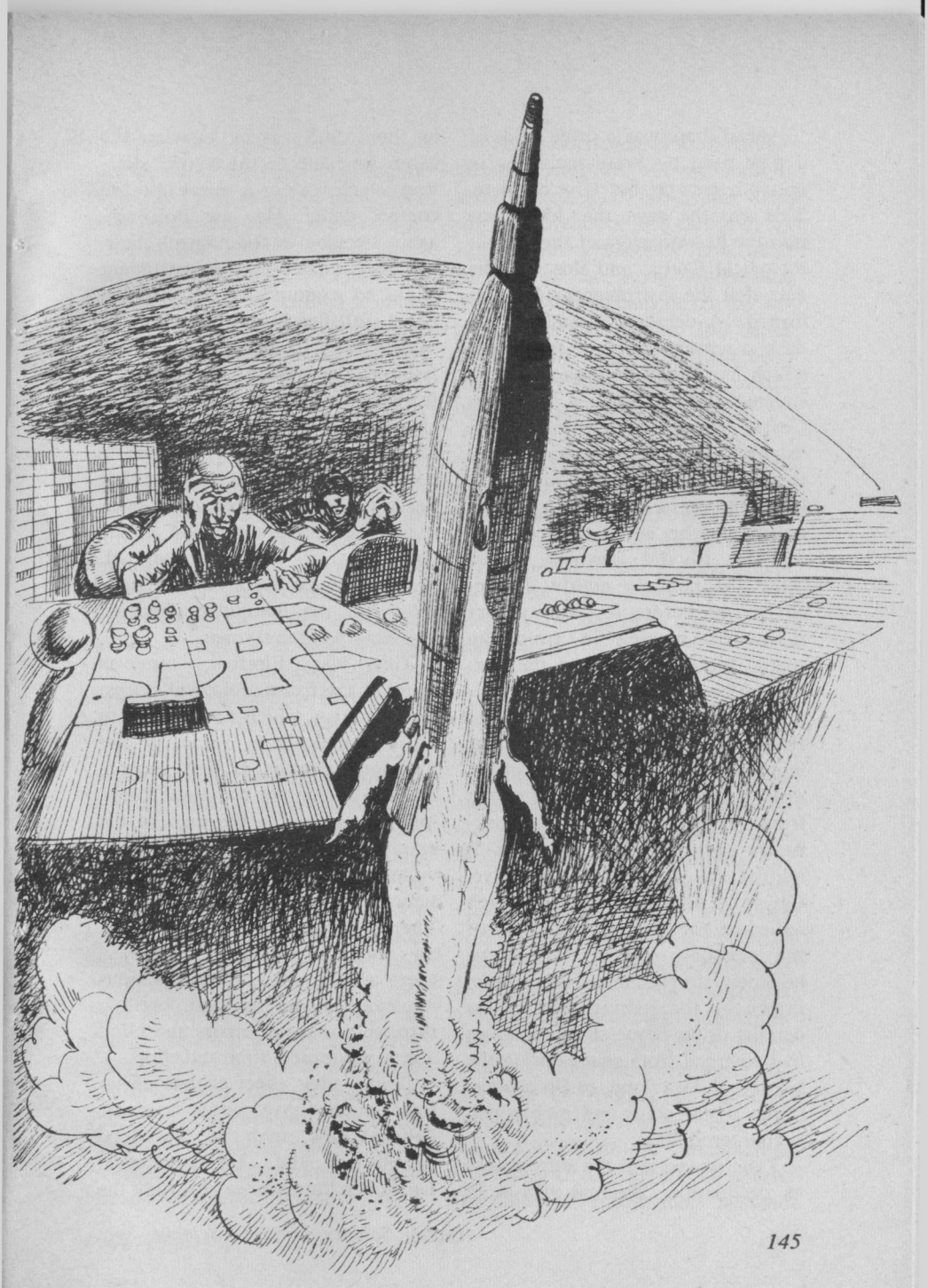
Towards noon it became too hot for comfort, as the wind died and the air began to shimmer in the heat. Then he rose and turned his footsteps back the way he had come, back towards the headquarters of the Corps. Soon the long, low buildings were looming up ahead of him, white and dazzling; the scoutships, too, were shining silver in the sunlight, gleaming as they stood on the black surface of the landing ground. As he approached, he wondered idly how long he would be there, how long it would be before his next mission was decided.

The time, as always, was short. As the sun slid towards evening, he was again in a scoutship, rising smoothly from the black landing ground, feeling around him the faint crispness of the drive field. Certain information had come into the headquarters of the Epistemological Corps; they had immediately realized its implications, and he was on his way to investigate. Soon the planet was receding and ahead lay space, smooth and dark, through which the ship slipped as did the fleeting shadows in that Swaylone forest.

In the ship were two men from Swaylone, sleeping and relying on the alarms to give notice of anything worthy of their attention. Firefoal lay sleeping in his bunk, motionless under sedation as the drugs swept away the cumulative fatigue products of his last mission. In the control dome slept Poleflash, the pilot, lightly dozing as he lay back in the big control chair, secured in place by magnetic clasps which held him to the sides and back of the chair.

Through the dome, almost perfect in its transparency, space stretched away into emptiness, its blackness broken only by the half-visible glow of the drive field as it distorted the fabric of space. An alarm buzzed softly on the huge control console and a light flashed an intermittent series of pulses, well down into the violet end of the spectrum. Instantly Poleflash was awake; noting the alarm, he made the necessary adjustments to the instruments and then leaned back into the chair to look out into space through the dome, out through the haze of the drive field into the emptiness beyond.

He observed and waited, his face impassive and unchanging in the mixed lighting of the control dome. A computer sang softly in a series of atonal cadences, and then faded into stillness as a small screen became lighted. On it appeared data, formed in small, neat words and figures. Reading it, Poleflash pressed the switch to record it, and then sat back to muse on the object of the mission, as far as he knew it.



Ahead there was a drive field, of a type used by Swaylone ships in previous periods but now obsolete. This was the news that had come into the headquarters of the Epistemological Corps, and this was the data that the instruments now confirmed. A derelict, thought Poleflash, a remnant of some expedition which had found its limbo in some isolated system. This is what the Corps were interested in, to the extent of sending a top-level agent to investigate. Poleflash did not yet know the reason for the Corps' interest, and he could only wait to find out. He did, however, understand the need to nullify derelict equipment before it could attract marauders moving in from the spatial hinterland beyond the borders of Swaylone.

Reaching forward to the controls, Poleflash centered the ship's course more exactly upon the source of the drive traces. These came, he noted, from the sector where the starkbeasts came through; the need to nullify the drive was imperative. Carefully, he studied the dials which indicated the state of readiness of the weapons systems. Marauders, he knew, might already be there, drawn by the pulsing field of the derelict drive. Some strange entities had emerged from space during the history of Swaylone, to do strange things to the ships and men which encountered them.

Time passed and the ship neared its destination. Firefoal stirred in his bunk and awoke. Leaving the cabin, he came up the central stairway which rose in a spiral into the control dome. He saw Poleflash, again sleeping in the control chair, and then turned to the instrument banks to examine the information panel. Satisfied by what he saw, he settled down to await their arrival. Around him was the familiar control dome of the scoutship, a faintly gleaming surface of curving and limpid material, barely tangible in a manner which made it appear that one was sitting unprotected in open space. Low noises sounded as the equipment of the ship operated; small lights danced across the console, and the computer chuckled and sang its atonal tunes.

This was Firefoal, top-level agent of the Epistemological Corps, an institution which had proved to be of incalculable value to the Swaylone empire. It had become obvious during the course of Swaylone expansion, as the men of the empire came into contact with alien cultures, that the development of a science could take many courses. There was no steady development, no smooth progression. Rather, there was a tortuous and devious movement, winding and twisting through a maze of errors and blind alleys, wasteful of time and effort.

Seeing what effect chance deviations could have upon scientific cultures, the men of Swaylone established the Epistemological Corps. Its function was to study the

scientific development of any culture found by the empire during its expansion, and to study the errors which occurred during the development of that science. Information thus gained enabled Swaylone to smooth the path of its own science.

So Firefoal waited, pondering upon his present mission. The Swaylone parkland seemed very distant now; it was, he thought to himself, an odd situation, unique in the records of the Corps. Musing, he heard the drive fade and knew that the ship was at the end of its journey. Poleflash was awake now, and together they looked out through the dome, examining a small system which hung nearby, its small star reduced in brightness by the dimming mechanism of the dome to a level which they could inspect without discomfort.

Poleflash ran his hands over the control console, smoothly, without faltering. Onto a small screen appeared a schematic of the system, with planets which ranged from small and barren rocks to gaseous giants. He then pressed a key and a red light began to flicker from the third planet; this, they knew, was the location of the derelict drive. They moved the ship in slowly, to inspect the third planet, examining it as it loomed up, first in the screen and then directly through the dome. The signs were obvious; it was inhabited by a human culture at an intermediate stage of development. Firefoal turned to Poleflash.

"This must be handled carefully," he said, using the harshly consonanted language of Swaylone, slurring rapidly over the cadences of agglutinated syllables. "This must be one of the early settlements, from the first expansion at the beginning of the empire, lost since then. But the drive must have been cast away here long afterwards, because it is a fairly recent type."

They studied the third planet, noting the extensive signs of technological works on the surface, and the bright lights of cities on the dark side. They scoured the planet with their instruments, noting the presence of electrical and nuclear energies.

"No sign of a space drive, apart from the derelict," said Firefoal. "They are using rockets to reach their satellite."

