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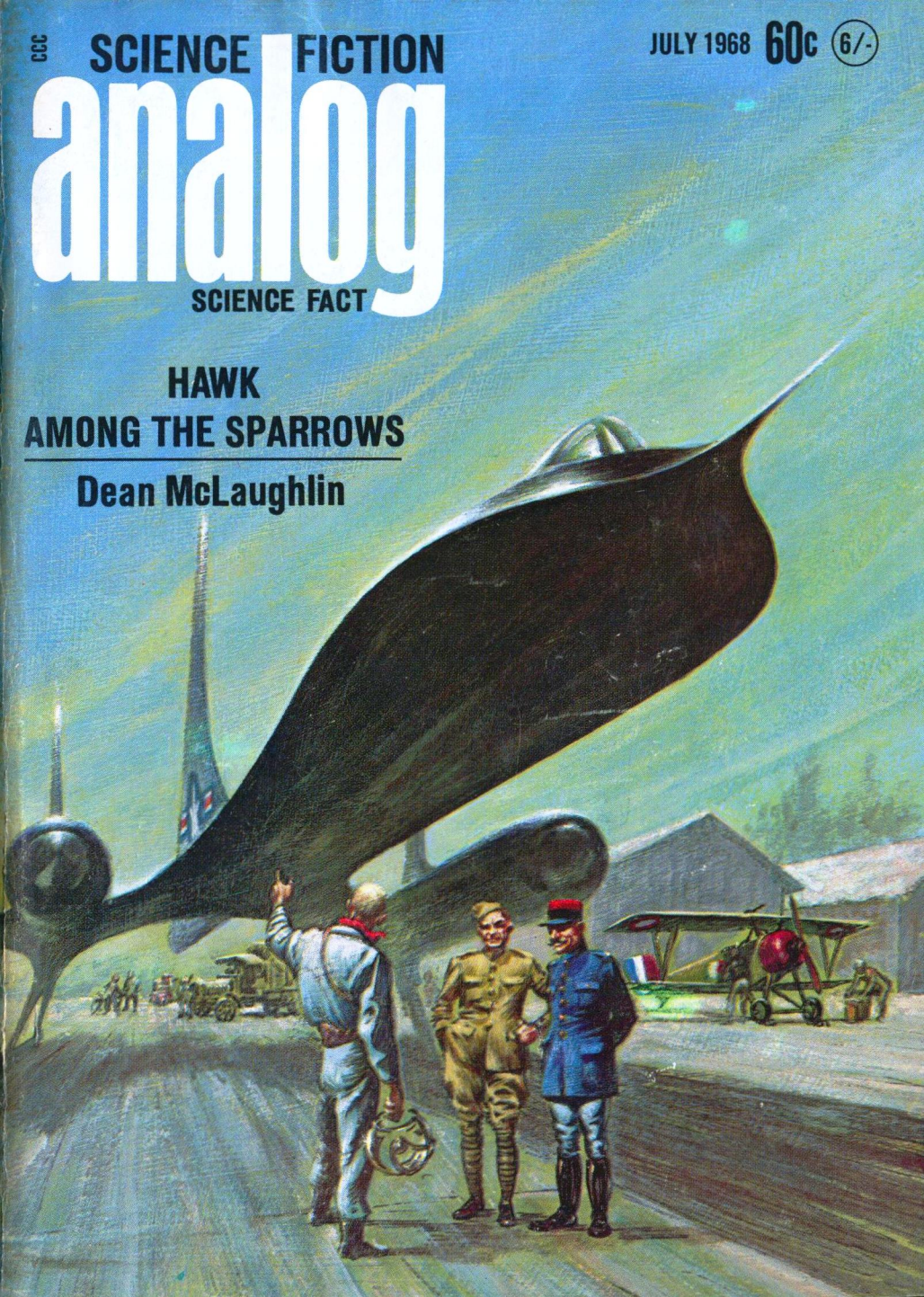
HAWK AMONG THE SPARROWS

Dean McLaughlin



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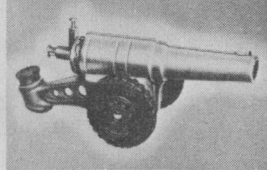

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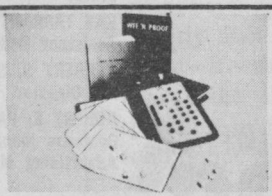

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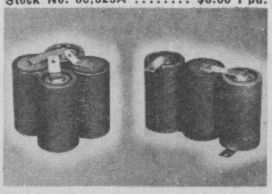

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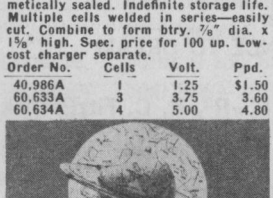

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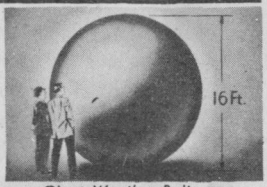

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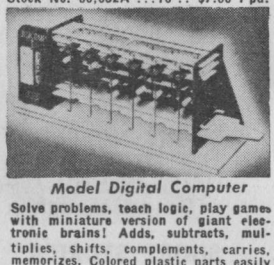

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NEXT ISSUE ON SALE
July 9, 1968
$6.00 per year
in the U.S.A.
60 cents per copy

Cover by
Kelly Freas

Vol. LXXXI, No. 5 July 1968

Analog Science Fiction/Science Fact is published monthly by the Condé Nast Publications, Inc. Executive, Publishing, Editorial and Advertising offices: 420 Lexington Avenue, New York, N.Y. 10017. I.S.V. Patcevitch, President; Alfred W. Cook, Treasurer; Mary E. Campbell, Secretary. Second class postage paid at New York, N. Y. and at additional mailing offices, under the Act of March 3, 1879. Subscriptions: in U.S. possessions and Canada, $6 for one year, $10 for two years, $13 for three years. Elsewhere, $8 for one year, $16 for two years. Payable in advance. Single copies: In U.S., possessions and Canada, 60¢. Six weeks are required for change of address. In ordering a change, write to Analog Science Fiction/Science Fact, Boulder Colorado 80302. Give both new and old address as printed on last label. The editorial contents have not been published before, are protected by copyright and cannot be reprinted without the publisher's permission. All stories in this magazine are fiction. No actual persons are designated by name or character. Any similarity is coincidental. We cannot accept responsibility for unsolicited manuscripts or art work. Any material submitted must include return postage.

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the non-gold crisis

an editorial by John W. Campbell

Gold is an unusual metal. Of course, every element, metallic or nonmetallic, is inherently unique—by the definition of "element." But gold is unique in other ways—historically, and physically. Only two metals, gold and its close chemical cousin copper, are naturally colored, and no metal can match gold for the range of beautifully colorful alloys it can form—from a brilliant purple Au-Al alloy to the bright green Au-Fe alloys.

It's one of the very few elements that normally occurs free in the metallic state in nature in any quantity here on Earth. (Sure, the iron-nickel family occurs in far greater quantities in space!)

Early man discovered gold, naturally—it was there to see, glittering in the sands of streambeds sparkling in fractured rocks, even solid lumps weighing many pounds. The Golden Fleece that the Argonauts sought were quite real—not mythical, as many moderns believe. A lot of the mountain tribes of the Middle East had discovered that, if the waters of mountain streams were allowed to wash over a sheepskin, grains of gold would be trapped in the fleece—while the lighter sand grains washed on through. Hence—golden fleeces were a real article of commerce!

Gold was a highly workable metal; it can be melted readily and with practically no loss in an ordinary charcoal fire. (Iron takes a very special furnace; the melting point is too high for an open charcoal fire—and it has a bad tendency to oxidize. So does copper, tin, or lead.) Gold is the most malleable of metals; it could be shaped by beating almost indefinitely; copper and bronzes work-harden, become brittle and shatter. It was great for making ornaments for kings and princes—though of no earthly use as weapon or armor. It's so soft you could chop holes in it with a fire-hardened wooden stick.

But gold is a unique thing to the human senses—it feels, looks, even tastes different from all others. Cop-

per, lead or iron has a taste—the readily recognized "metallic" taste. Tin, silver and gold do not.

But gold is yellow—a bright, sunlight yellow rather than the deeper, duller color of copper. Gold is heavy—with a density better than twice that of lead. No one who had ever actually held a gold brick would be fooled by a gold-plated lead brick. It *feels* different.

Gold won't corrode—even buried a thousand years in some forgotten hoarder's cache, while copper coins corroded away, and silver turned black and crusty, gold coins emerged shining yellow. It was the ancient symbol of wealth, incorruptibility, and purity.

For some seven thousand years of history, gold *was* wealth; gold *was* money.

The earliest coins were created by the fabled (and perfectly real) King Croesus, the first to mint gold coins. The "gold of Croesus" is around today—strange coins, in our eyes, yet the first true coins. They're about the size and general shape of coffee beans, with a small design stamped into one side. Just little drops of molten gold allowed to harden, and then stamped with a government mint mark. The mint mark was simply the official Royal Government's stamp certifying that this lump of gold had such-and-such a weight, and was pure gold. They were invented and made for the purpose of supplying commercial buyers and sellers with small, convenient pieces of gold bullion, certified as being of proper weight and purity. A great and very useful convenience in expediting trade.

There aren't many left in the world. What few there are are worth perhaps ten dollars for the gold content—and, if you're lucky to attend the right numismatics auction, you may see one when some major collection is broken up. The price is not, be assured, anything like ten dollars. I've very much wanted to get one myself—but not *that* very much!

However, we do have a series of coins representing the great empires man has built. A coin of Alexander the Great—of Augustus Caesar—the Islamic Empire—the Eastern Roman Empire of Justinian—of the first commercial empire, the Republic of Venice—of Ferdinand and Isabella—of Queen Elizabeth I—and of Victoria Regina.

Those early coins, Greek, Roman, Islamic, Venetian, were government-certified pieces of bullion. Sturdy, solid, well-made disks of gold, with clearly stamped designs on obverse and reverse.

The coins of the late Renaissance, the Spanish and English coins, are wholly different. Elizabeth's coin has a cracked planchette; the coin is so thin that when the marking die struck it solidly, to give a clear impression, the metal was practically cut through. The Spanish coin is equally thin—but the die wasn't struck quite so hard. It's almost il-

legible as a result, but the flimsy planchette wasn't broken.

Of course the coin of Victoria Regina is well and soundly made; it's sturdy, with a beautifully clear, strong die-impression, and beautifully designed so that the rim of the coin is the thickest part, permitting the coins to stack properly. (Alexander's coin is thickest where the bas-relief of Alexander's face—done with true artistry!—is placed. You couldn't stack such coins, naturally; the middle is rounded thicker than the edges.)

There's more than history-book style history built into the coins; they also express the economic philosophy of the times. Originally, gold *was* money, and the coins were strictly certified pieces of gold bullion. Therefore, the coin was designed to have a predetermined weight in sturdy, compact form, with a clearly legible certification stamp.

By the late Renaissance, something wholly new had been added to commerce; most of the world's trade, by that time, was being conducted by letters of credit—by exchange of trusted promises. A man's success depended on having others trust the value of his word—his credit rating—so that if he sent a promise to pay, a man in a distant city would know that that man's promise would be fulfilled.

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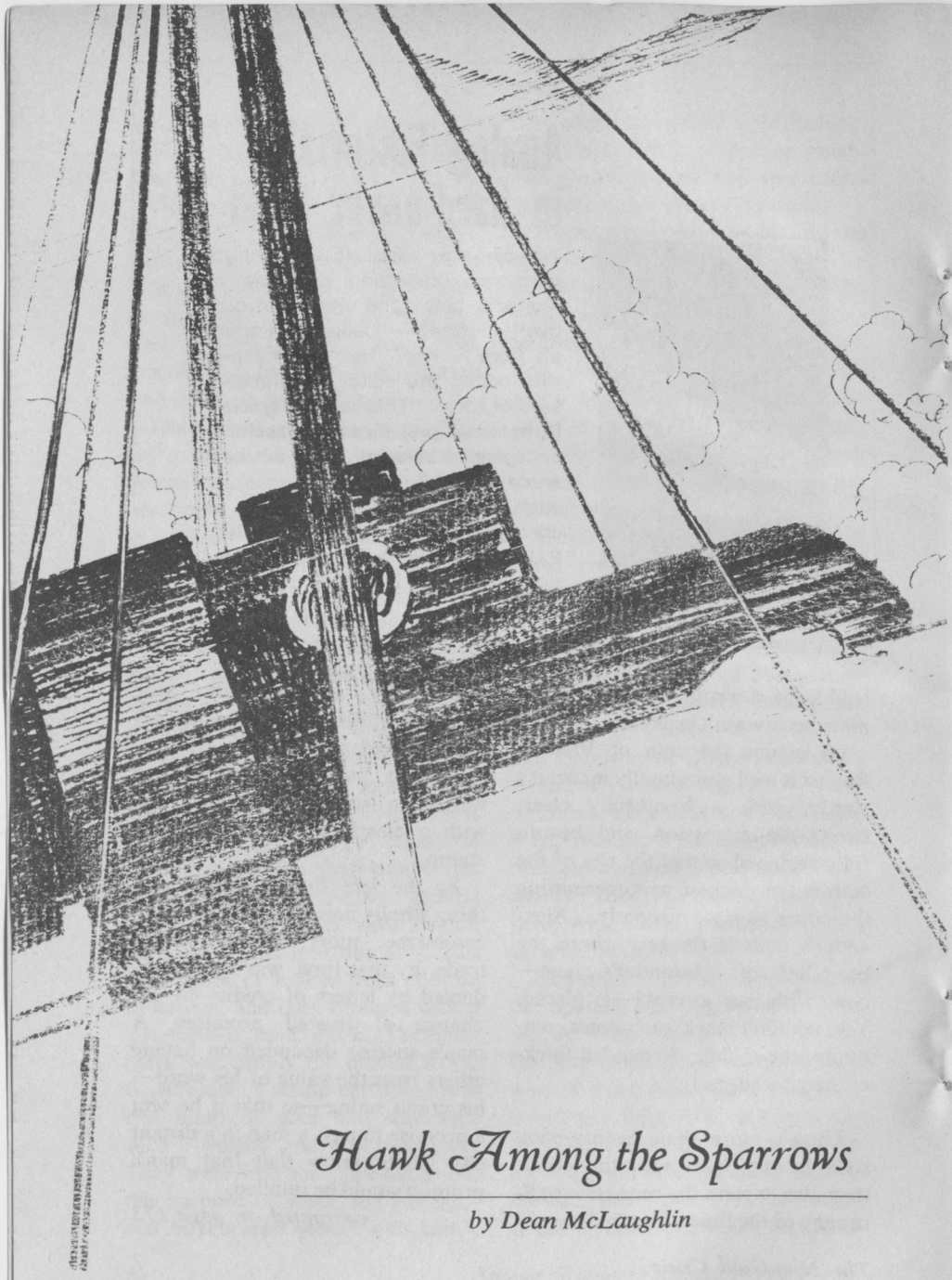


Hawk Among the Sparrows

by Dean McLaughlin

Throw an ultra-modern, nuclear-missile-armed supersonic fighter back through time against WWI planes—and what chance would the wood-and-cloth planes of that era have?!

Illustrated by Kelly Freas

The map-position scope on the left side of *Pika-Don*'s instrument panel showed where he was, but it didn't show airfields. Right now, Howard Farman needed an airfield. He glanced again at the fuel gauge. Not a chance of making it to Frankfurt, or even into West Germany. Far below, white clouds like a featureless ocean sprawled all the way to the horizon.

Those clouds shouldn't have been there. Less than four hours ago, before he lifted off the *Eagle,* he'd studied a set of weather satellite photos freshly televised down from orbit. Southern France had been almost clear—only a dotting of cottonboll tufts. It shouldn't have been possible for solid overcast to build up so fast. For the dozenth time, he flipped through the meteorological data on his clipboard. No, nothing that could have created such a change.

That made two things he hadn't been able to figure out. The other was even stranger. He'd lifted from the *Eagle's* deck at midmorning. The French bomb test he'd been snooping had blinded him for a while—how long he didn't know—and *Pika-Don* was thrown out of control. The deadman circuit had cut in; control was re-established. When his sight came back—and it couldn't have been terribly long—the sun had been halfway down in the west.

It wasn't possible. *Pika-Don* didn't carry enough fuel to stay up that long.

Just the same, she'd stayed up, and she still had almost half her load. When he couldn't find the *Eagle* near Gibraltar, he'd thought there was enough to take him to the American airbase at Frankfurt. (And where could the *Eagle* have gone? What could have happened to her radar beacon? Could the French blast have smashed *Pika-Don's* reception equipment? Everything else seemed to work all right. But he'd made an eyeball search, too. Aircraft tenders didn't just vanish.)

On the map scope, the Rhone valley crawled slowly southward under the north-moving central

piplight that marked *Pika-Don*'s inertially computed position. It matched perfectly the radar-scanned terrain displayed on the airspace viewscope on the right-hand side of the instrument panel. Frankfurt was still beyond the horizon, more than four hundred miles off. *Pika-Don* didn't have fuel to cover half that distance.

Well, he wouldn't find an airfield by staying up here, above that carpet of cloud. He eased the throttles back and put *Pika-Don*'s nose down. She'd burn fuel a lot faster down close to the deck, but at mach 1.5 he could search a lot of ground before the tanks went dry.

Not that he absolutely had to find an airfield. *Pika-Don* could put down almost anywhere if she had to. But an airfield would make it a lot simpler to get a new load of fuel, and it would make less complicated the problems that would come from putting down in a technically still friendly nation.

It was a long way down. He watched the radar-echo altimeter reel downward like a clock thrown into panicked reverse; watched the skin temperature gauge edge up, level out, edge up again as *Pika-Don* descended into thicker air. For the first eighty thousand feet, visibility was perfect, but at twelve thousand feet *Pika-Don* went into the clouds; it was like being swallowed by gray night. Uneasily, Farman watched the radar horizon; these clouds might go down all the way to the ground, and at mach 1.5 there wouldn't be anything left but a smear if *Pika-Don* hit. She was too sweet an airplane for that. Besides, he was inside.

He broke out into clear air a little under four thousand feet. A small city lay off to his right. He turned toward it. Beaufort, the map scope said. There'd be some sort of airfield near it. He pulled the throttles back as far as he dared —just enough to maintain airspeed. The machmeter slipped back to 1.25.

He passed north of the town, scanning the land. No sign of a field. He circled southward, careful to keep his bearing away from the town's center. There'd be trouble enough about his coming down in France—aerial trespass by a nuclear-armed warplane, to start with—without half the townspeople screaming about smashed windows, cracked plaster, and roosters that stopped laying eggs. The ambassador in Paris was going to earn his paycheck this week.

Still no airfield. He went around again, farther out. Dozens of villages flashed past below. He tore his flight plan, orders, and weather data off their clipboard—crammed the papers into the disposal funnel; wouldn't do to have nosy Frenchmen pawing that stuff, not at all. He substituted the other flight plan —the one they'd given him just in case he had to put down in French or French-friendly territory.

He was starting his third circuit and the fuel gauge was leaning against the red mark when he saw the field. It wasn't much of a place—just a grassy postage stamp with a few old planes in front of three ramshackle sheds and a windsock flopping clumsily over the middle one. He put around, aimed for it, and converted to vertical thrust. Airspeed dropped quickly—there was a momentary surge of wing-surface heating—and then he was hovering only a few miles from the field. He used the deflectors to cover the distance, losing altitude as he went. He jockeyed to a position near the hangars, faced *Pika-Don* into the wind, and let her down.

The engines died—starved of fuel—before he could cut them off.

It took a while to disconnect all the umbilici that linked him into *Pika-Don*'s control and environment systems. Some of the connections were hard to reach. It took a while longer to raise the canopy, climb over the side, and drop to the ground. Two soldiers were waiting for him. They had rifles.

The bigger one—the one with the bushy moustache—spoke dangerously. Farman didn't know French, but their gestures with rifle muzzles were a universal language. He raised his hands. "I'm an American," he said. "I ran out of fuel." He hoped they weren't disciples of the late *le grand Charles*. They looked nasty enough.

The two exchanged glances. "Americaine?" the smaller one asked. He was clean-shaved. His eyes had a deep, hollow look. He didn't sound at all displeased.

Farman nodded vigorously. "Yes. American." He pointed to the fifty-one-star flag on his coverall sleeve. Their faces broke into delighted smiles and they put down their weapons. The small one—he made Farman think of a terrier, and his rifle was absurdly big for him—pointed to a shack beyond the hangars. "Come."

Farman went. The area in front of the hangars had been paved—an uneven spread of asphalt. Half a dozen rattletrap airplanes stood in a line, facing out toward the field. Where the pavement met unpaved ground, it was one mud puddle after another. Farman had to be careful where he put his feet; his flight boots had been clean when he took off this morning. The soldiers didn't seem to mind. They splashed cheerfully through the wet and scuffed their heels on the tufts of grass.

The planes were all the same type—biplanes with open cockpits and two-bladed wooden propellers and radial-type piston engines. The kind of planes, Farman thought, that shouldn't even be flying any more. Nevertheless, they were obviously working airplanes, with oil stains on their cowls and the smell of gasoline and patches glued-over holes in the fabric of wings and

fuselage. A crop-dusting outfit? Did the French have crop-dusting outfits? Then he realized those things in front of the cockpits were machine guns. Air-cooled machine guns rigged to shoot through the propeller. And those odd, oval-shaped tail assemblies . . .

Some kind of museum?

"That is a strange aeroplane you have," the moustached soldier said. His accent was as thick as the grass on the field. "I have not seen one like it."

Farman hadn't known either of them spoke English. "I'll need to make some phone calls," he said, thinking of the ambassador in Paris. A mechanic was working on one of the planes they passed; he was standing on a wooden packing crate, tinkering with the engine.

A movie outfit, doing a period flick? But he didn't see any cameras.

Another biplane taxied in from the field—a Nieuport, like the others. Its engine racketed like a lawnmower. It joggled and bounced in the chuckholes. There were a lot of chuckholes in the mud at the pavement's fringe. The plane came up on the pavement and the engine cut out. As the propeller turned around to a spasmodic stop, Farman realized that not just the propeller but the whole engine had been spinning. What kind of crazy way to build airplanes was that?

The Nieuport's pilot climbed up out of the cockpit and dropped to the ground. "Guns jammed again!" he yelled loudly, hellishly mad. He flung a small hammer on the ground at his feet.

Three men came out of the hangar carrying packing crates. They set them down around the Nieuport's nose, got up on them, and started working on the guns. The flier pulled off his scarf and draped it over the cockpit's side. He turned away, spoke a few French words to the mechanics over his shoulder, and walked off.

"*Monsieur* Blake!" the big soldier hailed. When the flier didn't seem to hear, the soldier ran to him, caught his shoulder. "*Monsieur* Blake. A countryman." The soldier beside Farman pointed to the flag on Farman's sleeve.

Blake came over, stuffing a goggled cloth helmet into a pocket of his heavy overcoat as he approached. His hand was out in welcome.

"This one has teach all my *Anglais* to me," the big trooper grinned. "Is good, *non*?"

Farman scarcely heard him. All his attention was on this American. "Harry Blake," the man introduced himself. " 'Fraid I won't be able to hear you too good for a while." He swung a glance at his Nieuport's motor and raised hands to his ears to signify deafness. He was young —not more than twenty-two or three—but he had the mature poise of a man much older. "I'm a Lafay-

ette with this outfit. From Springfield, Illinois. You?"

Farman accepted the hand in numb silence. Calling himself a Lafayette, he'd obliterated Farman's last incredulous doubt. It wasn't possible—not real. Things like this didn't happen.

"Hey, you don't look so good," Blake said, grabbing his arm with a strong hand.

"I'll be all right," Farman said, but he wasn't really sure.

"Come on," Blake said. He steered Farman into the passageway between two of the hangars. "We've got what you need back here."

The troopers came after them. "*Monsieur* Blake. This man has only now arrived. He has not reported."

Blake waved them away. "I haven't either. We'll report later. Can't you see when a man's breathed too much oil?"

The soldiers turned back. Blake's hand steered Farman onward. Puddles slopped under Blake's boots.