He indicated a base on the moon which circled the third planet; silver rockets were gleaming on the starkly lit surface. Briefly, Firefoal reflected upon the nature of that blind alley, which he had seen a number of times. He knew how the production of rockets could consume time and resources, carrying themselves on with such complex momentum that it became almost impossible to re-examine the basic premises. The existence of rockets, he decided, meant that this culture had not made a study of the fundamental properties of the fabric of space. His interest quickened, because

they should have done this, if his estimate of their stage of development was correct.

"This needs great care," he said to Poleflash. "They may have detected the effects of that derelict upon the properties of space in their vicinity. And if they have, they may be looking for the origin of the drive field. They may even have inferred what it is, and be waiting for us to come looking for it."

"Tell me," asked Poleflash, "just why the Corps is interested in this. Why not just send a wrecker to close it down, so that it won't attract marauders?"

They sat in the twin control chairs, studying the third planet through the dome, and examining its magnification on the screens. Firefoal thought for a few moments before replying.

"Because we suspected that the drive may have been cast upon an inhabited planet, and we wanted to see what effect the drive field would have had upon the science of that culture. I think you will see why. Can you think of a basic experiment on the nature of light, something performed by all cultures at the beginning of the development of their physics?"

Poleflash considered the problem for a few minutes. "Yes, I know the one you mean. Its aim is to detect the velocity of the planet through the fabric of space, by measuring the effects of that movement upon the speed of light on the surface of the planet."

"Yes," agreed Firefoal. "They calculate the velocity of light in a vacuum. They then realize that, since the planet must be in motion relative to the spatial fabric in at least part of its orbit, the velocity of light on the surface of the planet should vary. The motion of the spatial fabric past the moving planet will either advance, or retard, the speed of light, in the same way that the motion of an airstream affects the velocity of sound. The apparent velocity of light on the surface of the planet should be greater when the planet is moving towards the point of emission, and less when it is moving away from the point of emission. In the first case, of course, one has to add the velocity of the planet to the speed of light; in the second case, the velocity of the planet must be subtracted from the velocity of light."

"That I know," replied Poleflash. "The usual method of detecting this effect is to use an interferometer. Light from a source is partly transmitted and partly reflected at a half-silvered mirror. Each beam is then reflected back at another mirror, these two mirrors being at the same distance from the half-silvered one. When reflected back, the beams are recombined and viewed. Interference fringes are observed, and these indicate the extent to which the time taken by the light to travel between the mirrors is

affected by the motion of the planet. Thus, when the apparatus is rotated, the light velocity along the mirror arms varies, due to the velocity of the planet, and this shows itself in changes in the position of the interference fringes."

"Correct," replied Firefoal. "And what is the result of this experiment?"

"The velocity of light varies on the surface of the planet, just as one would expect it to, according to the direction and velocity of the planet relative to the fabric of space. This is the same way the velocity of sound relative to the ground is affected by the velocity of an airstream, or the way the movement of a liquid affects the velocity of anything borne in that liquid," replied Poleflash.

Firefoal paused, and then spoke again. "That experiment is crucial to the development of physics and the space drive. From what the Corps knows of the way physics develops, it is always this experiment which makes the physicist aware of the reality of the spatial fabric. Then they study the properties of that fabric, and are led towards the development of the space drive."

Again he paused, then went on. "But on this planet, with that derelict drive field still operating, the planet will be encapsulated, with the result that the movement of the planet through the spatial fabric will be totally masked. The result is that the interferometer experiment will have a negative result, so that the motion of the planet will appear to have no effect upon the velocity of light. This will produce a paradox which those physicists will have to deal with, and the Corps is interested to find out how they do this. It may be that they have deduced the existence of some artificial interference, or they may have some other solution. Whatever they do, it will be valuable, because the situation is unique."

They both sat in silence, knowing how important it was to avoid the contamination of a culture with science beyond its own level. Knowledge, they knew, must be worked for if there was to be any benefit from it, because the effort of producing it was as valuable as the science itself. Firefoal rose and went down the central staircase, heading for the locker which held the powered suits.

"I know that something odd has happened down there," he said as he went. "You saw that they are using rockets, and that there are some on their satellite. I have never seen a culture of their apparent level still using rockets. It usually becomes obvious early that one can make a more efficient space drive which reacts with the spatial fabric, with the result that rockets are never developed. But those down there are obviously highly developed and sophisticated, as though someone has devoted much effort

and great resources to them. Something must have happened, because that is also unique."

Opening the locker, he took out a suit and climbed into it. With a final check of the seals, he cycled himself through the lock.

In the control dome, Poleflash saw the suited figure fade away into the darkness in the direction of the third planet. He knew that there would be some time to wait before Firefoal returned, so he left the control dome and began to collate the results of the routine observation which every scoutship carried out during its travels. And while he did this, he listened constantly for the weapons system alarms; this was the sector where the starkbeasts came through some time before.

Poleflash had led the counter attack, and the memory of it was always with him. Now, as he worked, he thought of it again. Shimmering movement in the fabric of space as it was twisted from some unknown beyond, twisting at the sanity of those watching, and bringing into weird shapes anything which was caught in it. Shapes which still lived and moved and had some kind of being.

Then the shimmering breaks and the starkbeast comes through, misty and swirling in its dim outline, dotted with pinpoints of brilliance. It attacks everything in its vicinity, spreading its huge shape to cover an area as big as a system; blasting around itself with gusts of energy, until it is itself scattered into fragments by the concentrated firepower of hundreds of ships. Then the individual segments are still fighting, each driven by its own pinpoint of light.

Time passed, and the planet rotated on its axis a score of times. Poleflash waited, knowing that it would take time for Firefoal to learn the languages and extract the information he wanted from the planet's scientific literature. He was immersed in his work, but gradually became aware of the nearness of the starkbeasts. Visions of the hanging city came to him, as they did to anyone when the starkbeasts were near, impelled by some vague leakage of alien ideation from the beyond where they dwelt. The visions grew clearer, and he uneasily made ready with the scoutship's weapons.

It was a planet with mountains of crystal, glowing with shifting colors in the light of a huge moon. There was a sense of the weight and pressure of a great civilization, a culture with a dark and implacable purpose of its own. The planet loomed out of space again, a weird patterning of colored stars.

Then there was the jagged outline of an alien city, reaching high into a sky full of racing clouds. The city was an intricate pattern of interwoven triangles, suspended above a clifftop, moving and changing. Sea beat slowly against the rocks at the bottom, responding

sluggishly to a driving wind. Beyond the city there was a vast and smooth surface extending away to the horizon, dotted with ships that rose silently and flickered away.

The alarms rang softly to indicate that the lock was being activated from the outside. Poleflash was then sitting in the dome, observing the system's star with the aid of a bank of instruments. Firefoal came up through the stairwell and sat down in the vacant control chair, looking pensive and quiet under the impact of the image of the city.

"They are near," said Poleflash. "This is as strong as ever I have felt it. But tell me, what did you find down there?"

Firefoal paused, and then finally spoke. "What would you do," he asked, "if you were a scientist on that third planet, faced with the effects of the drive field upon the interferometer experiment? What would you do if you found that the results were negative, and that the velocity of light on the surface of the planet was apparently not affected by the motion of the planet?"

"I would make the simplest hypothesis," replied Poleflash after a moment's thought. "This would be as follows . . ." And he paused again to frame the words, and then said slowly; "The velocity of light in a closed path, containing relatively stationary mirrors, is constant in all directions, in a local reference frame moving with the surface of the planet."

"Quite," said Firefoal. "Then one would begin to wonder why a local reference frame should have such odd properties, and be unaffected by the motion of the planet. One would look for a reason, in the form of a specific effect operating locally."

"And that, I presume, is what they did," said Poleflash. "Have they come anywhere near to suspecting that it is someone else's space drive that is causing the paradox?"

Firefoal replied, slowly and musingly. "They did the experiment. They call it the Michelson-Morley experiment after the men who first did it. It did have a negative result, for the reasons we know of. All this is what one would expect, but after that, their thinking was uniquely odd."

He sat brooding, looking out into space, feeling the visions of the hanging city seeping in from the periphery of his awareness. The mysteries of the universe were endless, he thought, and the incomprehensible was always ready to emerge. Then he went on.

"Basically, what they did was to assume that conditions on the surface of the planet were completely representative of conditions throughout the universe. This means that they did not make the simplest hypotheses which you just mentioned. Instead, they assumed that

the velocity of light is constant in *all* reference systems, for *any* motion of these systems."

Poleflash turned sharply to look at Firefoal, pushing his instruments away abruptly. "But the sufficient condition for the negative result of that experiment is given in the simplest hypothesis which I mentioned. To assume that the whole universe has these characteristics is impossible, because of the paradoxes it leads to. Did they not think of any other explanations?"

"Yes," replied Firefoal. "They considered the possibility that the planet dragged the neighboring spatial fabric with it as it moved. This is implausible, so they came to reject the entire concept of a spatial fabric, or aether, as they termed it. They tried to use the explanation that the velocity of light varies with the velocity of its source, and this was also impossible. They even tried to assume that a moving object contracted in the direction of its motion, just sufficiently to cancel out the effects of the velocity of the object upon the velocity of light. None of these explanations were satisfactory, so they produced the one I have mentioned, which they term the theory of relativity. It is very complex and highly elaborated, but is based on the premise that the velocity of light is constant in all frames of reference, irrespective of the motion of these frames."

"But how could anyone envisage such a universe?" queried Poleflash in amazement. "You'd need a most odd set of transformation equations." With the precision and speed characteristic of the men of Swaylone, he quoted a string of symbols.

Firefoal listened, and then said, "Yes, they have those equations. They term them the Lorenz transformations, again after the man who first produced them."

The full implications came to Poleflash. "They must believe that one cannot travel faster than light, because the amount of energy needed increases asymptotically as one approaches that velocity."

"They do believe that," replied Firefoal. "A drive such as ours is totally outside their comprehension, because they have dismissed the concept of a spatial fabric, independent of the bodies in that space, as meaningless. Furthermore, they have noticed that one cannot accelerate subatomic particles up to or beyond light velocity in an accelerator, and have taken this as evidence to support the theory. This, of course, is due to the local characteristics of accelerators, and has nothing to do with anything wider or outside that."

"That always happens," said Poleflash. "A theory always attracts to itself other data which seems, by some analogy, to support it. Then this data is built into it and taken as confirmation."

They paused and sat in silence,

listening idly to the chuckling of the computer, their faces reflecting a passing series of hues from the shifting lights of the control console.

"They must believe, if they use those transformation equations, that the basic idea of transmitting any causal action faster than light is contradictory," mused Poleflash. "They must also believe that temporal sequences are retarded in bodies traveling at velocities approaching that of light."

"They do," replied Firefoal. "They are deeply committed to this theory of relativity, as they term it. A large body of data has been accumulated, supposedly to confirm it, and any contradictory evidence is ascribed to error or faulty observations. When one of their scientists by name of Miller repeated the interferometer experiment, and found positive effects, his results were ignored as being due to error. What he actually detected was probably some fluctuation or weakening in the drive field as its components deteriorated."

"But why all the complications," asked Poleflash, with a feeling of incredulity that such a theory should even have been entertained. "Why didn't someone—one of their scientists—point out how much simpler it would have been to assume that a derelict drive from an interstellar civilization was on the planet, affecting the behavior of light?"

Firefoal was moved to laughter, despite the pressing images of the hanging city and the ever present feeling of the proximity of the starkbeats. He recovered, and apologized for his amusement.

"If you had been on that planet," he said, "you would see how impossible that is. In their climate of opinion, if a member of the scientific community were to suggest anything like that, he would not only have his career terminated, but his actual sanity would be doubted."

"But some kind of local effect could have been suggested," protested Poleflash. "It needn't be a drive. All that is needed is some realization of the fact that conditions on the surface of their planet are not necessarily representative of those in the universe at large."

"That, too, is impossible," replied Firefoal. "They must, for their own peace of mind, feel that conditions on their planet are representative of the rest of the universe."

"Their view of the universe is absurd," said Poleflash. "One cannot create a physical model of the universe, if the speed of light is assumed to be the same in all frames of reference. One cannot even visualize it, or think about it."

"That does not worry them either," replied Firefoal. "They rely heavily on mathematics as a language of description, and for them, anything which can be described in mathematical terms is satisfactory,

whether or not a physical model is possible. There is also another factor, a subjective one, which operated early on. The man Einstein, who produced the theory, made this clear in his autobiography, when he made a statement which showed that he prejudged the entire issue."

Firefoal paused, and then went on, quoting, "A paradox which I already hit at the age of sixteen. If I should pursue a beam of light with the velocity c, the velocity of light in a vacuum, I should observe such a beam of light as a spatially oscillatory electromagnetic field at rest. However, there seemed to be no such thing. From the beginning it appeared to me immediately clear that, judged from the standpoint of such an observer, everything would happen according to the same laws as for an observer who, relative to the earth, was at rest."

Firefoal leaned over to look at the screen, where the red light still flashed from the third planet. "That is what Einstein said, and due to the unfortunate coincidence of the drive being there, he found himself right."

Poleflash rose and began to manipulate the controls. "I presume," he said, "that we close down the drive, before the starkbeasts come through to investigate?" He knew the answer, and began to set the controls for the weapons system.

"Yes," replied Firefoal. "We blast the derelict. It will destroy the whole basis of their physics, but that is just a fantasy anyway. They are better if they start again."

Shimmering fire emerged in a stream from the underside of the ship, and faded away in the direction of the third planet, seeking out the drive unit. They waited, until the flashing red warning light vanished from the screen. Then Poleflash set course out of the system, relieved to move away from the presence of the starkbeasts.

Firefoal finally broke the silence. "Their scientists differed from ours in one basic way. They were not really pragmatists, or instrumentalists; many of them despise the idea that the function of theories is to enable one to manipulate one's environment in some way. They, therefore, had no objection to a theory which suggested that they could not travel faster than light, and which would bar them from reaching the stars. We would inevitably reject such a theory because it had no pragmatic value, apart from any other considerations, while they accepted it because many of them do not want to leave their planet."

The system faded behind them as the scoutship built up velocity. As they approached the velocity of light, they looked through the dome and saw the shimmering of the spatial oscillatory field surrounding them, at rest relative to the ship. Passing light velocity, they left

these fields behind them as they headed for Swaylone.

"What has the Corps learned from this?" asked Poleflash as he made the final adjustments to the controls.

"It confirms something which is indicated by everything which we have discovered," replied Firefoal. "All the Corps' researches indicate that there are two kinds of scientific activity. The first of these is the creative scientific method, where the aim is to produce new ideas, concepts, data. The second is what we term institutional science, which consists of taking some theory-system as correct, and then working within this system to confirm and elaborate it. The gulf between these two is great. Institutional science is hostile to creative science because new concepts can destroy the basic foundations of institutionalized theories. And their theory of relativity had become institutionalized."

He rose and went down the central stairs to make his report, and Poleflash settled down in the control chair for the return journey. Firefoal's voice came up the stairwell.

"In Swaylone, there is only one kind of science, the creative and pragmatic. Perhaps that is why we expand, when so many are planet-bound."

So Firefoal mused, as he waited for the return to Swaylone. His thoughts strayed once again to the glimmering light of the forest, broken by the dull luminescence of the giant fungi which grew on the tree boles. Soon he would be there, seeing the dawn come up over the grassy plain, lying in the warmth listening to the hum of the insects. Faintly, he felt the visions of the starkbeasts tugging at the periphery of his awareness, and some slight unease grew in him. Then he wondered idly what kind of science these entities had, and whether he would find himself studying it at some time in the future. And so he dozed, waiting for the end of the mission. ■

"In Days of Old . . ." *Back when sandglasses and waterclocks were the latest horological devices, people had as much tendency to get turned around backwards as now. But not having any clocks, they couldn't be told "Turn clockwise!" Moreover, before the day of machine lathes with calibrated lead-screw drives, producing screw-threads was more a matter of high artistry than science. So they didn't have machine screws, wood screws, and screw clamps in common usage. Hence no "left-hand thread" terms.*

But they did need, and did have, terms specifying rotational direction. One of those old terms was "widdershins," which still lingers in arcane incantations.

Problem: Betcha you can't find the proper definition of widdershins or even find the pre-clock counter-widdershins term! ■ *The Editor.*

---

the reference library

P. Schuyler Miller

EX TV

The past two years—I am reliably informed by faithful television watchers—have been unusual for the emergence of a number of "science fiction" series worth watching. I can't speak from personal knowledge; I've seen a couple of "Star Trek" episodes and enjoyed them. I know that several top-notch SF writers were responsible for some of the original stories, if not for the scripts themselves, and a number of episodes were good enough to earn "Best Drama" nominations in the last "Hugo" contest, with one of them winning.

I have it strictly on hearsay that another series, "Time Tunnel," was a bore, that "The Invaders" was pretty good, and that "Lost in Space" earned its keep as a kiddy show several notches above the late unlamented "Captain Video" of fifteen years ago.

Now episodes from all three series are being converted into paperback books, with good and knowledgeable science-fiction writers converting other people's scripts into book-length "novels" and short stories. Like previous books based on motion picture scripts—not really excepting Isaac Asimov's novelization of the special effects carnival, "Fantastic Voyage"—the results are not good, but from where I sit the allegedly poorest program, "Time Tunnel," has produced the best books. For that thank the thorough-going professionalism of Murray Leinster . . . but how do you account for the less interesting results from the equally competent James Blish (for "Star Trek") and Keith Laumer (for "The Invaders")?

The seven "Star Trek" episodes "adapted" by James Blish (Bantam No. F-3459; 136 pp.; 50¢) give some idea of the variety and science-fictional maturity of the series, but tantalize more than they convey. As a Pittsburgh TV critic said of the programs, there is no time to do more than pose a challenging idea . . . then let it fizzle out. Bits of business and running comments that undoubtedly mean something to regular watchers of the series do nothing but handicap the adapter and that individualist, Mr. Spock, has a walk-on part. Even so, Blish has managed to write

almost his own kind of story in one of the seven, "Miri," with its world of immortal children. I wish I'd seen it.

If it weren't that Pyramid is the publisher of both "The Invader" (No. R-1664; 142 pp.; 50¢) with Keith Laumer as adapter and two "Time Tunnel" conversions by Murray Leinster, "The Time Tunnel" (No. R-1522; 143 pp.; 50¢) and "Timeslip!" (No. R-1680; 140 pp.; 50¢), I would blame the publisher for placing unreasonable limitations on Laumer and giving Leinster a free hand—which he employed to excellent effect. As it is, "The Invaders" grinds what I am told is a good program down into purely conventional "aliens among us" fiction with no Laumer flavor at all. The book contains three episodes, beginning with David Vincent's discovery of the aliens and ending, in the best of the three, as he prevents their landing a brood ship.