Behind the hangars, the path split in two directions. One way led to a latrine whose door swung loose in the breeze. The other led to a shack huddled up to the back of a hangar. It was hard to guess which path was more frequently used. Blake paused at the parting of the ways. "Think you can make it?"

"I'm all right." He wasn't, really. It takes more than a deep breath and a knuckling of the eyes to adjust a man to having lost six decades. Between books about aerial combat he'd devoured as a kid—two wars and all those brushfire skirmishes—he'd read some Heinlein and Asimov. If it wasn't for that, he'd have had nothing to hang on to. It was like a kick in the belly.

"I'll be all right," he said.

"You're sure? You breathe castor oil a few hours a day and it doesn't do a man's constitution much good. Nothin' to be embarrassed about."

Every now and then, Farman had heard castor oil mentioned, mostly in jokes, but he'd never been sure what it did to a man. Now he remembered it had been used in aircraft engines of this time. Suddenly, he understood all. "That's one problem I don't have."

Blake laughed. "It's a problem we all have." He pushed open the shack's door. Farman went inside at his nod. Blake followed. "Onree!" Blake called out. "Two double brandies."

A round little baldpated Frenchman got up from a stool behind the cloth-draped trestle that served as a bar. He poured two glasses almost full of something dark. Blake picked up one in each hand. "How many for you?"

Whatever it was, it looked evil. "One," Farman said, "for a start." Either this youngster was showing off—which didn't seem likely—or it

wasn't as deadly as it looked. "A double, that is."

Blake led the way to a table in the far corner, next to a window. It was a plain wood table, stained and scarred. Farman set his glass down and took a chair before he tried a small taste. It was like a trickle of fire all the way down. He looked at the glass as if it had fangs. "What is this stuff?"

Blake had sampled from each glass on the way to the table, to keep them from spilling. Now he was almost halfway through one of them and the other was close to his hand. "Blackberry brandy," he said with a rueful grin. "It's the only cure we've found. Would you rather have the disease?"

Flight medicine, Farman thought, had a long way to go. He put his glass carefully aside. "My plane doesn't use that kind of oil."

Blake was on him right away. "Something new? I thought they'd tried everything."

"It's a different kind of engine," Farman said. He had to do something with his hands. He took a sip of the brandy, choked, regretted it.

"How long you been flying?" Blake asked.

"Ten, twelve years."

Blake had been about to finish his first glass. He set it down untouched, looked straight at Farman. Slowly, a grin came. "All right. A joke's a joke. You going to be flying with us?"

"Maybe. I don't know," Farman said, holding his brandy glass in both hands, perfectly steady—and all the time, deep inside him, the small trapped being that was himself screamed silently, *What's happened to me? What's happened?*

It had been a tricky mission, but he'd flown a lot of tricky ones. Ostensibly, he'd been taking part in a systems-test/training exercise off the northwest coast of Africa. High altitude mach 4 aircraft, their internal equipment assisted by the tracking and computer equipment on converted aircraft carriers, were attempting to intercept simulated ballistic warheads making re-entry into the atmosphere. He'd lifted from the deck of the airplane tender *Eagle* in the western Mediterranean. Half an hour later he was circling at Big Ten—one-oh-oh thousand feet—on-station north of the Canary islands when the signal came that sent him on his true mission.

A guidance system had gone wrong at the Cape, said the talker aboard the *Iwo Jima,* and the range-safety system had failed. The misdirected warhead was arching over the Atlantic, farther and higher than programmed. Instead of splashing in the Atlantic, its projected impact-point was deep in the Sahara. It carried only a concrete block, not thermonuclear weaponry, but diplomatic relations with France—which still maintained military bases in this land it

had once governed—were troublesome. Standing orders for such an eventuality were that, as a good-faith demonstration, an attempt should be made to intercept it.

Operation Skeetshoot's master computer said Farman's *Pika-Don* was the only plane able to make the interception. No other plane was in the right position. No other plane had enough altitude, or fuel load. No other plane had such an advantageous direction of flight at that moment. Farman sent *Pika-Don* streaking toward interception point at full thrust.

As planned.

Nothing had really gone wrong at the Cape. It was a pretext. Washington knew the French were about to test a new model nuclear bomb. They would explode it above the atmosphere, in the radiation belt; the rocket would be launched from their main testing site, the Saharan oasis of Reggan; they would select the moment of launch to coincide with the arrival of a solar proton storm, when subnuclear particles from the storm would blend with the bomb's fission products, rendering surveillance by other nations more difficult and the findings less certain.

The proton storm had been already on its way when Farman left the *Eagle*'s deck. It was being tracked, not only by American installations around the world, but French stations also. Code message traffic was high between New Caledonia and Reggan. The time of the storm's arrival was known to within five seconds.

Farman hadn't paid much attention to why Washington wanted to snoop the test; the French were, after all, still allies in spite of the frictions between Paris and Washington. Asking questions like that wasn't Farman's job; he was just the airplane driver. But they'd told him anyway, when they gave him the mission. Something about Washington wanting to have up-to-date knowledge of France's independent nuclear capability. Such information was needed, they said, for accurate judgment of how dependent France might still be on America's ability to wage modern war. To Farman, the explanation didn't mean much; he didn't understand much about international politics.

But a warhead dropping into the atmosphere, sheathed in the meteor-flame of its fall—*that* he could understand. And a multi-megaton fireball a hundred miles up, blazing like the sun brought suddenly too close—that, too, he could understand. And a mach 4 airplane riding her shock-wave across the sky, himself inside watching instruments and flight-path guide scopes, and his thumb on the button that would launch the Lance rockets sheathed against her belly. Those were things he understood. They were his job.

Nor did the mission call for him to do more than that. All that was

really necessary was to have *Pika-Don* somewhere in the sky above Reggan when the French bomb went off. *Pika-Don* would do everything else, automatically.

All the planes in Operation Skeetshoot were equipped the same as *Pika-Don*. All of them carried elaborate flight recorders; and because they were fitted to intercept thermonuclear warheads, and their own Lance rockets had sub-kiloton fission tips, those recorders included all the instruments needed to monitor a nuclear explosion—even a unit to measure the still-not-fully-understood magnetohydrodynamic disturbances that played inside a nuclear fireball. (And it was known from previous tests, there was something unusual about the magnetic fields of French bombs.)

Nor would there be much risk if *Pika-Don* were forced down on French or French-friendly territory. All *Pika-Don* carried was standard equipment—equipment the French already knew about, in configurations and for purposes they also understood. There would be nothing the French could find to support a charge of deliberate snooping, no matter how much they might suspect. Not that the possibility was large; the explosion, after all, would be out in space. There'd be no blast effects, certainly, and very little radiation. Enough to tickle the instruments, was all.

And already the hot line between Washington and Paris would be explaining why an American plane was intruding on French-controlled airspace. Everything had been planned.

Farman watched his instruments, his flight-path guide scopes, his radar. *Pika-Don* slashed the thin air so fast she drew blood. She was up to one-thirty thousand now; rocket launch point lay five thousand higher, two hundred miles ahead. Reggan moved onto the edge of the inertial-guide map-position scope, ahead and off to the south. The projected trajectory of the warhead was a red line striking downward on the foreview guide scope. An X-slash marked Skeetshoot Control's computed interception point.

Something flared on the radar near Reggan. It rose, slowly for a moment, then asymptotically faster and faster, shining on the radar screen like a bright, fierce jewel. The French rocket. It had to be. Farman's breath caught as he watched it. The thing was going up. The test was on.

It rose, was level with him, then higher. Suddenly, it quivered like a water drop, and suddenly it was gone from the screen in an expanding black blindness like a hole in the universe; and simultaneously the cockpit was full of unendurable white light. The sky was flaming, so bright Farman couldn't look at it, didn't dare. He had just time enough to think, terrified, *Not in the radiaton belt!* and then *Pika-*

Don was spinning, spinning, spinning like a spindle—light flashing into the cockpit, then blackness, brightness, then blackness again, repeating and repeating faster and faster and faster until light and darkness merged to a flickering brilliance that dazzled not only the eyes but the whole brain. Farman battled the controls, but it was like fighting the Almighty's wrath. The flickering blaze went on and on.

And slowed, finally. Stopped, like the last frame of a halted movie projector, and it was only daylight again, and *Pika-Don*'s disabled pilot circuit had cut in. She was flying level, northwestward if the compass could be trusted, and the sun was more than halfway down in the west, although Farman was sure that much time hadn't passed.

The map scope confirmed the compass. So did the airspace radar view. The controls felt all right now, and *Pika-Don* seemed to fly without difficulty. He turned straight north toward the Mediterranean and came out over it not far from Oran. He curved west then, toward the spot he'd left the *Eagle*. He watched the foreview guide scope for the *Eagle's* homing beacon. It didn't come on. He spoke on the radio, got no answer. Equipment damage?

He took *Pika-Don* down to fifty thousand. He used the telescope-view scope on the ships his radar picked out. None were the *Eagle;* old freighters, mostly, and two small warships of a type he'd thought weren't used any more except by the Peruvian Navy.

His orders said, if he couldn't find his base ship, go to Frankfurt. The big base there could take him. He turned *Pika-Don* northwestward. He crossed the French coast. Overcast covered the land. It shouldn't have been there. Fuel began to run low. It was going into the engines faster than the distance to Frankfurt was narrowing. He tried to cut fuel consumption, but he couldn't cut it enough. He had no choice but to put down in France.

"Look, Mister. Either you've got orders to fly with us, or you don't," Blake said. "What outfit are you with?"

It was restricted information, but Farman didn't think it mattered much. "The CIA, I think."

He might as well have said the Seventh Cavalry with General Custer. "Where's your base?" Blake asked.

Farman took another swallow of brandy. He needed it, even if not for the reason Blake thought. It wasn't so bad, this time. He tried to think of a way to explain the thing that had happened to him. "Did you ever read 'The Time Machine'?" he asked.

"What's that? A book about clocks?"

"It's a story by H. G. Wells."

"Who's H. G. Wells?"

He wasn't going to make much explanation by invoking H. G. Wells. "It's about a man who . . . who builds a machine that moves through time the way an airplane moves in the air."

"If you're having fun with me, you're doing it good," Blake said.

Farman tried again. "Think of a building—a tall building, with elevators in it. And suppose you don't know about elevators—can't even imagine how they work. And suppose you were on the ground floor, and suppose I came up and told you I was from the twentieth floor."

"I'd say that's doing a lot of supposing," Blake said.

"But you get the idea?"

"Maybe. Maybe not."

"All right. Now imagine that the ground floor is now. Today. And the basement is yesterday. And the second floor is tomorrow, and the third floor is the day after tomorrow, and so on."

"It's a way of thinking about things," Blake said.

Give thanks the elevator was invented. "Take it one step more, now. Suppose you're on the ground floor, and someone comes down from the twentieth floor."

"He'd of come from somewhere the other side of next week," Blake said.

"That's the idea," Farman said. He took more of the brandy. He needed it. "What if I told you I . . . just fell down the elevator shaft from sixty years up?"

Blake appeared to consider while he started on his second glass. He permitted himself a smile and a chuckle. "I'd say a man's got to be a bit crazy if he wants to fly in this war, and if you want to fight Huns you've come to the right place."

He didn't believe. Well, you couldn't expect him to. "I was born in 1946," Farman told him. "I'm thirty-two years old. My father was born in 1920. Right now, it's nineteen . . . seventeen?"

"Nineteen *eighteen*," Blake said. "June tenth. Have another brandy."

Farman discovered his glass was empty. He didn't remember emptying it. Shakily, he stood up. "I think I'd better talk to your commanding officer."

Blake waved him back to his chair. "Might as well have another brandy. He hasn't come back yet. My guns jammed and I couldn't get them unjammed, so I came home early. He'll be back when he runs out of bullets or fuel, one or the other."

His back was to the door, so he had to twist around while still talking, to see who came in. The small, razor-moustached man draped his overcoat on a chair and accepted the brandy the barman had poured without having to be asked. "Today, *M'sieu* Blake, it was a small bit of both." His English had only a flavor of accent. "On coming back, I find I am left with one bullet."

"How was the hunting?"

The Frenchman gave a shrug that was as much a part of France as the Eiffel tower. "Ah, that man has the lives of a cat, the hide of an old bull elephant, and the skills of a magician."

"Keyserling?" Blake asked.