But by sheer professionalism, an evident interest in history, and what is clearly willingness to take as many pains with his adaptations as with his own original stories, Murray Leinster has made two good, if not exceptional, books out of four pieces of what the faithful insist is a nothing series.

"The Time Tunnel" has two full and one—possibly—partial episode. The first is what I understand was the opener of the TV series: experimenting with the Time Tunnel, the hero tries to stop and then to reduce the tragedy of the Johnstown, Pennsylvania flood of 1889. Attempting to return to the present, he and his companion find themselves helping Bat Masterson fight off an Indian attack on the outpost of Adobe Walls, Texas. In the final short episode, they are able to thwart an alien invasion of Earth in the not very far future.

These books come alive because Murray Leinster has recreated the actual historic situation in Johnstown and Adobe Walls as meticulously as he creates his landing grid universe in the Med Ship stories you read here in Analog. You don't absorb the settings unconsciously as you do in books by Robert Heinlein or in Conrad Richter's historical novels: Leinster shows it to you as a looker-on, explains it to you, points out interesting details. And he does it again, in more detail and with a more advanced time-paradox plot, in "Timeslip!," in which our friends have the job of salvaging a nuclear missile that has been accidentally deposited in Mexico City during the Mexican War, and is now about to be set off by bulldozers.

"Time Tunnel" was evidently a low-budget series that couldn't afford very exotic—and hence expensive—settings for its visits to the past and future. Murray Leinster has done a noble job of making up for the deficiency. If he'd written the series in the first place, it might still be on the air.

IS ANYONE THERE?

By Isaac Asimov • Doubleday & Co., New York • 1967 • 320 pp. • $5.95

Unlike good Dr. Asimov's most recent collections of essays on science, this book is made up of articles that originally appeared in a variety of magazines and newspapers during the past eleven years. The result is a far better—at least, more interesting and readable—book than the compendia of *Fantasy & Science Fiction* columns we've been getting from him.

There are thirty-seven essays in the book. They have appeared in magazines as dignified as *Harper's, The Humanist, North American Review* and the *New York Times Magazine* and as relaxed as *Cavalier, Esquire* and *True*. They come from technical journals such as the *Bulletin of the Atomic Scientists, Journal of Chemical Education, Chemical & Engineering News* and *Petroleum Today* . . . and as nontechnical as *Diner's Club Magazine, Mademoiselle, True* and also the *TV Guide*.

Three even appeared in science-fiction magazines, two in an encyclopedia yearbook, and two or three appear to be written for the book—including the short, hard-nosed, to-the-point "On Flying Saucers."

This is the many-interested, many-talented, many-insighted Dr. Asimov at his best. There is an opening section of nineteen essays on "the more or less known," from enzymes to oceans . . . another group of twelve on "the more or less unknown," including a few predictions . . . and a short concluding section on science fiction. With all this variety, I can't and won't pick favorites. It's simply the best Asimov article-collection in a long, long time.

VOYAGERS IN TIME

Edited by Robert Silverberg • Meredith Press, New York • 1967 • 243 pp. • $4.95

An anthology of time-travel stories that begins with my own first story for Astounding ("The Sands of Time," April 1937—the earlier "Chrysalis" had been bought for *Unknown Worlds*) and ends with excerpts from H. G. Wells' "Time Machine" can't be all bad. It isn't. The editor made his selection for teen-agers—for high-school libraries, really—and he has chosen well. He has had to leave out some of the classic treatments of time paradoxes, such as Heinlein's "All You Zombies," but he has managed to cover a great many of the variations that are standard to us but may not be to younger readers and certainly will astound teachers. And he has not neglected current authors. If Wells and I are the most venerable contributors, there are also Larry Niven's "Wrong Way Street" from 1965, David I. Masson's "Traveler's Rest" from the same year, Wilma Shore's "A

Bulletin from the Trustees" and Alfred Bester's brain-twisting "The Men Who Murdered Mohammed" from 1964, and Michael Moorcock's "Flux" from 1963.

Analog/Astounding is represented twice among the twelve stories in the book, by my story and Poul Anderson's "Time Heals" . . . about the uselessness of a man from our time in the future. (I'd have loved to see his even better story about the helplessness of a modern man in Iceland of a thousand years ago.) Then you get Lester del Rey with ". . . And It Comes Out Here" ("closed-circuit" time travel), William Tenn's "Brooklyn Project" (oscillatory time travel), C. M. Kornbluth's "Dominoes" (beating the stock market by reading a future newspaper), and the editor's "Absolutely Inflexible," complete for the first time (time travel as a social problem for the future).

In Niven's effective yarn a lunar explorer monkeys with a time machine, with unfortunate effects. In Masson's, you have an already classic story, bewilderingly strange, built on the concept of a world with a steep time gradient. Moorcock's "Flux" is a kind of variant on "Brooklyn Project," though with totally different hypotheses and development. Bester's title does nothing to suggest the uniqueness of his story of chronic frustration. And Miss (Mrs.?) Shore has an equally unique, equally frustrating little story of temporal universality that mustn't be missed.

I'm pleased to ride in such company.

THE PEOPLE: NO DIFFERENT FLESH

By Zenna Henderson • Doubleday & Co., New York • 1967 • 236 pp. • $4.50

When I was of grade-school age, one of the highlights of the fall months was the day when the breakfast menu shifted from corn flakes to Cream of Wheat. I can still taste the nuggets of butter and brown sugar, feel the smoothness of it on my tongue . . . and remember how soon it was that I was heartily tired of its smoothness and blandness.

Something of the same sort has happened to Zenna Henderson's stories about the People . . . the psionically powerful, totally human refugees from a shattered planet, some of whom were cast away in the Southwest around the beginning of this century, and whose scattered remnants slowly made a place for themselves among our kind and eventually found their own and the New Home in the stars. The People are still completely believable . . . warm . . . idealizations of qualities that are latent in us all. Yet in the six stories gathered in this book they begin to grow a little bland, a little tiresome, a little too nice. You can't really grow bored with them—they're too

nice for that—but you can avoid them. And if you do, I can guarantee you'll feel guilty about it.

The six stories go back to fill in the chronicle of the People in their original Home and follow them to their New Home. They are linked together rather in the manner of the Canterbury Tales, as various of the People drop in to tell parts of their story to a human friend. Maybe bad neighbors—trouble-makers—are the kind who keep us interested, not the good neighbors who are always there, always reliable, always helpful. It's our shortcoming . . . not the People's.

LOGAN'S RUN

By William F. Nolan & George Clayton Johnson • Dial Press, New York • 1967 • 134 pp. • $3.95

It may have been a good, typical SF idea . . . but one no better than scores you've seen here. It may be the efforts or the prestige of Dial Press, which is not particularly given to the publication of "popular" books. It may be that co-authors Nolan—who has some good science fiction collections and anthologies to his credit—and Johnson—whom I don't know—have "connections" in Establishment circles. Anyway, the New York *Times* Book Review greeted this book with nearly half a page of praise which judges it to be not science fiction but that wholly respectable minority *genre*, allegory.

The theme is an extrapolation of the population explosion, juvenile alienation, the totalitarian society, and some other hardy science-fictional elements. In 2116 the young have taken over. It's their world to the point where anyone over twenty-one is not only not trusted but eliminated by the "Sandmen," the Administration huntsmen. A talisman embedded in the child's palm at birth changes color as he grows, classifying him and dooming him—yellow to blue at seven, blue to red at fourteen when the good years begin, red to black on Lastday when he turns twenty-one. If he's a loyal conformist, he turns himself in at a Sleepshop to be eliminated. If he's a maverick, he runs . . . with a Sandman after him.

The book is the story of Logan, a Sandman who relentlessly hunts down one runner who seems to know of an escape route to an underground sanctuary . . . and who begins to run himself as his Lastday approaches. It's a nightmare world he runs through, and I really have only one complaint: that the authors make their teen-age characters think and act like middle-aged people of today. I know that men and women in their teens made the frontier, and maybe in a suitable environment maturity will come at fourteen or seven. This may be the authors' unemphasized point. But it would be a better book if some of the monstrous kids of a century and a half from now acted their ages.

Let me close by paraphrasing, in

part, the book's opening: "By the early 1970s over 75% of the people living on earth were under twenty-one. . . . In the 1980s the figure was 79.7%. In the 1990s, 82.4%. In the year 2000—critical mass."

This isn't allegory. This is solid, classical science fiction.

NINE BY LAUMER

By Keith Laumer • Doubleday & Co., Garden City, N.Y. • 1967 • 222 pp. • $3.95

As Harlan Ellison points out in his characteristically positive introduction, this is a Keith Laumer you would never imagine if you have read only his "Retief" lampoons of High Diplomacy. The biographical bits in Harlan's essay show where the stories came from, but they hardly prepare you for the other face of Janus Laumer. You should meet him:

"Hybrid"—in which a strange kind of symbiosis (something Philip José Farmer might have imagined) turns a nobody into a superman.

"End as a Hero"—in which a superman fights a society that has no place for him.

"The Walls"—an utterly hideous story of the destructiveness of status. It may keep me from *ever* having a TV set.

"Dinochrome"—the last of a battalion of war robots, more or less accidentally reactivated centuries after the war has ended, tries to find the purpose of its new-found "life."

It's "like" many other stories you'll remember—and unlike any of them.

"Placement Test"—I retract: this one is in the "Retief" mood, and Mart Maldon and Jame Retief should get on well—if warily—together. If you've ever wanted to thumb your nose at the System, this one is for you. If you've done it, so much the better.