The newcomer took a chair at the table. "Who else? I have him in my sights. I shoot, and he is gone. It would be a shame to kill this man —he flies superbly!—and I would love to do it very much." He smiled and sipped his brandy.

"This is our CO," Blake said. "Philippe Deveraux. Thirty-three confirmed kills and maybe a dozen not confirmed. The only man on this part of the front with more is Keyserling." He turned to Farman. "I don't think I got your name."

Farman gave it. "He's just over from the States," Blake said. "And he's been funning me with the craziest story you ever heard."

Farman didn't bother to protest. In similar shoes, he'd be just as skeptical. "This Keyserling," he said. "That's Bruno Keyserling?"

He'd read about Keyserling; next to Richthofen, Bruno Keyserling had been the most hated, feared, and respected man in the German air force.

"Tha's him," Blake said. "There's not a one of us that wouldn't like to get him in our sights." He set his empty glass down hard. "But it won't happen that way. He's gotten better men than us. Sooner or later, he'll get us all."

Deveraux had been delicately sipping his drink. Now he set it down. "We shall talk of it later, *M'sieu* Blake," he said firmly. He addressed Farman. "You have been waiting for me?"

"Yes. I . . ." Suddenly, he realized he didn't know what to say.

"Don't give him the same you gave me," Blake warned. "Now it's business."

"You are a pilot, *M'sieu* Farman?" Deveraux asked.

Farman nodded. "And I've got a plane that can fly faster and climb higher than anything you've got. I'd like a try at this Keyserling."

"That could possibly be arranged. But I should warn you, *M'sieu* . . . Farman, did you say?"

"Howard Farman."

"I should warn you, the man is a genius. He has done things his aeroplane should not be possible to do. He has shot down forty-six, perhaps more. Once three in a day. Once two in five minutes. It has been said the man came from nowhere—that he is one of the gods from the *Nibelungenleid,* come to battle for his fatherland. He . . ."

"You might say I'm from nowhere, too," Farman said. "Me and my plane."

When Deveraux had finished his brandy and when Blake had downed his fourth, they went out in front of the hangars again. Farman wanted them to see *Pika-Don.*

Pika-Don would be sixty years ahead of any plane they'd ever seen.

Her skids had cut into the turf like knives. Blake and Deveraux examined her from end to end. They walked around her, their boottips whipping the grass. "Don't touch anything," Farman told them. "Even a scratch in the wrong place could wreck her." He didn't add that the rockets concealed under her belly could vaporize everything within a hundred yards. The false-skin strips that sealed them from the slipstream were supposed to be tamper-proof, but just to be safe Farman placed himself where the men would have to go past him to investigate *Pika-Don*'s underside.

Pika-Don was eighty-nine feet long. Her shark-fin wings spanned less than twenty-five. She was like a needle dart, sleek and shiny and razor-sharp on the leading edge of her wings. Her fuselage was oddly flat-bodied, like a cobra's hood. Her airscoops were like tunnels.

Blake crouched down to examine the gear that retracted the skids. Farman moved close, ready to interrupt if Blake started to fool with the rockets. Instead, Blake discovered the vertical thrust vents and lay down to peer up into them. Deveraux put his head inside one of the tail pipes. It was big enough to crawl into. Slowly, Blake rolled out from under and got to his feet again.

"Do you believe me now?" Farman asked.

"Mister," Blake said, looking at him straight, "I don't know what this thing is, and I don't know how you got it here. But don't try to tell me it flies."

"How do you think I got it here?" Farman demanded. "I'll show you. I'll . . ." He stopped. He'd forgotten he was out of fuel. "Ask your ground crews. They saw me bring her down."

Blake shook his head, fist on hips. "I know an aeroplane when I see one. This thing can't possibly fly."

Deveraux tramped toward them from the tail. "This is indeed the strangest zeppelin I have ever been shown, *M'sieu*. But obviously, a zeppelin so small—so obviously heavy . . . it can hardly be useful, *M'sieu*."

"I tell you, this is a *plane*. An *air*plane. It's faster than anything else in the air."

"But it has no wings, *M'sieu*. No propeller. It does not even have wheels on the undercarriage. How can such a thing as this gain airspeed if it has no wheels?"

Farman was speechless with exasperation. Couldn't they see? Wasn't it obvious?

"And why does it have so strong the scent of paraffin?" Deveraux asked.

A Nieuport buzzed over the hangars in a sudden burst of sound. It barrel-rolled twice, turned left,

then right, then came down onto the grass. Its engine puttered. Its wires sang in the wind. It taxied across the field toward them.

"That'll be Mermier," Blake said. "He got one."

Two more planes followed. They did no acrobatics—merely turned into the wind and set down. They bounced over the turf toward the hangars. One had lost part of its upper wing. Shreds of cloth flickered in the wind.

Blake and Deveraux still watched the sky beyond the hangars, but no more planes came. Blake's hand clapped Deveraux's shoulder. "Maybe they landed somewhere else."

Deveraux shrugged. "And perhaps they did not live that long. Come. We shall find out."

They walked to the other end of the flight line where the three planes straggled up on the hardstand. Deveraux hurried ahead and Mermier and then the other two fliers climbed out of their cockpits. They talked in French, with many gestures. Farman recognized a few of the gestures—the universal language of air combat—but others were strange or ambiguous. Abruptly, Deveraux turned away, his face wearing the look of pain nobly borne.

"They won't come back," Blake told Farman quietly. "They were seen going down. Burning." His fist struck the hangar's wall. "Keyserling got Michot. He was the only one of us that had a hope of getting him."

Deveraux came back. His face wore a tight, controlled smile. "*M'sieu* Farman," he said. "I must ask to be shown the abilities of your machine."

"I'll need five hundred gallons of kerosine," Farman said. That would be enough for a lift-off, a quick crack through the barrier, and a landing. Ten minutes in the air, if he didn't drive her faster than mach 1.4. Enough to show them something of the things *Pika-Don* could do.

Deveraux frowned, touched his moustache. "Kero-sine?"

"Paraffin," Blake said. "Lamp oil." He turned to Farman. "They call it paraffin over here. But five hundred gallons—are you nuts? There isn't an aeroplane flying that needs that much lubricating. Shucks, this whole *escadrille* doesn't use that much *gas* in a week. Besides, it's no good as a lubricant—if it was, you think we'd be using the stuff we do?"

"It's not a lubricant," Farman said. "She burns it. It's fuel. And she burns it fast. She delivers a lot of thrust."

"But . . . five hundred gallons!"

"I'll need that much just for a demonstration flight." He looked straight and firm into Blake's incredulous eyes, and decided not to add that, fully loaded, *Pika-Don* took fifty thousand gallons.

Deveraux smoothed his moustache. "In liters, that is how much?"

"You're going to let him . . ?"

"*M'sieu* Blake, do you believe this man a fraud?"

Challenged like that, Blake didn't back down. "I think he's funning us. He says he'll show us an aeroplane, and he showed us that . . . that thing over there. And when you want to see how it flies, he says it's out of fuel and asks for kerosine—*kerosine* of all things! Enough to go swimming in! Even if that's what she burns, he doesn't need anywhere near that much. And who ever heard of flying an aeroplane with lamp oil?"

Farman took Blake's arm, joggled it, made him turn. "I know," he said. "I'm telling you things it's hard to believe. In your shoes, I wouldn't believe me, either. All right. But let me have a chance to show you. I want to fight the Germans as much as you do." In his thoughts was the picture of a whole jagdstaffel of Albatrosses being engulfed by the fireball of one of *Pika-Don*'s rockets. They'd never even see him coming, he'd come at them so fast; even if they saw him, they wouldn't have a chance to get away. Sitting ducks. Fish in a barrel.

"Mister," Blake said, "I don't know what you want all that kerosine for, but I'm sure of one thing—you don't need it to fly. Because if I was ever sure of anything, I know that thing can't fly."

"*M'sieu* Blake," Deveraux said, moving in front of the American. "This man may perhaps be mistaken, but I do not think he lies. He has a faith in himself. We have need of such men in this war. If he cannot use the paraffin when we have obtained it for him, it will be given to the chef for his stoves. We shall have lost nothing. But we must let him prove his abilities, if he can, for if there is some portion of truth in his claims, why, it is possible that we have before us the man and the machine that shall hurl Bruno Keyserling from the sky."

Blake gave way grudgingly. "If you're funning us, watch out."

"You'll see," Farman promised, grim. And to Deveraux: "Make it a high-grade kerosine. The best you can get." A jet engine could burn kerosine if it had to, but kerosine wasn't a perfect jet fuel any more than wood alcohol could make good martinis. Kerosine was just the nearest thing to jet fuel he could hope to find in 1918. "And we'll have to put it through some kind of filters."

"M'sieu," Deveraux said. "There is only one kind of paraffin. Either it is paraffin, or it is not."

Two days later, while they were waiting for the kerosine to come, Blake took him up in a Caudron two-seater to show him the landmarks. It was a clear day, with only a little dust haze in the direction of the front. Farman didn't think much of learning the landmarks—

Pika-Don's map scope was a lot more accurate than any amount of eyeball knowledge. But the scope wouldn't show him the front-line trenches twisting across the landscape, nor the location of the German airfields. It might be useful to know such things. Farman borrowed flying clothes, and they were off.

The Caudron looked like nothing so much as a clumsy box kite, or a paleolithic ancestor of the P-38. Its two racketing engines were suspended between the upper and lower wings, one on either side of the passenger nacelle. The tail empennage was joined to the wings by openwork frames of wire-braced wood that extended back from behind the engines. It had a fragile appearance, but it held together sturdily as it lurched across the field like an uncontrolled baby carriage. Finally, after what seemed an interminable length of bumping and bouncing it lofted into the air at a speed that seemed hardly enough to get a feather airborne. A steady windblast tore at Farman's face. Hastily, he slipped the goggles down over his eyes. The climb to six thousand feet seemed to take years.

Blake didn't turn out of their spiral until they reached altitude, then headed east. The air seemed full of crests and hollows, over which the Caudron rode like a boat on a slow-swelled sea. Now and then, woozily, it swayed. A queasy feeling rooted itself in Farman's midsection, as if his stomach was being kneaded and squeezed.

Airsick? No, it couldn't be that. Anything but that. He was an experienced flier with more than ten thousand hours in the air. He couldn't possibly be airsick now. He swallowed hard and firmly held down.

Blake, in the forward cockpit, yelled and pointed over the side. Farman leaned over. The rush of air almost ripped his goggles off. Far below, small as a diorama, the trench systems snaked across a strip of barren ground—two latticework patterns cut into the earth, roughly parallel to each other, jaggedly angular like toothpick structures that had been crushed. Between them, naked earth as horribly pocked as the surface of the moon.

The Caudron had been following a rivercourse. The trenchlines came down from the hills to the south, crossed the river, and continued northward into the hills on that side. Ahead, over the German trenches, black puffs of antiaircraft fire blossomed in spasmodic, irregular patterns. Blake banked the Caudron and turned south, yelling something over his shoulder about the Swiss border. The antiaircraft barrage slacked off.

Recognizing the front would be no problem, Farman decided. He tried to tell Blake, but the slipstream ripped the words away. He reached forward to tap Blake's

shoulder. Something whipped his sleeve.

He looked. Something had gashed the thick fabric, but there was nothing in sight that could have done it. And for some unaccountable reason Blake was heeling the Caudron over into a dive. The horizon tilted crazily, like water sloshing in a bowl. The Caudron's wire rigging snarled nastily.

"Use the gun!" Blake yelled.

There was a machine gun mounted behind Farman's cockpit, but for a shocked moment Farman didn't grasp what Blake was talking about. Then a dark airplane shape flashed overhead, so close the buzz of its motor could be heard through the noise of the Caudron's own two engines. The goggled, cruel-mouthed face of its pilot turned to look at them. Blake threw the Caudron into a tight turn that jammed Farman deep in his cockpit. Farman lost sight of the German plane, then found it again. It was coming at them.

It was purple—a dark, royal purple with white trim around the edges of wing and tail, and around the engine cowl. Little flashes of light sparked from its nose, and Farman heard something—it sounded like thick raindrops—spattering the upper wing close to the passenger nacelle. Tracer bullets flashed past like quick fireflies.

"Use the gun!" Blake yelled again. They were climbing now. They leveled off, turned. The German plane came after them. "Use the gun!"

He was being shot at. It was appalling. Things like that didn't happen. In a moment, Farman was too busy to think about it. He got turned around in the cockpit, fumbled with the machine gun's unfamiliar handles. He'd never handled a gun like this before in his life. He found the trigger before he knew what it was. The gun chattered and bucked in his grasp. He looked all over the sky for the purple airplane. It was nowhere in sight. Blake hurled the Caudron through another violent maneuver, and suddenly there were three German planes behind them, high, the one with the white trim in front and the others trailing. The one with the white trim shifted a little to the left, turned inward again. It nosed down, gun muzzles flickering.

Farman swung the machine gun to bear on the German. He pressed the trigger. The gun stuttered and a spray of tracers streamed aft as if caught in the slipstream. They passed under the German, not even close.

Aerial gunnery wasn't something Farman ever had to learn. Combat was done with guidance systems, computers, and target-seeking missiles, not antique .30 caliber popguns. He raised the gun and fired another burst. Still too low, and passing behind the German, who was boring close in, weaving up, sidewise, and down as he came. The

gun didn't have any sights worth mentioning—no target tracking equipment at all. Farman wrestled with the clumsy weapon, trying to keep its muzzle pointed at the German. It should have been easy, but it wasn't. The German kept dodging. Farman emptied the machine gun without once touching the other plane. He spent an eternity dismounting the empty magazine and clipping another into place while Blake hurled the Caudron through a wild series of gut-wrenching acrobatics.

A section of the cockpit coaming at Farman's elbow shattered and disappeared in the wind. He got the gun working again—fired a burst just as the German sidled behind the Caudron's right rudder. The rudder exploded in a spray of chips and tatters. The German swung out to the right, gained a few feet altitude, turned in again and down again. His guns hurled blazing streaks. Blake sent the Caudron into a dive, a turn, a twist that almost hurled Farman out of his cockpit. Abruptly, then, the German was gone. Little scraps were still tearing loose from the rudder, whipped away by the slipstream.

"Where?" Farman shouted. He meant, where had the German gone, but his thoughts weren't up to asking a question that complicated.

"Skedaddled," Blake yelled back. "We've got friends. Look."

Farman twisted around saw Blake point upward, and looked. Five hundred feet above them five Nieuports cruised in neat formation. After a moment, the formation leader waggled his wings and they curved off eastward. Farman looked down and saw they were far behind the French lines, headed northwest. They were flying level and smooth—only the slow, gentle lift and descent of random air currents, like silence at the end of a storm. "You all right?" Blake asked.

"I think so," Farman said. But suddenly, as the Caudron slipped into a downdraft, he wasn't. His stomach wrenched, and he had time enough only to get his head over the cockpit's side before the first gush of vomit came. He was still there, gripping the coaming with both hands, his stomach squeezing itself like a dry sponge, when Blake circled the airfield and slowly brought the Caudron down to a three-point landing. All Farman could think—distantly, with the part of his brain not concerned with his own terrible miseries—was how long it had been since anyone, anywhere in the world, had even thought about making a three-point landing.

He wouldn't admit—even to himself—it had been airsickness. But after a while the horizon stopped wheeling around him and he could stand without needing a hand to steady him. He discovered he was very hungry. Blake went down to the mess hall and came back with

a half-loaf of black bread and a dented tin of *paté*. They went to the shack behind the hangars. Henri gave Blake a bottle of peasants' wine and two glasses. Blake put them down in the middle of the table and sat down across from Farman. He poured, and they went to work on the bread and *paté*.

"He was trying to kill us," Farman said. It just came out of him. It had been there ever since the fight. "He was trying to *kill* us."

Blake cut himself another slice of the bread. He gnawed on the leathery crust. "Sure. And I'd of killed him, given the chance. That's what we're supposed to do—him and us, both. Nothing personal at all. I've got to admit I wasn't expecting him, though. They don't often come this side of the lines. But . . ." He made a rueful grimace. "He's a tough one to outguess."

"He?"

Blake stopped gnawing, frowned. "You know who it was, don't you?"

The idea of knowing an enemy's name after such a brief acquaintance was completely strange to Farman. He couldn't even think it. His mouth made motions, but no words came out.

"Bruno Keyserling," Blake said. "He's the only man with an aeroplane painted that way."

"I'm going to get him," Farman said.

"Easier said than done," Blake said. His mouth turned grim. "You'll have to sharpen up your gunnery quite a bit, if you're going to make good on that."

"I'm going to get him," Farman repeated, knuckles white on the table.

The next day it rained. Thick, wet, gray clouds crouched low to the ground and poured down torrents. All patrols were canceled, and the fliers sat in the shack behind the hangars, drinking and listening to the storm as it pelted the shingles. At first light, when he woke and heard the rain, Farman had borrowed a slicker and gone out to *Pika-Don*. She was all right. He'd left her buttoned up tight, and the rain was doing her no harm.

Blake was still the only man Farman could talk with, except for Deveraux. None of the other fliers had more than a smattering of English. When they left the mess hall after a drab lunch, instead of returning to the drinking shack, Blake led him to one of the hangars. There, in a back corner, were stacked wooden boxes of ammunition and others full of the bent-metal sections of disintegrating-link machine-gun belts. Blake showed Farman how to assemble the links and how to check both the links and the cartridges for manufacturing defects. He handed Farman a gauge into which a properly shaped cartridge should fit perfectly, and they spent the next several hours inspecting cartridges and assembling belts of ammunition. It was tedious work.

Each cartridge looked just like the one before it. The imperfections were small.

"Do you always do this yourself?" Farman inspected his grimy hands, his split cuticles. He wasn't accustomed to this kind of work.

"Every chance I get," Blake said. "There're enough reasons for a gun to jam without bad ammunition being one of 'em. When you're up there with Keyserling's circus flying rings around you, all you've got are your guns and your engine and your wings, and if any of those go, you go. And it's a long way down."

Farman said nothing for a while. Rain drummed on the roof. Now and then came the clang of tools being used in another part of the hangar. "How come you're here?" he asked finally. "What's in it for you?"

Blake's busy hands paused. He looked at Farman. "Say that again, slower."

"This here's a French squadron. You're an American. What are you doing here?"

Blake snorted—not quite a chuckle. "Fighting Germans."

Farman wondered if Blake was making fun of him. He tried again. "Sure—but why with a bunch of Frenchmen?"

Blake inspected a cartridge, fitted it into the belt. He picked up another. "Didn't care to transfer," he said. "Could have, when they started bringing US squadrons over. But I like the plane I've got. If I transferred, they'd give me a plane the French don't want and the British don't want, because that's all the American squadrons are getting. Well, I don't want 'em, either." He dropped a cartridge in the reject pile.

"I didn't mean that," Farman said. "You joined before America got into the war—right?"

"Came over in Sixteen."

"All right. That's what I mean. Why help France?" He couldn't understand why an American would do anything to help the personal kingdom of *le grand Charles*. "You weren't involved," he said. "Why?"

Blake went on inspecting cartridges. "Depends what you mean, involved. I figure I am. Everyone is. The Germans started this war. If we can show the world it doesn't pay to start a war, then there won't be any more. I want that. This is going to be the last war the human race will ever have."

Farman went back to inspecting cartridges. "Don't get your hopes too high," he said. It was as near as he could bring himself to telling Blake how doomed his optimism was. The rain made thunder on the roof like the march of armies.

Late in the afternoon, two days later, three lorries sputtered into the supply area behind the hangars. They brought fuel for the *escadrille*, but also, crowded among the drums of gasoline were twenty hundred-liter barrels of kerosine

which were carefully put aside and trucked down to the mess hall's kitchen and then—when the error was discovered—had to be reloaded and trucked back up to the hangars again.

Farman had managed to rig a crude filtration system for the kerosine. The stuff they cooked with was full of junk. He'd scrounged sheets of silk, and enlisted a crew of mechanics to scrub empty petrol drums until their innards gleamed like the insides of dairy cans. He even managed to test the rig with a bucket of kerosine cadged from the kitchens. The process was glacially slow, and the end product neither looked nor smelled any different from the stuff he started with. But when he tried it in one of *Pika-Don*'s engines, the engine had started and—at low RPM—had delivered thrust and had functioned as it should until the tank was sucked dry. More important, when he inspected, none of the injectors had fouled.

He started the filtering process, and stayed with it through the night and all the next day. He had a mechanic to help him, but he had no confidence in the mechanic's understanding of how vital fuel quality was to an engine. It wasn't a thing an airplane mechanic of this time could be expected to know. Deveraux came around once, inspected the raw material and sniffed the filtered product, and went away again having said nothing.

Once, between missions, Blake came and sat to watch. Farman showed him the sludge the filters had taken out of the kerosine. Blake scowled. "It's still kerosine," he said. "You can't fly an aeroplane on kerosine any more than you can feed it birdseed. I don't know what you really want it for, but don't expect me to believe it's for flying."

Farman shrugged. "I'll take *Pika-Don* up tomorrow morning. You can tell me what you think tomorrow afternoon. Fair enough?"

"Maybe," Blake said.

"You think I'm a cushmaker, don't you."

"Possible. What's a cushmaker?"

Blake hadn't heard the story. Maybe it hadn't been invented yet. Farman explained it—the ultra-shaggy joke about the cushmaker who, obliged by an admiral to demonstrate his specialty, after commandeering a battleship and tons of elaborate equipment, and after arduous technological efforts, finally dropped a white-hot sphere of steel amid the ice floes of the Antarctic Ocean, where it went *kussh*.

Blake went away, then. "I'll say this. If you're pulling a deal, you're a cool one." He shook his head. "I just don't know about you."

Morning brought high, ragged clouds. They'd make no trouble for the demonstration flight. Farman waited beside *Pika-Don* while Blake took off and slowly climbed to ten thousand feet, circling over the field

the whole time. "I think we are ready, *M'sieu,*" Deveraux said, fingering his trim moustache.

Farman turned to his plane. "Better make everybody stand back," he said. Turbine scream wasn't gentle to unprotected ears. He climbed up on the packing crate —pulled himself up *Pika-Don*'s sloped side and dropped into the cockpit. Looking back, he saw the onlookers had retreated about twenty-five feet. He had quite an audience. He grinned. They'd back off a lot farther when he got the engines going.

He got the cockpit hatch down. He checked the seal; it was tight. He went through the pre-ignition cockpit check. He began the engine start-up cycle, felt the momentary vibration and saw the twitch of instruments coming alive. Engine One caught, ragged for an instant, then steady as the tachometer wound around like a clock gone wild. Its scream of power drilled through the cockpit's insulation. Farman started Engine Two, then Engine Three. He brought them up to standby idle. They burned smooth.

Good enough. He didn't have fuel to waste on all the pre-takeoff operations; some were necessary, some not. He did all the necessary ones, turned the jets into the lift vents, and brought them up to full power. By that time, *Pika-Don* was already off the ground. She bobbled momentarily in the light breeze, and rose like a kite on a string. The sprawling fuselage surface prevented him from looking down at the airfield; it didn't matter. They'd be watching, all right—and probably holding shriek-filled ears. He grinned at the trembling instruments in front of him. He wished he could see their eyes, their open mouths. You'd think they'd never seen a plane fly before.

He took *Pika-Don* up to ten thousand feet. Hovering, he tried to find the image of Blake's Nieuport on the airspace view scope. It didn't show. For a worried moment, Farman wondered if something had gone wrong and Blake had gone down. Then the Nieuport flew past him on the left, a little above. It turned to pass in front of him. He could see Blake's goggled face turned toward him.

Even then, there wasn't an image on the radar. Farman swore. Something was wrong with the equipment.

No time to fiddle with the dials now, though. *Pika-Don* was guzzling the kerosine like a sewer. He converted to lateral flight. As always, it was like the floor dropping out from under him. He moved all three throttles forward, felt the thrust against his back. For a frightened instant, he saw Blake had turned back—was coming straight at him, head-on. He'd warned Blake not to get ahead of him like that. But *Pika-Don* was dropping fast. At speeds less than mach 0.5 she had

the glide capability of a bowling ball. She slashed underneath the Nieuport with a hundred feet to spare. The altimeter began to unwind, faster and faster. The horizon lifted on the forward view scope like a saucer's rim.