"Doorstep"—this one should not only have been left out; it should have been thrown out. I might have written it thirty years ago, but now. . . ?

"The Long Remembered Thunder"—a wonderful title, and the most intricately plotted story in the book. It's just a story, but a good one.

"Cocoon"—this carries the return to the womb one stage beyond "The Walls," to the point of no return. Read them together.

"A Trip to the City"—maybe this is a story of the world that follows "Cocoon," though we do have rather unlovely Aliens as villains. Is there really a New York out there somewhere? A Pittsburgh?

THE TECHNICOLOR® TIME MACHINE

By Harry Harrison • Doubleday & Co., Garden City, N.Y. • 1967 • 190 pp. • $3.95

You read this yarn here in Analog just a few months ago. A crisis-ridden Hollywood producer uses a time machine to transport his company back to 1000 A.D.—give or take a few months and years—to film the Viking discovery of America with the original cast.

The result is a grand shemozzle in which everything goes wrong and everything comes out right. Harry Harrison has lived among the Scandinavians long enough so that I am sure he does justice to their disorderly ancestors, but I can't help wishing Poul Anderson had written it. (Do you suppose some producer will finance a time machine and try to film *this* yarn in the actual setting of the story?)

GALACTIC ODYSSEY

By Keith Laumer • Berkley Books, New York • No. X-1447 • 160 pp. • 60¢

Here is an unabashed, fast-moving interstellar adventure saga somewhere between the author's "Retief" yarns and the tales Poul Anderson recalls about Dominick Flandry.

The hero, Billy Danger, is shipwrecked and rescued by some roving aristocrats from a far world. Attacked by aliens, he spends the rest of the book, or most of it, trying to find the girl he had undertaken to protect. In the process, he finds himself in conflict and fellowship with an amazing assortment of races and peoples—though no more amazing than those Retief copes with. The plot unravels in about the way a frisky kitten unwinds a ball of yarn, drawing on

classic devices that were probably good long before Shakespeare got someone to print them.

Just ride along and enjoy the scenery.

SOLDIER, ASK NOT

By Gordon R. Dickson • Dell Books, New York • No. 8090 • 222 pp. • 60¢

Gordon Dickson has reported that he is writing a long continuum of—as I recall—nine books which will extend from our own time into the far future. This is the third of the sequence, all set in a portion of the future when mankind has expanded into the galaxy and has begun to develop the differentiated physical and psychological characteristics that result from inbreeding and cultural crystallization in isolated populations. Unless you subscribe to the theory of independent origins from five different protohominoids for the present races of Man, something of the kind has produced them during some hundreds of thousands of years. In these books you see it happening again.

The last and best third of the novel, which carries the title, won a Hugo as best novelette of its year. The complete book doesn't quite measure up to either "Dorsai!" or "Necromancer," its companion novels—under those and other titles. One reason may be that its anti-hero, Tom Olyn, is pretty hard to like—a self-centered, ruthless SOB who sets out to destroy the culture, and consequently the motivating and characterizing spirit, of the fanatic "Friendly" worlds. Ostensibly, his motive is revenge for the execution of his rather hapless brother-in-law—a death that was as much the result of his own arrogant conviction that he had been born to throw his weight around, as it was of the hardshelled intransigence of the Friendlies. Practically, it was merely an attempt to test the validity of that conviction, for his own satisfaction and as a demonstration to the powers of his time and world.

When the whole sequence is finished—and probably reshaped to suit the author's shifting and maturing ideas—this may turn out to be one of the key books. Dickson's world is already far more complex than that of Isaac Asimov's "Foundations" or Robert Heinlein's "Future History," and it has a Foundation of its own in the Final Encyclopedia, important to the action but never entirely realized. Read the book for its ideas, if not for its story.

THE EINSTEIN INTERSECTION

By Samuel R. Delany • Ace Books, New York • No. F-427 • 142 pp. 40¢

Delany's "Babel-17" shared the 1967 Nebula award of the Science Fiction Writers of America, for best novel of 1966, with Daniel Keyes' "Flowers for Algernon." His

new book is even better. It also emphasizes the similarity between the leading new science-fiction writers of the last few years . . . the fact that there is no similarity, as there was among the "Astounding school" that John Campbell built up in this magazine twenty years ago. Delany, Zelazny, Avram Davidson . . . they're all individualists.

They are also "Renaissance men" with broad, rich interests that they employ rewardingly in their books. Delany has had training as a scientist, a mathematician and a composer, has tried his hand at poetry, and wrote "The Einstein Intersection" during a year of travel in Europe. It blends concepts of relativity and mathematics in a way that the story itself must explain . . . it is a projection of the Orpheus legend into a far future . . . it offers the concept of an ancient star-race who have poured themselves into the bodies of worn-out, inbred humanity in order to force new varieties of thought, being and experience on both species . . . in fact, it packs into itself enough tantalizing concepts, enough color, enough insight for a whole shelf of books. I've lost count of the number of warps and woofs of myth and symbol that are woven into the tapestry . . . a tapestry with as much action and movement as the great Bayeux.

You may not like it at all—some people don't—but you shouldn't miss it.

REPRINTS

EARTHWORKS

By Brian W. Aldiss • Signet Books, New York • No. P-3116. • 128 pp. • 60¢

Reprint of this English author's grimmest story of a future when White Europe and England are ground down by a mechanized, brutalized, starving society and the only possible refuge seems to be in Black Africa.

THE TROUBLE TWISTERS

By Poul Anderson • Berkley Books, New York • No. X-1417 • 190 pp. • 60¢

The components of this new story of the Polesotechnic League of intragalactic traders originally appeared here in Analog: remember the three-cornered wheel? David Falkayn, young go-ahead, is the linking hero. Good, expert fun.

THE FIRST MEN IN THE MOON

By H. G. Wells • Dell Laurel-Leaf Library, New York • No. 2552 • 192 pp. • 50¢

Wells is in the public domain now, so anyone can reprint his books without worrying about copyright . . . and everyone is. This edition is intended for schools. It has an informative introduction by Willy Ley, and a wild cover illo.

brass tacks

Dear Mr. Campbell:

Re: Claudia Jensen's poem in the August edition of Analog

If quasars and quarks make your reader feel queasy,
Those aren't all the terms that make *me* feel uneasy;
The amps and the ergs and the volts and the watts
Have my cerebrum tangled and tied up in knots.
Unpronounceable handles like archaeopteryx
Are sure to drive me into layman's hysterics;
Pteranodon, stegosaur, megalosplanchnic,
Dolichocephalic and racemose branch-nic;
Phthisis, phthiriasis, asthmatic wheezes,
And things you'd think plants, that are really diseases:
Rubella and hernia and psychoneuroses,
Pellagra and yaws and myxomatosis;
And names that denote who has made a discovery
But don't help my memory in the recovery
Of what the things are. I am lost, my apology
In tropical jungles of weird terminology!

(Mrs.) R. G. Nunes
323 Endymion Road,
Mondeor,
Transvaal, South Africa

This one needs no comment whatever—it's perfect as it stands.

Dear Mr. Campbell:

The time lag in receiving copies of Analog in Germany is decreasing, so perhaps my AnLab votes will count: August: 1. Babel II, 2. Depression or Bust, 3. Starfog, 4. Cows. September: 1. King's Legions, 2. Fiesta Brava, 3. Lost Call-

ing, 4. Important Difference. *King's Legions* is one of the best stories I have read in many years. What does the legend on the Empire Shield/-sword mean?

To quote a quote from a quote; here is an excerpt from "Cyborg," by D.S. Halacy, Jr. published 1965. On organ transplants: *The Seven Ages of Ideas,* by Dr. C. Walter Lillehei, professor of Surgery at the University of Minnesota:

1. The idea state: "Won't work; it's been tried before."
2. After successful experiments with animals: "It won't work in men."
3. After one successful clinical patient: "Very lucky. Doubt if patient really needed treatment. Too bad. A tragedy, really, because now they'll continue."
4. After four or five clinical successes: "Highly experimental, too risky, immoral, unethical. I understand they've had a number of deaths they're not reporting."
5. After ten or fifteen patients: "They can succeed occasionally in carefully selected cases. But most patients with the defect don't need the operation anyhow."
6. After large series of successes: "So and so in Shangri-la has been unable to duplicate their results. I hear a number of their patients are dying later deaths."
7. The final stage: "You know, this is a very fine contribution, a straightforward solution to a difficult problem. I predicted this. In fact, in 1929, I had the same idea. Of course, we didn't publish anything, nor did we have penicillin, cortisone, and fine anesthesia in those days."

Too bad the FDA stopped at ages 1, 2 & 3 with Krebiozen and Thalidomide. And now they're going to classify drugs as to their effectiveness . . . Looks like all of the Cold Remedies will have to carry a statement to the effect that: "This preparation was found to be virtually ineffective in combatting the common cold. The only ingredient found to be of any real virtue was acetylsalicylic acid, buffered, which reduced pain in some subjects. WARNING: THIS DRUG MAY NOT IMPROVE YOUR HEALTH . . . AND PROBABLY WILL NOT. Consult your local Medicare representative if symptoms persist.

JOHN K. LYNN

APO N.Y. 09130

A most excellent brief summary of Orthodoxy vs. Innovation!

Dear Mr. Campbell:

Thanks for an excellent editorial on the use, or rather misuse, of hallucinogens. Evidently, by their nature, they do not expand consciousness, or increase creativity or imagination, and no culture making widespread use of them will be noted for these qualities. As you say "where are the breakthrough

discoveries and the new understandings of the world and how to use it" and everything else claimed for LSD? LSD quite obviously does not "put up" in respect of its claims —though in other respects, such as treatment of mental disorder it may do so. Soon in fact, if it does not produce more results, it will have to "shut up."