He watched the machmeter. It was edging up. He could feel the drive of the engines, full thrust now, exciting him like they always did, hurling him across the sky. The altimeter steadied, began to rise again. He tipped *Pika-Don*'s prow upward and cracked the barrier in a rocketing fifty-degree climb. Blake's Nieuport was nowhere in sight.

At forty thousand he cut the engines back, leveled off, and started down. He had to search hard for the airfield; without the map scope he couldn't have found it. It was just another green field in a countryside of green fields. At five thousand feet he converted back to vertical thrust and let *Pika-Don* drop to a landing —quickly for most of the distance to save fuel, with a heavy retarding burst in the last thousand feet. He hovered a moment two hundred feet up, picked out a landing spot, and put down. According to the gauges, less than thirty seconds' fuel was left in the tanks.

He dropped to the ground without waiting for a packing crate to be brought. He stood and looked around in disbelief. There was hardly a man in sight, and none of the *escadrille's* planes remained on the field. He saw them, finally, small specks flying off eastward. He walked back to the hangars, perplexed. Was that all the impression he'd made? He grabbed the first man he found—a mechanic. "What happened?"

The mechanic grinned and made gestures and gabbled in French. Farman shook him and asked again —or tried to—in pidgin French. All he got was more of the same jabber and some gestures in the general direction of the front lines. "I know they went that way," Farman growled and flung the man away. He stalked back to the shack behind the hangars and asked Henri for a Scotch. He drank it, waited five minutes, and had another. He was deep into his fourth when the men came back.

They trooped into the shack, and Henri set a row of glasses on the counter and went down the line with the brandy bottle. As soon as a glass had been filled, a hand snatched it away. Blake came to Farman's table, a brimful glass in his hand, sat down.

"Howard," he said, "I don't know how that thing of yours works. I don't even know if you can call it an aeroplane. But I've got to admit you got it off the ground, and the only thing I ever saw go past me faster was a bullet. Now, if you'll just tell me one thing . . ."

"Anything you want to know," Farman said, abruptly raised from dejection to smugness.

"How can you fly when you don't have the wind on your face?"

Farman started to laugh, but Blake wasn't even smiling. To him, it wasn't an old joke. He was serious.

With effort, Farman controlled his amusement. "I don't need the wind. In fact, if the window broke, I'd probably be killed. I've got instruments that tell me everything I need to know."

He could see the skeptical expression shaping itself on Blake's face. He started to get up, not quite steady because of the Scotches he'd downed. "Come on. I'll show you the cockpit."

Blake waved him down. "I saw the cockpit. You've got so many things in there you don't have time to look outside. I don't know if I'd call it flying. You might as well be sitting at a desk."

Sometimes, Farman had thought the same thought. But all those instruments were necessary to fly a thing like *Pika-Don*. He wondered if he'd have taken up flying if he'd known it would be like that. "Or maybe a submarine?" he asked, not entirely sarcastic. "The thing is, did I fly circles around you, or didn't I?"

Blake's reply was a rueful shrug. "First, you hung there like a balloon. If I hadn't seen you, I wouldn't believe it. Then all of a sudden you were coming at me like something out of a cannon. I got to admit you had me scared. I never saw anything move like that thing of yours. By the time I got turned around you were out of sight. If we'd been dogfighting, you could of put a string of bullets through me from end to end, and I couldn't of got a shot off."

A shadow intruded onto the table between them. They looked up. "Indeed, *M'sieu* Farman," Deveraux said, "your machine's speed gives it the ability to attack without the risk of being attacked itself. I will not pretend to understand how it can fly with such small wings, nor how it can rise directly into the air, but I have seen it do these things. That is enough. I must apologize that we could not be here to applaud you when you landed."

So he'd made an impression after all. "Where'd you go? I thought you didn't have any patrols scheduled until this afternoon."

Deveraux pulled out a chair and sat down beside Blake. With delicate care, he placed a half-full wineglass in front of him. "That is true, *M'sieu*. But we heard the sound of big guns at the front, and our duty is to be in the air at such times, until the matter is clarified, doing such things as will assist our men in the trenches."

"I didn't hear any guns," Farman said. "When I got back here, it was as quiet as a bar mitzvah in Cairo."

He realized almost at once, seeing their faces, the metaphor had no meaning for them. Well, they hadn't heard of Social Security, either.

"It is curious," Deveraux said. "When we are come to the front, it is as you say—most quiet. The guns have stopped, and we see no aircraft but our own. We search for fifty kilometers along the front. There is no evidence of even small actions. When we come back, I message to commanders at the front, and they tell me there has been no action. Nor have guns in their sectors been made use of—theirs or the Boche—though it is curious . . . some do say that they have heard guns being used in other sectors. And you can see . . ." He pointed to the window—the clear sky. "It could not have been thunder."

He said it all with the innocent mystification of a small boy, still not sure of all the things in the universe. Farman suddenly laughed and Deveraux blinked, startled.

"Sorry," Farman said. "I just realized. It wasn't guns you heard. It was me."

"You, *M'sieu?* What jest is this?"

"No joke. What you heard was my plane. It makes a shock wave in the air, just like an explosion's." He looked at their faces. "You don't believe me."

Deveraux's wineglass was empty. Blake stood up, empty brandy glass in hand. He reached for Deveraux's glass, but the Frenchman put his hand in the way. Blake went to the bar with only his own glass. Farman nursed his drink.

"I do not pretend to understand this aeroplane of yours," Deveraux said. "But now that you have shown its abilities . . ."

"Some of them," Farman said. They'd only seen an iceberg tip of what *Pika-Don* could do.

"Yes. But now we have seen," Deveraux said. "I will agree, it is possible your machine could outmatch Bruno Keyserling."

"I know she can," Farman said.

"Perhaps," Deveraux said with a small smile, but very firm. "But I agree—it should be tried. If you will tell us where to mount the guns on your machine . . ."

"I don't need guns," Farman said. "Don't want them."

"But *M'sieu,* an aeroplane *must* have guns. Without guns, it is like a tiger without teeth and claws."

The thought of machine guns stuck on *Pika-Don*'s prow was a horror. "I've got my own weapons," Farman said. Blake came back, sat down heavily. His glass slopped a little on the table. "Machine guns would . . . they'd destroy her aerodynamic integrity. They'd . . . she probably couldn't even fly with them sticking out in the wind."

"Aerody . . . what integrity?" Blake snorted. "What are you talking about?"

Farman leaned forward. "Look. You've seen my plane. All right. Now—you've seen those overlapping strips along her belly, between the ports the skids retract into?"

"I have noticed," Deveraux said.

"There's a rocket under each one

of them," Farman said. "Just one of those can wipe out a whole squadron."

"Ah? How many rockets? Eight?"

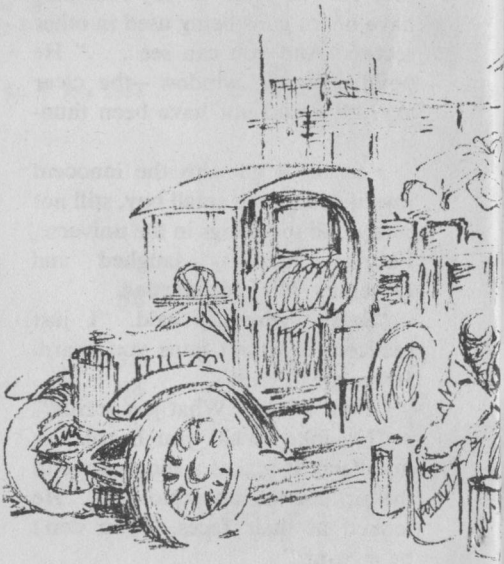
"Six," Farman said. "How many squadrons have the Germans got in this sector?"

"Two *jagdstaffels,*" Deveraux said. "They are quite enough." He shook his head. "But *M'sieu,* the men who planned the equipping of your aeroplane did not understand the needs of combat. It is assuming a marksman's skill beyond human abilities to believe that with only six of these rockets you could expect to be effective against enemy aircraft. One must remember, they are not motionless targets, like balloons. It is difficult enough to strike a balloon with rockets—balloons do not move—but to destroy an aeroplane . . . that cannot be done. Often I have expended all my ammunition—hundreds of rounds—without so much as touching my opponent. That you would imagine going into combat with a mere six possibilities of striking your target . . . this is folly. It is not worth the effort."

"They're not just things I shoot off," Farman said. Did he have to explain everything? "In fact, my plane's so fast any weapons system that depends on human senses couldn't possibly work. My rockets find their targets themselves. They are . . ."

He saw the utter disbelief on their faces. "Look," he said, "I've shown you my plane can do everything I told you it could. It flies faster and climbs faster than anything you ever saw. Now, if you'll give me enough fuel to take her up against Keyserling, I'll show you what my rockets can do. They'll wipe him out of the sky like a blob of smoke in a high wind."

"Bruno Keyserling is a very skilled and deadly man," Deveraux said. "A man impossible to kill. We have tried—all of us. He has killed many of our men, and he will send more of us down in flames before this war ends. I would suggest you be not so confident of yourself and your equipment."




PARAFIN

"Just give me enough kerosine for a mission," Farman said. "One mission. Let me worry about the rest of it." He wasn't worried at all. A dogfight between World War I model planes and something from 1975 would be like a wrestling match between a man and a gorilla.

"But *M'sieu,* you *have* the paraffin," Deveraux said, mildly puzzled. "You have almost two thousand liters."

Farman shook his head. "I burned that. There's just about enough left to fill that glass of yours."

Deveraux looked down at his empty wineglass. "*M'sieu,* you must be joking."

"No joke," Farman said. *"Pika-Don* flies fast and climbs like a rocket, but you don't get something for nothing—law of conservation of energy, if you know what that is. She drinks fuel like a sewer."

There was a silence—a silence, Farman realized, not only at their own table, but all through the shack. Maybe these fliers understood more English than he thought. Blake downed a large swallow of brandy.

"How much do you need for a mission?" he asked.

"Ten thousand gallons will do for a short one," Farman said. "An hour —hour and a half."

There was another long silence. *"M'sieu,"* Deveraux said at last, "I have wide discretion in the requisition of the usual materials. I am trying to balance in my mind the possible destruction of Bruno Keyserling—which is a thing we all desire—against the difficulty I must expect in explaining my request for so much kitchen fuel. And I remain in doubt you will be able to accomplish as successful as you claim. So I must ask—have I your word of honor as an American that you must have this paraffin to fly your machine?"

"You've got it, on a stack of Bibles."

"The good old USA is alive with con men," Blake said.

"*M'sieu* Blake," Deveraux said reproachfully, "we must not assume that a man tell lies because he claims ability to do a thing we cannot do ourselves. He is optimistic, yes. But that is a fault of almost all the young men who come to us. If we do not put him to the test, we shall not know if he could do the thing he claims or not."

Blake made a sour twist of his mouth. "All right. But how are you going to explain wanting forty thousand liters of kerosine?"

Deveraux cocked his head to one side, as if listening to a voice no one else could hear. "I think I shall merely tell a part of the truth. That we wish to try a weapon suggested by one of our men, a weapon which makes use of paraffin."

"Such as?" Blake asked.

"If they want details," Farman said, leaning forward, "tell them you're putting it in old winebottles and cramming a rag in the neck.

And before you drop the bottle on the Germans you set fire to the rag. The bottle breaks when it hits, and spills burning kerosine over everything."

Blake and Deveraux looked at each other. Delight animated their faces. "Now that's something I think might work," Blake said, rubbing his jaw. "Why didn't somebody think of it before?"

It was the first time Farman had heard him enthusiastic about something. This, at least, was a weapon they could understand. "It might work," he said. "But gasoline does it better. It's called a Molotov cocktail."

"M'sieu Farman," Deveraux said, "I think we shall try that, also." He stood up, wineglass in hand. "Henri!" he called. "More wine!"

Early that afternoon, two men came to the airfield fresh from training school. Boys, really; neither could have been more than seventeen. They were eager to get into the war—looked disconsolate as they came away from reporting to Deveraux. "They'll have to spend a day or two learning their way around," Blake said, a twisty smile curling his mouth. "Some guys just can't wait to get killed."

Their Nieuports were straight from the factory, new as pennies. The smell of dope and varnish surrounded them like an aura. Blake worked his way around them, a point by point inspection. The new men would be assigned to his flight. He peered intently at struts and wires and fabric surfaces. "Good aeroplanes," he said finally. Then it was time for him to go out on patrol. Three other men went with him. Farman watched them take off. They disappeared eastward. He went back and saw about readying his jerrybuilt filtration plant for the job of turning ten thousand gallons of cooking oil into aviation fuel.

At first light next morning, the new men stood beside their planes and watched the *escadrille* fly out on dawn patrol. They looked like children not invited to play. Farman went and checked *Pika-Don*; there was sign of a gummy deposit in her tailpipes, but a close inspection of her compressor blades showed they were clean, and none of the fuel injectors were fouled. He buttoned her up again and headed for the drinking shack. Until he got a shipment of kerosine, he'd have nothing to do.

The *escadrille* came back three hours later. If there'd been any Germans in the sky that morning, they'd made themselves hard to find. There'd been no action. Six planes refueled at once and went out again. Deveraux took the new men out on an orientation flight. In the afternoon, Blake and another pilot took the new men out for a mock dogfight. When they came back, Farman was waiting at the edge of the field; he'd had an idea he felt foolish for not having thought of

sooner—to make a start on the long kerosine-upgrading job by borrowing a barrel or two of the raw material from the mess hall. He needed Blake to translate and haggle for him.

As Blake taxied up onto the hardstand, Farman saw the tattered fabric fluttering from the right upper wing. He ran over as Blake cut the motor. "Hey! You've been in a fight!"

Blake dropped down from the cockpit. He stripped off helmet and goggles and gloves. Farman repeated his question. Blake grinned and pointed to his ears and shook his head. Farman pointed at the shredded wing.

"Yeh. I've been in a fight," he said, his voice loud as if he was trying to talk through the noise his motor had made.

Farman looked out at the other planes taxiing in from the field. "They're all right," Blake said. "We jumped a Pfalz—what he was doing way off there behind the lines, don't ask me. I got the observer interested in me"—he nodded at the damaged wing—"and Jacques moved in and put a few in the engine. Simple enough."

The other planes of the flight came up on the hardstand, and the mechanics moved in to turn them around and chock the wheels. The pilots climbed out, and the new men crowded around the other veteran—Jacques, Farman assumed. They pumped his arm and slapped his back and jabbered jubilantly. Jacques managed to break free of them long enough to reach Blake. He grabbed both Blake's arms and spoke with a warm grin. Blake looked a little embarrassed by the attention and managed, finally, to shrug off Jacques' hands without offending. By then the new men had closed in again. A rapid four-way conversation broke out.

Blake got loose again after a minute. "They never saw an aeroplane shot down before." He grinned. "Wasn't much of a shoot-down, really. Jacques put a few in the engine, and it just sort of went into a glide." He nodded at the three men; they were still talking energetically. "I guess they liked the show, even if they don't understand some of it. They're wanting to know why we didn't go on shooting after Jacques got their engine."

It sounded like a reasonable thing to ask. "Well, why didn't you?" He remembered to speak loud.

Blake shrugged. "Why kill 'em? There's enough people getting killed. They were out of the war as soon as their propeller stopped."

"Well, yes. Sure. But . . ."

"Oh, we made sure they landed close to a convoy on the road, so they'd be captured all right," Blake said. "Didn't want a pair of Huns running loose behind the lines."

"But they were Germans. The enemy."

Blake punched a finger into Farman's ribs. "Once Jacques got their

engine, they were just a couple of poor guys in an aeroplane that couldn't fly any more. We got no fight with guys like that. It's the man they worked for we're against. The Kaiser. Besides, that guy in the rear cockpit still had a lot of bullets in his machine gun, and he was sort of mad at us. I figure we were smart to keep our distance."

The new men had a few more training flights the next day, and the day after that they went out with the dawn patrol. The patrol met a flight of German machines led by Keyserling's white-trimmed purple Albatross. It was a fast, cruel scrap. Only one of the new men came back.

"We shouldn't of put 'em on service so quick," Blake said, nodding across the shack toward where the survivor was slowly drinking himself into numbness; he'd been in shock ever since he climbed out of his cockpit. "But we've got to have men. It takes three months to train a man enough so he's got a chance in the air—and Keyserling and his circus kill 'em in five minutes. Like swatting a fly." He picked up his brandy and downed it whole.

Deveraux came and put a hand on Blake's shoulder. "It is true," he said. "One might wish we did not so desperately need men to fight. But we fight a war to preserve civilization, and for that it is necessary that some good men die. And so we have lost one man today. And one other machine is damaged. Do not forget, Keyserling has lost two men in this morning's battle, and three of his aeroplanes will need considerable work before they fly again. We have done well, this day."

"Yeh. Sure. But he was just a kid," Blake said. His open hand banged on the table. Glasses rattled. "A poor, dumb kid. As green as—"

"To keep a civilization is worth a few lives, *M'sieu* Blake." Deveraux squeezed Blake's shoulder, held the grip a moment, let his hand slip away. He moved off to talk with the men at another table.

"Civilization," Blake muttered.

"Stick around," Farman said. If he lived long enough, Blake would know of Dachau, Bataan, Hiroshima, and the bloody mess France herself would make of her African colonies. And lots more.

"You haven't seen anything yet," Farman said.

The kerosine began to come two days later. It came spasmodically, in odd-sized lots: one day a demijohn arrived, the next—half a lorry load. Kerosine wasn't, to these people, a strategically vital petrochemical; it was a fluid used in lamps and stoves. It couldn't just be commanded up from the nearest supply dump in anything like the quantities a supersonic jet had to have. Genghis Khan's army might have been similarly inept at meeting a sudden, inexplicable demand

for a few thousand pounds of gunpowder.

June became July. The summer sun burned warm. There was talk of heavy fighting to the north, in a place called *Bois de Belleau*. Farman worked at the makeshift filters day after day. The smell of warm kerosine was a weight in his lungs, an ache in his brain. Some evenings, he was too sickened to eat.

The weeks blended into each other. He didn't have much idle time; there was always more kerosine to be poured into the system, or a filter to be changed and the clogged filter to be scraped and scrubbed and carefully examined for flaws before being used again. After a while, he stopped looking up when he heard the sound of airplane motors.

But in that time he saw airplanes lose power as they left the ground, stall, and nose stiffly into the turf. Their wings snapped like jackstraws. He saw a tattered plane coming back from a dogfight; it fell apart over the field and its pilot died in the wreck. He saw a man bring his plane down, taxi off the field, and die from loss of blood with the engine still running. And there were many times when he saw men watch the sky, searching for planes that would not come back, ever.

Some nights, he heard the big guns thunder at the front, like a grumbling storm just beyond the horizon. Muzzle flash and shellburst blazed in the sky.

Several days came when no new loads of kerosine arrived. He used that time to learn what he could about the Germans—their tactics, their formations, the capabilities of their planes. Not much of the information was useful—he'd expected that; matched against *Pika-Don,* they'd be almost motionless targets. But with only ten thousand gallons to fly on, it would be a good idea to know where he'd be most likely to find them. He wouldn't have much more time in the air than just enough to lift off, aim and launch rockets, and return to base. He started planning the mission.

"They stay mostly on their own side of the lines," he said to Deveraux. "All right. When I go up, I don't want you to have any planes on that side. I want to be sure any planes I find over there are theirs, not yours. I'll be going too fast to look at 'em close."

"You ask more than is possible, or even wise," Deveraux said. Breeze ruffled grass on the field. The Frenchman's scarf flapped and fluttered. "It is necessary always to have patrols in all sectors to protect our reconnaissance aeroplanes. If we do not patrol, the reconnaissance aeroplanes would be attacked. They could not do their missions. Perhaps it would be possible to remove patrols from one sector for a few hours—one in which none of our observation missions will be flying. Is not that as much as you shall need?"

"Not quite," Farman said. "I don't think you've thought it all the way through. You cover the front between the Swiss border and the Vosges Mountains. Right?"

"There are several *escadrilles* with which we share that duty."

"Yeah. Well, that's not important except they'll have to be warned off, too. What I'm asking now is, how many miles of front are you covering? Fifty? Seventy-five?"

"It is fifty kilometers," Deveraux said.

"All right. I'll be flying at about mach 2. At that speed, I can cover that much distance in three minutes. It takes me twenty miles just to get turned around. I can patrol the whole front, all by myself. You don't need to have anybody else out there."

Deveraux's face wore a scowlish mask. "So fast? I must assume you do not exaggerate, *M'sieu.*"

"At sixty thousand feet, I could do it twice that fast," Farman said. "But I'm going to cruise at forty. Air's too thick for full power flying that low down. I'd burn like a meteor."

"Of course, *M'sieu.*"

Farman couldn't be sure if Deveraux believed him or not.

"But I must say, it would seem you have not considered all the necessities," the Frenchman went on. "Even if you are able to patrol all the sectors, that would be true only should you not find a Boche patrol. Then you would move to attack it, and *voila,* you would be engaged in combat, *M'sieu.* You would cease to patrol. And it is not uncommon for the Boche to have four or five flights in the air at one time. Who would be protecting our observation missions while you are fighting?"

"I don't even want any observation flights on that side of the lines while I'm flying," Farman said. "Because I'm going to wipe that sky clean like a blackboard. If you have observation planes over there, they might get it, too. So you don't need to have any patrols out to protect 'em. Anyway, it won't take me more than five minutes from the time I've spotted a flight until I've launched rockets, and then I'll be free to go back on patrol. That's not much more than if I'd took time out for a smoke."

They heard, then, very faint but growing, the sound of aircraft motors. Deveraux turned to search the eastward sky for the approaching planes. "And have you thought, *M'sieu* what the Boche would be doing while you are shooting these rockets of yours? Bruno Keyserling and his men are aviators of consummate skill. They would not fly calmly, doing nothing, while you attack them. And even should your rockets each find a target, that would still be only one of their aeroplanes for each rocket. You have, I believe you said, only six."

"They won't even see me coming, I'll jump 'em so fast," Farman

said. "They won't have time to do anything but look surprised. And one of my rockets can . . ." He made a wipe-out gesture. "Look. All I'm asking—keep your planes on this side of the lines for a couple of hours. With only ten thousand gallons, I won't be able to stay out even that long. Am I asking too much? Two hours?"

The returning planes were in sight now. There were three of them, strung out, the one in the rear far behind the other two, losing altitude, regaining it, losing it again. Farman didn't know how many had gone out on that particular patrol—he hadn't been paying much attention to such things—but it was rare for a patrol of only three planes to go out. There would be some empty chairs in the mess, this evening.

The first plane came in to land. Its lower wing was shredded close to the fuselage—loose fabric fluttered like torn flags—and the landing gear wheel on that side wobbled oddly. As it touched down, the whole gear collapsed. The wing dipped—caught the ground—and flung the machine into a tangle of broken struts, tail high in the air. Men ran across the field. Farman caught a glimpse of the pilot's arm, waving for help. A thin black thread of smoke began to rise. A moment later it was a fierce inferno. No one could get near it. There wasn't a sign of the man. The second plane landed and taxied across the grass unheeded.

Deveraux turned to Farman again. "No, *M'sieu,*" he said. "You do not ask too much. It is we, who ask too much of men."

Farman boosted *Pika-Don* from the field while dawn was still a growing light in the east and all the land was gray. She lifted sluggishly; well, the gunk he was feeding her was a poor substitute for her usual diet. He took her to eight thousand feet before converting to lateral flight. She was down to four before she cracked the barrier and down to three and a half before she bottomed out and started to climb. The machmeter moved past 1.25. He raised *Pika-Don*'s nose and drove her at the sky.

She broke into sunlight at twenty thousand feet. The sun was gold and the air was as clean as clear ice. Somewhere in the darkness below two armies faced each other as they'd faced each other for four years. At forty thousand feet he leveled off and began his loiter pattern—a slim-waisted figure eight course, looping first to the south, then to the north—overflying the German lines from the Swiss border to the Vosges Mountains. He watched the airspace view scope for the pip that would be German aircraft.