However, in the same issue you carry an article about a drug which, to my mind, has been "putting up" for about the last three hundred years—tobacco. Professor Burn's article gives some very good evidence that the use of tobacco may well provide genuine mental stimulation as well as many other qualities. And as to the concrete evidence, the breakthrough discoveries, et cetera,—well . . .

Tobacco was introduced to Western Europe, and to the European colonists in the New World and elsewhere, at the end of the sixteenth, beginning of the seventeenth centuries. And since, say, 1600 just look at the rate of expansion of European civilization—and of course North America. We have seen the Age of Discoveries, the Age of Science, the Age of Inventions, the Industrial Revolution, the development of steam, then electric, then petroleum, and finally nuclear power, the invention of new techniques and the development and industrialization of existing ones to such an extent that our world would be quite unrecognizable to a man from before 1600. Developments in the physical, chemical, biological and engineering fields have, to a certain degree, been balanced on the Arts side by a new art form—the novel and short story—and by a proliferation of experiment in all the older arts, music, painting, poetry, sculpture and so on; though maybe the result, as regards quality, is often a matter of opinion. All this mental activity of all kinds has taken place since about 1600-1650—just about the time that tobacco began to be widely used by the leisured classes; those who had the time and education to make something of this additional stimulus.

Sir Walter Raleigh, one of the greatest men of his age, no doubt started it off, but since then how many of the world's foremost thinkers, philosophers, inventors, scientists and artists have been smokers? Finally, of course, a man living in the age of tobacco does not even need to be a smoker himself to benefit from its stimulation. Even if he does not inhale enough of other people's smoke to affect him, he can still receive a stimulus indirectly, caused by the increased competition from his smoking colleagues —and everyone in our Western Society knows that competition is a stimulus!

How about that for a theory?

OLIVER WHARMBY
17 bis ave des Aqyedycs
(94) Arcueil, France

Well . . . I can't quite believe tobacco can claim all that! But I do feel it is essential that the completely one-sided and massive anti-nicotine campaign be balanced a little!

Dear Mr. Campbell:

Your editorial, "Gadgeteer vs. Scientist," discourses on a subject so dear to my heart I just had to comment on it.

I've been asked to instruct a course, in a small college, beginning in February called "Aspects of Invention, Technical, Practical & Creative." Bob Woodbury and I are engaged with two other fellows in R & D on creative techniques and development of ideas to enable us to better understand what creativity is.

From the study I've made of the subject I've devided creative individuals into three groups:

1) The creator who first creates the problem and then the solution.

2) The chap who given a problem creates the solution.

3) The improvisor who given a basic solution can create solutions to many problems.

Most of our so-called scientists fall into the third group. A recent study showed that, at best, 2% of our R & D personnel are truly creative. When you say, "Not infrequently it is authoritatively known that what he's trying to do is the impossible," you are getting into the meat of the problem one has in "selling" new technology. Bob Woodbury calls an expert (scientist) one who knows what can't be done. Eric Salzen of Waterloo University talks about educators, but his statement could encompass most well-trained technical people.

He states, "Many authorities in the field of education (science) reject religious articles of faith but consider scientific articles of faith 'worthy of all acceptation.' They apparently fail to realize that faith in the 'facts' of science can fasten the mind as securely as religious faiths. Moreover, today's technological society encourages and reinforces faith in science, thus making this faith potentially more damaging than a religious faith might be."

You mention, "real phenomena are well-understood phenomena." Well understood by whom? The man deciding to accept or reject an idea, or the man who has developed the idea. Fewer subjects are less understood or have more untrue "facts" believed in than the field of invention.

Your editorial dwells on "gadgeteer" saying that, "The essence of the thing is that gadgeteers inevitably precede scientists. A gadgeteer does something that works; at some time science catches up with the gadgeteer." Unfortunately there is enough truth in that statement to mislead one believing it is completely true.

The problem, more often than one might think, is that the so-called gadgeteer knows the whys, wherefores and the answers but

they are unacceptable to science because they are different from the facts as presently known by science. If De Forest never invented the vacuum tube does it follow that we wouldn't have our present day technology? Would the transistor or a different better method of developing things electronic have been discovered?

Dr. Haggerty, President of Drexel Institute of Technology can wax quite eloquently on the "fact" that education (formal) takes creativity out as it puts knowledge in. Science develops in a way analogous to a draftsman drawing a straight line. He puts three reference points on the paper with a ruler and then draws the line. Science makes physical discoveries and then draws between them. Is it not possible that some assumptions, made many years ago, were either partially wrong or else inferior to other "discoveries" that would have made the development of that particular technology more rapid? An apparent insinuation you make is that if a "gadgeteer" makes a discovery because he is not limited by a fixed fount of knowledge that he is violating some physical law because of his ignorance.

I'm presently in the process of marketing a loudspeaker that represents new technology. Two weeks ago I was demonstrating a portable unit for use in mob control to the NYC Police Department. (It has a 360-degree circle of sound.) While most people evaluating the item were intrigued, the electronic "Expert" in the department regaled me for an hour with the "technical" reasons why the speaker he was listening to wouldn't work.

You mention aspirin. It's true what you say. One of our gadgeteers has spent more than ten years in research on arthritis. Dr. Ehrlich invented aspirin to combat arthritis. Unfortunately many of his original papers were lost which leaves to speculation the reasons why he believed aspirin works. I believe we now know. We are in the process of attempting to prove it scientifically. We have a real problem in getting people in the medical field to listen to us. We've been told time and again that "It's assinine to think that any one outside of the the medical field could come up with an important development for the medical field."

Dr. Jacob Schmookler, Professor of Economics, University of Minnesota puts it this way: "To assert that an invention is made because it was possible to make it, or that a commodity will be produced because it has been invented is on par with the statement that the Golden Gate Bridge was built because the building art permitted it. The missing ingredient is the man to recognize that the demand and the knowledge are both there."

George E. Frost of Frost, Bermeister & Kulie says, "One of the clear lessons of history is that the

'Experts' in both industry and government are likely to miss important technical leads, to assume that some particular technical approach is the only practical approach and to resist fresh thoughts. With surprising frequency it is the uninhibited outsider who comes forth with the key concept that breaks technical bottlenecks. This applies both on the level of research and the level of application of technology."

Sir Alexander Fleming had determined the principal properties of penicillin and wrote a paper on the subject in 1929 which was made available to the world; yet it was almost fifteen years before someone saw fit to make it available for public use. During this time our congress considered a complete revamping of our patent system as they felt it was partially responsible for the depression because it didn't provide more technology to spur economic development. It would be interesting to analyze the patents issued during that period to find those that represented true technological progress with a commercial value but were never developed because of the resistance of "Science" to new technology.

Al Reynols, Marketing Manager for the New Product Division of the 3M company told me, last July, that their present R & D Department, of which he is proud, could never have come up with the adhesive which is the basic of their tape business. He gave me an analogy by way of explanation. The product they are now selling, used for covering racetracks, was an R & D project for quite some time. A maintenance man working in the area heard of the project and asked for permission to also work on the problem, which was granted. After the R & D department gave up on the project, this man came in with the finished product just as they are selling it now.

Taking the field of invention, which includes the development of creativity and the production of the creations, as a whole and comparing its development with the progress of man kind I believe it is still in the dark ages.

The foment the world, through the rejection of so many of old structures and standards, presents us with a golden opportunity to bring purpose and meaning to the lives of those who compose our world society. It behooves us to recognize this opportunity and bend our wills to creating the atmosphere necessary to the development of this opportunity. I wish I had the time to explain the exciting projects that Bob Woodbury and I are involved in leading to this end.

JACK WORSFOLD
353 S. Main Street,
Bel Air, Maryland 21014

It's obvious that anything a gadgeteer does must conform to the real laws of the Universe—however they

violate "the known Laws of Science."

The fundamental law on that is simple: "Anything that has ever happened is something the laws of the Universe permit. Otherwise it wouldn't have happened in this Universe."

Dear Editor:

Your argument that dowsing works because it is in practical use with good results leads to interesting results if applied to the Roman custom of consulting the sacred chickens before conducting any important public business.

Sacred chickens were in use for many centuries, and Rome won war after war with their help. A few headstrong Romans rejected their advice, with uniformly disastrous results. Suetonius tells the following story: "Claudius Pulcher (an ancestor of Nero) began a sea fight off Sicily, though the sacred chickens would not eat when he took the auspices. He threw them into the sea in defiance of the omen, saying that they might drink since they would not eat. He was defeated."

Some centuries later the sacred chickens were discarded and the Augurs replaced by Saints with new and evidently less efficacious superstitions. The Empire was promptly overrun by barbarians, and the Italian reputation for military success fell from the superb Roman to the abysmal present level.

It follows that President Johnson can get really good advice, with time tested reliability, by firing a few cost/effectiveness analysts and converting their Pentagon suite into a henhouse.

W. H. CLARK
3134 South Meadowlark Drive,
Salt Lake City, Utah

Well, you've sure got a logical argument. That does not, of course, mean it's necessarily rational, because of the selection-or-evidence effect in getting your basic postulate.

Dear John:

The testing and use of drugs has always been a sensitive, and somewhat secretive area. I am a medical student, and as such, am probably a little better informed, and possibly a little more concerned than most.

Tobacco, or nicotine in particular, like alcohol, LSD, heroin, morphine, thalidomide—indeed, like nearly any drug or medicine available, has both good effects and bad. In some cases, like thalidomide, the deleterious side effects can be quite simply avoided or compensated for; in others, like LSD and, in my opinion, tobacco, they cannot. The weight of evidence for cigarette smoking as a probable causative agent in lung disease is enough of a reason for me not to smoke. Any beneficial effects would have to be great indeed to weigh effectively against that hazard; they do not appear to be great.

The other point to be made—

two points, actually—is about LSD. It has been noted in sundry medical journals (which clippings I have somewhere in my files, and which I could find for those interested) that LSD has been experimentally shown to produce chromosome damage. This may help answer the question of "What sort of children are they going to produce?" Mutants.

In my histology course, we got one lecture/slide show about an elephant. It seems that somehow some researchers discovered that there is a compound in the lacrimal secretion of elephants that is similar to LSD. The hypothesis was that, if enough collected, and was ingested, it might cause the rage that elephants are known to go into occasionally. They prepared a dose of LSD, mistakenly calculating dosage by body weight, however, instead of brain weight. The result was that the 10,000 pound animal received a fifty-times overdose by human standards. He went into a rage, all right. And was dead in five minutes!

I have always held that intelligent people that smoke, or drink and drive, or take LSD, get what they deserve.

JAMES R. SAKLAD
153 Morris Avenue
Providence 6, Rhode Island

One important job of medicine has been separating the side effects from the desirable effects of a drug. How about doing that for nicotine, instead of simply damning the whole thing because of some unneeded side effects.

Moreover, truly honest statistical analysis shows air pollution, not cigarette smoking, is the carcinogenic agent!

South Africans are the world's heaviest smokers of cigarettes, with Australians second. Yet South Africa and Australia—settled from England—have a far lower lung cancer rate among heavy smokers than England has among nonsmokers!

Dear Mr. Campbell:

"There Is a Tide" in the January issue is an exceedingly fine story; in my opinion one of the finest you have published in recent years. Miss Richmond and Mr. FitzPatrick are worthy of high praise for their achievement.

However, there is one important respect in which the story is in error, and it is an error that I suspect is probably due to your influence. Frederic Sklowdowska, as he is presented and allowed to speak for himself in the story, is not a theoretical physicist, except possibly in initial training. He is a philosopher.

I do not say this in any vague sense, either commendatory or pejorative. It is simply the case that the particular problem he is presented as attempting to deal with, and the particular types of considerations he finds it fruitful to examine, are not in the realm of any kind of

physics, but are classically philosophical. A physicist who speaks about time-binding, and who characterizes human intelligence as operating essentially in time rather than in space, and who describes time as three-dimensional, making in addition the distinction between time as duration and as sequence, is no more speaking within and out of his role *qua* physicist than was Albert Einstein in any of his celebrated speculations about deity and design in the universe. An airy reference to "mathematical equations," even though it is a derogatory reference, does not make Sklowdowska's speculations belong to the realm of philosophy—nor, for that matter, does the use of Marie Curie's maiden name. And it is not, of course, at all certain that a precise description of the nature of space and time, and of their relation to each other, either needs to be or can be mathematized.

As a student of philosophy, I cannot say that I found Sklowdowska's statements, such as they were, either startling, original, or especially illuminating. This is not to criticize the authors, who could not be expected to be wholly familiar with such an exceptionally difficult and rather technical field as the philosophy of time; they showed enough such familiarity for the needs of the story.

But I think the fact that they found it necessary to label their character a "theoretical physicist" rather than a philosopher, reflects one of your own very strong prejudices. All things considered, your prejudice against philosophy, particularly some forms of contemporary academic philosophy, is not wholly without foundation. But the contemptuous chuckle and snort of "Bah, humbug!" that I can readily imagine you emitting as you read this letter, is not, I submit, consonant with fair, considered, and informed opinion on the matter.

It would take too long, and would distract from my attention to matters more immediately pressing for me, to attempt to fully justify my contentions in this letter, or to give you a reasonably full bibliography of writings on the philosophy of time. However, with hesitation—since I have not completed the book myself and am therefore unwilling to vouch for it unreservedly—I might commend to your attention the recent Anchor paperback, "The Philosophy of Time," edited by Richard M. Gale.

I would conclude with the suggestion that you hereafter give the philosopher, like the devil (an intimate friend of yours if some reports are to be believed—his just due.

M. David Stein
1575 Oak Avenue
Evanston, Illinois 60201

But—all the great mathematical physicists are, in an older terminology, Natural Philosophers. Einstein certainly was, and how about Russell, Shannon and Wiener?

Inherited Xenophobia

continued from page 7

that you can't take blood from one man's arm, run it through a rubber tube or the like, directly into another man's veins and expect it to be, and remain, free of clots. Blood is very specially designed to clot and plug up leaks in the circulatory system; the trigger of that clotting reaction is contact with something other than the special lining of blood vessels. Rubber tubes aren't lined with blood-vessel tissue. In the early days they sometimes got away with it by making a direct blood-vessel-to-blood-vessel transfusion —more by good luck than technical validity.

When blood-typing was discovered, the success of blood transfusions rose to a practicable level; instead of being a desperate last-chance, what-have-we-got-to-lose measure, it became a therapeutic technique. The discovery of the simple anticlotting techniques involving sodium citrate vastly improved matters.

The reason those two "organ transplants"—corneas and blood—worked was simply because (1) the cornea has no blood circulation, and the immune reaction isn't triggered by reason of no contact, and (2) blood is a temporary thing anyway. A skin graft fails because it is sloughed off in a matter of a few weeks; blood has a service life of only a few weeks anyway. The transfused blood is rapidly destroyed, too—but not before it's served its temporary purpose. It's rather like the suture materials a surgeon uses in suturing internal tissues; they're made of chemically treated animal tissues which are attacked by the body and dissolved away in a matter of a couple of weeks—by which time they've served the intended purpose of holding the wound closed until healing has knit the tissues again.

As the immune reaction became better recognized, efforts at organ transplants were largely abandoned; about the only consistent efforts were in the direction of skin grafts. Man-to-man skin grafts never "take" except in the case of genetically identical twins—it is, in fact, the current best proof of "one-egg" twinship. Fraternal twins may look alike—but skin grafts won't "take."

If you don't have an identical twin, and must have a skin graft—the surgeon will take skin from one part of your body and graft it where needed.

This recognition of homografting as a successful technique led to bone grafts, on the same basis; a piece of a bone from one part of a patient's body could be sawed out and installed in another place to act as a bridge, so that sound bone could grow around it and unite separated damaged bone-ends.

That technique worked, and many a patient had function restored after what would have been a permanently crippling injury. Homografts worked.

Grafts from identical twins worked. Even complex organs such as kidneys could be grafted between identical twins.

But that genetic xenophobia blocked efforts between nonidentical-twin individuals. To optimize the chances of success, the blood types of the two individuals had to be matched, for the biochemistry of the blood is naturally matched to the other cells of the organism.

As the immune reaction became understood, and surgeons found it blocking their efforts, their natural response was to seek ways and means of suppressing that xenophobia. If only that damned xenophobia didn't act up, this man, dying because of diseased kidneys, could be given this perfectly healthy and functional kidney from this other individual who has just been killed in an accident. But make the transplant—and the stupid immune reaction kills the transplanted organ that could save the whole organism, if it were only given a chance.

They found ways to suppress the immune reaction—with predictable results. With no immune reaction, the body's defenses against disease collapsed. Antibiotics are wonder drugs—but they aren't *that* wonderful! There are a lot of germs that antibiotics don't bother much. So far as I know, none of the suppressed-immune-reaction patients has lived long enough to have time to develop cancer, but that would probably show up; the Internal Security system wouldn't be able to react against traitors, deviants and crackpot cells.

Inasmuch as the immune-suppression techniques involve heavy doses of carcinogenic drugs and radiations, even a perfectly normal, healthy person subjected to that therapy could reasonably be expected to develop cancer.

But as I say, I know of no case where survival has been extended enough for that reaction to appear.

It seems to me that the approach now being attempted is, at the very best, a blowout-patch, temporary expedient type of thing.

It works just fine for blood transfusions—because blood's inherently temporary.

It will never work for more complex, normally permanent organs—because that immune reaction, that ancient IFF system, *must* be retained to defend the organism against the would-be invaders that are constantly menacing us.

The first successful human heart transplant—a magnificent achievement of surgical technique—was performed by a South African surgical team; a dying girl's heart was transplanted into the chest of a man

dying of heart disease. The girl was dead before the operation was begun, of course—but she died in the hospital after an automobile accident, solely due to mechanical injury, not to any breakdown of health. And the team of surgeons was able to know sufficiently before her death that she would die—with a crushed skull there was no chance of life—and make the necessary elaborate preparations.

The man was dying anyway—it was a matter of days at most for him: the gamble was worth it.

And the operation was completely successful—a true triumph of exquisite surgical technique and skill.

The result can be predicted as death; at this writing Mr. Louis Washkansky hasn't yet died, but the result will be death.

Initially, the tissues were not well matched; the girl's blood type was O, the "universal donor" type. She could have given Mr. Washkansky a blood transfusion, because the O-type blood does not carry antibodies that attack either type A, B, or AB. But a blood transfusion is a temporary thing anyway; a heart transplant is intended to be permanent. The Type O heart tissues were not a match for anything but a Type O recipient—and Mr. Washkansky was not.

Second, the IFF mechanism obviously has to work on the basis of genetic coding of the cells. The only thing that is "the same" about all the cells in any individual's body is that they all carry exactly the same genetic code—whether they specialized as nerve cells, kidney cells, heart muscle or pituitary cells, they all stemmed from the same original fertile ovum cell. Genetically they are identical—which is why grafts between one-egg twins are as successful as homografts. The Security Force reacts against any cell that does not carry the genetic code of native-born citizens in good standing—and *only* descendants of that original fertile ovum, of all the entities in the Universe, carry that precise genetic coding.

The tissues of the heart donor were markedly different; she was a young woman, and, therefore, had, in every cell, one more chromosome than did the cells of the man.

The immune-reaction suppression drugs and radiation did suppress immediate rejection reactions, and the transplanted heart functioned well in its new environment; healing of the wound proceeded normally.

But actually, the immune reaction cannot be completely suppressed, even temporarily. That genetic xenophobia is far too deep in the cells; it's been in our genes not for mere millions of years—it's been there for at least a billion years. And it's been absolutely essential to survival through all billion years. It's not something that's going to be tossed overboard lightly or easily.

The "suppression" seems, rather, to be a disturbance, a distortion, of

the mechanism. Like a man who's been knocked on the head heavily, it's dazed and confused.

Mr. Washkansky's confused IFF system seems to have made a serious mistake in that dazed condition; when the immune reaction system recovered enough to act—it "recognized" his own lung tissue as "foe" apparently.

The effort at organ transplantation by any means is valid—when there is nothing else possible. The South African team proceeded correctly; both patients had nothing whatever to lose, and there was a chance of very great gain in knowledge.

But the approach to transplantation by suppression of that crucially important immune reaction is invalid—save only as a measure of recognized desperation, recognized as, at the very best, a short-term expedient. Interfere with the IFF system only at your dire peril; upset it and it may react against your own tissues, or simply fail to react against any invading germ. In either case, your normal, healthy life is ended; in one case your own tissues destroy themselves; in the other, you can live only in a sterile, germ-free, totally-sealed environment. Antibiotics can't replace your natural antibody defenses.

The approach to true organ transplantation is, it seems to me, to accept the nature of that genetic xenophobia, and comply with it. Homografts succeed brilliantly. Use that approach.

True—while a man has skin to move from one spot to another, and bone can be shifted around, and the wounds heal—who's got a spare heart to move into place? Unless you had an identical twin who happened to get killed in an accident that didn't injure his heart, where can you get a homograft heart?

I think the answer is "Grow one!" Grow a spare heart, kidney, liver—whatever it is that's needed.

That's not impossible; organs can be kept alive *in vitro*; it's been found that kidney or liver cells, chopped up bits of kidney, stirred in nutrient solution, will cluster and reorganize themselves in a definite effort to reconstruct an organ.

This field is almost unexplored—yet half a century ago Alexis Carrel showed that a bit of chicken heart could be kept alive and grew rapidly as long as anyone wanted to supply the fresh nutrient medium.

Biopsy techniques have been developed which permit samples of the tissues of almost any organ to be abstracted. Cultured to grow a new complete organ, that substitute would have the identical genetic code of the individual from whom the cells were taken. They would, therefore, constitute a homograft—and there would be no immune reaction to contend with.

True; there's a long road of research and development to be traversed down that path. But that

path conforms with the gigayear-old demands of the immensely important survival characteristic—genetic xenophobia. It fits a very deep and ancient law of nature.

The present bulldozer approach, seeking to suppress that law of nature, is inherently contra-scientific. True science does not seek to override, or discard, laws of nature—it seeks to understand and apply them.

To grow a new organ will take time, of course, just how long we cannot really guesstimate at this juncture. What can be done, then, for a man who suddenly has to have a replacement for an inoperative heart—and can't wait a few weeks to culture a new one?

I suspect the external mechanical heart will be a better solution; we already know that the body can tolerate—and for extensive periods—metal and plastic structural materials, without upsetting the IFF system. The fact that such a mechanical contraption is unsatisfactory by reason of clumsiness, and dependence on a technological power supply does not inhibit its use as a stopgap measure while a new homograft organ is being grown.

Normally, kidney failures give months of notice; there would be adequate time for new organ growth; if special circumstances require immediate help, the clumsy, but workable artificial kidney devices are already available. Livers, spleens, a dozen different organs could be replaced successfully *as homografts*.

And with no need to disturb the intricate, highly sophisticated, and enormously effective immune reaction, it would no longer be a case of "by a feat of brilliant surgical technique, the operation was successful . . . but the patient died."

It's long been suggested that, if organ-transplant techniques were successfully developed, some really sticky ethical problems would start popping up. Ruthless, powerful, dying men would not be content to wait in hope that someone with the right blood and tissue type would happen to be killed in an accident that didn't injure the needed new organ. Accidents can be produced to order.

But so long as the ancient genetic xenophobia operates—even if that heterograft organ were ruthlessly arranged for—it could mean only a short span of miserable, defenseless semi-life.

The homograft approach will take a lot of research that hasn't yet been started—but that road is clear of legal, ethical, and moral blocks. It's also scientifically sound—because it doesn't seek to override, to suppress, a law of nature.

It just requires a full, hard developmental effort along the line of organ culture. A developmental approach that respects and works with, not against, a law of nature—which is the essence of sound science. ■ The Editor.

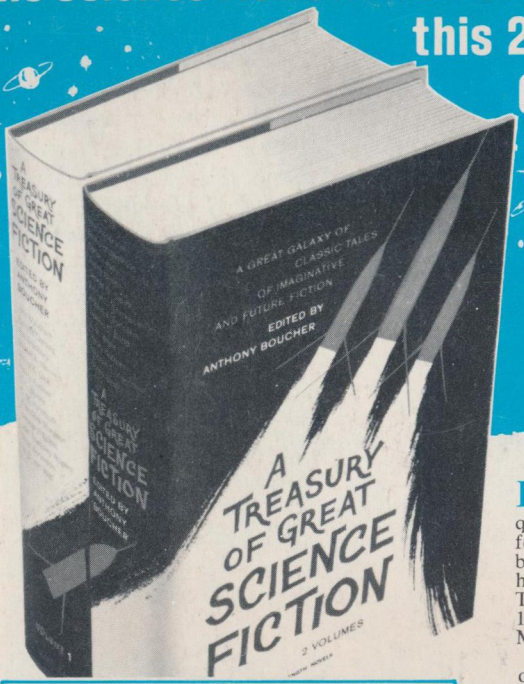
Buy Bonds where you work. They do.

Over 90% of the 101st Airborne Division's 1st Brigade has signed up for U.S. Savings Bonds through the Payroll Savings Plan. That's what their Minute Man flag signifies. These men, now in Vietnam, deserve your support. When you purchase Savings Bonds regularly, you show the men of the 1st Brigade you're with them. And you walk a bit taller.

Buy U. S. Savings Bonds

The Science Fiction Book Club invites you to take this 2-volume Treasury of Great Science Fiction *for only* 10¢

when you join the Science Fiction Book Club and agree to accept only 4 books during the coming year.



A TREASURY OF GREAT SCIENCE FICTION
Edited by Anthony Boucher

Two giant volumes. Over 1000 pages of exciting fiction. A handsome addition to your library. Includes John Wyndham's classic **Re-Birth** . . . Heinlein's **Waldo** . . . Anderson's **Brain Wave** . . . a total of 4 full-length novels, 12 novelets, 3 short stories by such masters as Bradbury, Arthur Clarke, Judith Merril, Alfred Bester, A. E. Van Vogt, C. M. Kornbluth, Theodore Sturgeon — and more.

How to Get This Unusual Value

BECAUSE you enjoy Science thrillers, the Science Fiction Book Club would like to acquaint you with the most imaginative, informative, entertaining new science fiction books as they are written. That is why we have arranged to send you this 1000-page Treasury of Great Science Fiction for only 10¢ — to help cover shipping — with a Trial Membership in the Club.

Here's how the Club works: each month it offers a really superb new science fact or fiction book at a fraction of its regular price. Even though these books sell for $4.95, $5.95 and more in their original editions, club members get special full-length, hard-cover editions, FOR ONLY $1.49 each (unless you choose to take an extra value selection at higher prices). And the Club tells you in advance what each monthly selection will be. During your Trial Subscription you agree to take as few as four books in the next twelve months. After that you may take as few or as many books as you want, and you may cancel at any time.

SCIENCE FICTION BOOK CLUB
Dept. 84-AEX, Garden City, N.Y. 11530

Please accept my application for membership in the Science Fiction Book Club and rush me The Treasury of Great Science Fiction. I enclose 10¢ to help cover shipping. Then, every month, send me the Club's free bulletin, "Things to Come," which describes coming selections. For each book I accept, I will pay $1.49 plus shipping and handling, unless I take an extra value selection at a higher price. I need take only four books within a year and may resign any time thereafter.

NO-RISK GUARANTEE. If not delighted with my introductory package, I may return it in 10 days, pay nothing, owe nothing, and my membership will be canceled.

Name _____
(Please Print)

Address _____

City _____ State _____ Zip _____

If under 18 parent must sign here (Offer good in U.S.A. only.) 23-573C

3. FOLD COIN POCKET OVER COUPON

SAFETY COIN HOLDER

1. FOLD DOWN OVER DIME

PLACE DIME HERE

2. FOLD UP OVER DIME

DO NOT TAPE OR SEAL

NO RISK GUARANTEE

If not delighted with introductory package, return it within 10 days to cancel membership. Mail coupon to: Science Fiction Book Club, Garden City, New York, 11530.