Almost always, on good flying days, the Germans sent up patrols a few minutes before sunrise, to intercept the reconniassance planes the French almost always sent over on good flying days. Bruno Keyserling would be leading one of

those patrols. Farman watched particularly the area surrounding the German airfield. The Germans would climb quickly to fighting altitude; as soon as their altitude and motion dissociated them from the ground, *Pika-Don*'s radars would pick them out. He watched the scope, followed his loiter pattern, and waited for the German planes to appear.

Two circuits later, he was still up there. The scope showed the shaded contours of the land, but that was all. Not one German plane—no planes at all, even though the whole *escadrille* had flown out ahead of him to watch the fight he'd promised. He had fuel enough for six or eight more circuits—it was going faster than he'd counted on—before there'd be only enough to get him back to the field.

And more weeks of filtering kerosine? Not if he could help it. He made two more circuits—still nothing. He put *Pika-Don*'s needle prow downward. If they wouldn't come up and fight, he'd go after them. He checked the German field's position on the map scope. He could fly down straight to the end of its runway, and he had six rockets. One would be enough. Two would destroy it utterly.

He was down below twenty thousand feet when he saw the airplanes. They were flying on a northerly course, as he was, patrolling above the German lines in a Junck's row formation—each plane above, behind, and to the side of the one below it; an upright, diagonal line. A quick glance at the radar scope: not a hint of those planes.

Nuts with the airfield. Not with those planes over there. Flying where they were, using that formation, they had to be Germans. Farman pulled out of this attack dive, immelmanned into a corkscrew turn that would take him back and place him behind their formation. He lost sight of them in that maneuver, but the map scope showed him where they had to be; they didn't have the speed to move far while he was getting into position.

Behind them now, he turned again and drove toward them. Still nothing on the airspace scope, but he knew where they were. He tried the target-tracking radar—the one in the middle of the instrument panel. They didn't show there, either.

But he knew where they were, and in another moment he saw them again. Little black specks, like gnats, only gnats didn't fly in formation. And one rocket anywhere near them . . .

Still they didn't show on the target-tracking scope. It would have to be an eyeball launch, then. He primed the proximity detonators on rockets one and six. There still wasn't a sign they'd seen him. They didn't even seem to move against the sky.

He launched the rockets at four miles. The distance was a guess—

without help from his radars, a guess was all he could do, but the German planes were still only specks. It didn't matter. The rockets were built to heat-seek a target from ten times that distance. He felt the shock as the rockets struck from their sheaths even as he sent *Pika-Don* screaming straight up, engines suddenly at full thrust, and over on her back, and a half-roll, and he was at forty-five thousand feet. Rockets one and six sketched their ionized tracks on the airspace scope, all the way to the edge.

The edge was somewhere beyond the crest of the Vosges Mountains. Farman couldn't understand it. He'd sent those rockets straight as bullets into that formation, proximities primed and warheads armed. They should have climbed right up those German's tailpipes and fireballed and wiped those planes from the sky like tinder touched by flame. It hadn't happened.

He brought *Pika-Don* around. On the map scope he found again the position where the German planes had been. They still didn't show on the airspace view—what could possibly be wrong with the radar—but they'd still be close to where he'd seen them last, and he still had four rockets left. On the airspace scope, the tracks of rockets one and six ended in tiny sparks as their propellants exhausted and their automatic destructs melted them to vapor. He turned *Pika-Don*'s down. He armed the warheads, primed the proximities. This time he wouldn't miss.

He saw the German planes from ten miles away. He launched rockets two and five from a distance of five miles. Two seconds later, he launched three and four and turned away in a high-G immelmann. His G-suit seized him like a hand—squeezed, relaxed, and squeezed again as he threw *Pika-Don* into a long, circling curve. The airspace scope flickered, re-oriented itself. His four rockets traced bright streaks across its face.

Explode! he thought. *Explode!*

They didn't. They traced their paths out to the scope's edge. Their destruct mechanisms turned them to vapor. Ahead of him now, again, he could see the disorganized swarm of the *jagdstaffel*. He hadn't touched one of them. And they still didn't show on the airspace scope.

Farman swore with self-directed disgust. He should have thought of it. Those planes were invisible to radar. They didn't have enough metal to make a decent tin can, so his radar equipment rejected the signals they reflected as static. For the same reason, the proximities hadn't worked. The rockets could have passed right through the formation—probably had—without being triggered. As far as the proximities were concerned, they'd flown through empty air. He might as well have tried to shoot down the moon.

He turned west, back to base. He located the field with the map scope.

He had enough fuel to get there, and some to spare. A thought trickled through his mind about the dinosaurs—how their bodies had been perfectly adapted to the world they lived in, and when the world changed their bodies hadn't been able to adjust to the changes. So they died.

Pika-Don was like that—a flying *tyrannosaurus rex* whose world now provided only insects for food.

"Yeh. We saw the whole action," Blake said. He sat with his back against the hangar wall, a wine bottle close to his hand. The sun was bright and the fields were green. A light breeze stirred.

The *escadrille* had come back a half hour after Farman landed. Farman had hesitated, but then went out to face Deveraux. He wasn't eager for the confrontation.

Deveraux was philosophically gentle. "You have seen now, *M'sieu,* the rockets you carried were not an adequate armament for combat situations. Now, if you will show our mechanics where you think it would be best to mount the machine guns they . . ."

"*Pika-Don* flies faster than bullets," Farman said. He kicked at a ridge of dirt between wheel ruts. The dirt was hard, but it broke on the third try. "I even heard of a guy that got ahead of his own bullets and shot himself down. And his plane was a lot slower than mine." He shook his head—looked back toward where *Pika-Don* crouched low to the ground, sleek and sinister looking, totally useless. "Might as well let her rot there."

He kicked the loosened clod off into the grass.

About eleven o'clock, Blake got a bottle of wine from Henri. It was plain peasant's wine, but that was all right. They sat in the narrow noontide shade of a hangar and worked on it.

"You've got to get in close before you shoot," Blake said. "I don't know where you learned combat, but it didn't look like you learned much. You flew at their formation so fast they wouldn't of seen you until you broke right through 'em, but you shot those rockets from a couple of miles away. You can't hit anything at that kind of range."

"I thought I could," Farman said. "And with the kind of warheads they had, it's a good idea to be a few miles away when they go off."

"You don't think you're funning me with that, do you?" Blake said. He sat up straight—looked at Farman. "Nothing scatters shrapnel that wide."

Farman helped himself from the bottle. "My rockets would have done more than just scatter shrapnel, if they'd gone off."

"Not much good if you've got to shoot 'em from so far off you can't hit the target," Blake said.

It was no use trying again to explain target-seeking missiles. Anyway, they hadn't worked. He'd final-

ly figured that out, too. Their heat-seeking elements had been designed to track on a hot jet's exhaust, or the meteor-flame of a ballistic warhead. All the German planes were putting out was the feeble warmth of a piston engine. That wasn't enough. If he was going to do any good in this war, it wasn't going to be with *Pika-Don*. "Harry, I want you to check me out on your plane."

"Huh?"

"My plane's useless. She hasn't any teeth left," Farman said. "If I'm going to do any more fighting, it's going to be in a plane like yours. I've got more flying hours than all of you put together, but I don't have any cockpit time in your—" He almost called them box kites. "I want you to show me how it flies."

Blake shrugged. "One plane's pretty much like another. They've all got their tricks—like these Nieuports you don't want to do much diving in them; takes the fabric off the top wings every time. But aside from that the only way you get the feel is by flying 'em."

They walked out to Blake's Nieuport. It looked about as airworthy as a model T Ford. Farman had a little trouble climbing up until Blake showed him the footholds. It was cramped in the cockpit, and the wicker seat was hard. Blake stood on a packing crate and leaned over the coaming.

Farman put his hand on the stick. That was what it was—an erect rod sticking up between his knees. He'd never seen one like it before. He tried moving it, and it moved with the smoothness of a spoon in a glue-pot. "Do you have to fight it like this all the time?" he asked.

"Takes some getting used to," Blake said. "It's easier when she's flying, though."

Farman turned his attention to the instruments. They were a haphazard assortment of circular dials, unevenly distributed, and except for one big dial straight in front of him there wasn't any apparent priority of position given to the more important ones—whichever ones they were. They were all identified, the words lettered across their faces, but the words were French.

"That's the oil pressure," Blake said, tapping the glass in front of a dial. "And that's RPM, and that's fuel mixture."

"Oil pressure. Is that important?"

Blake looked at him strangely. "You say you've been flying—*how* long? And you don't know oil pressure?"

"I've never flown a piston engine craft," Farman said. "*Pika-Don* has a different kind. Is it important?"

"Your engine doesn't work too good without it."

"And—fuel mixture, did you say?" Farman asked, putting his finger to the dial Blake had indicated. He was careful not to ask if it was important, though he wasn't sure what difference it made. Mixed with what, he wondered to himself.

"Right," Blake said. "And this here's your compass—don't trust it too far—and that's the altimeter, and here's the gas gauge."

At least those were instruments Farman understood. But he frowned at the altimeter. "Is that the highest this can fly?"

"Those are meters, not feet," Blake said. "This crate can go up as high as I can breathe. Sixteen . . . eighteen thousand feet." He pointed into the cockpit again. "This here's the switch, and that's the throttle, and that's the mixture control."

Farman touched them, one by one, trying to get their feel. His hand encountered a small plumb bob dangling from a cord. "That's a funny good-luck charm," he said.

Blake laughed. "Yeh, it's good luck all right. Without it I could be flying upside down and not know it."

"Don't you have a turn-and-bank indicator?" Farman wondered.

"Mister—that *is* my turn-and-bank indicator."

"Oh," Farman said, feeling foolish. But how could he have known.

"And these here," Blake went on, unnoticing, "that one tightens the flying wires, and that one the landing wires."

"What kind of wires?"

"Some wires you want tight when you're flying, and some others when you're coming in to land. If you don't, you stand a good chance of coming apart at the wrong time."

"Oh." Flying a Nieuport wasn't going to be as easy as he'd thought. It would be like trying to ride horseback after driving cars all your life. "My plane doesn't have wires."

"What holds it together?" Blake asked.

Farman ignored him. He was thinking about driving a car, and some of his confidence came back. This Nieuport was a lot different from *Pika-Don,* but her engine wasn't too much different from the one in his 1972 Chevvy—more primitive, maybe, but it worked on the same principles. He could handle a gasoline engine all right."

"How do I start it?" he asked.

Half a minute later he was looking forward through the blur of a spinning propeller. He felt the blast of air on his face, and the stench of exhaust made him want to retch. The oil-pressure gauge worked up. He experimented with throttle settings and fuel-mixture adjustments, trying to learn something about how it handled. It occurred to him that his Chevvy had two or three times the horsepower this thing had.

Blake handed him a helmet and goggles. Farman put them on. "Taxi her around a bit, until you get the feel," Blake yelled through the engine's blatting. Farman nodded, and Blake bent to pull the chocks from in front of the wheels; one side and then—slipping quickly underneath —the other. The Nieuport lurched forward even before Farman advanced the throttle. It bumped clumsily over the grass.

The thing had no brakes, so when he advanced the throttle again she hurtled forward, bumping and thumping across the field. The airspeed indicator began to show readings. The bumping got worse. He edged the throttle forward a little more. Except for the jouncing and that awful smell, it wasn't much different from driving a car.

The tail came up. It startled him, and it was almost by reflex—seeing the horizon lift in front of him—that Farman pulled the stick back. The bumping stopped as if it were shut off. The engine's sound changed, and airspeed began to slacken. The silly model T was airborne. He shoved the throttle forward and tried to level out. It shouldn't have been flying at this speed—he'd driven his Chevvy faster than this, and his Chevvy was a lot more streamlined.

He was beyond the field's edge now, with a rise of ground ahead of him. He tried to turn, but the Nieuport resisted. He pulled the stick back to clear the hill's crest. The airspeed meter started to unwind. He got over the hill with a few yards to spare, but airspeed was falling back toward zero. He tried to level out again; it wasn't easy to do without an artificial horizon on the instrument panel. The real horizon was rocking back and forth, up and down, and drifting sidewise. He tried turning the other way, and she turned easily but she also nosed down. He hauled back on the stick, swearing loudly. How any man could fly a crazy, contrary thing like this was more than he could understand.

The ground wheeled under him. The engine's sound changed, became a snarl, then a sputter. Wildly, he looked for a place to put down, but there was nothing but orchard under him as far as he could see—which wasn't far because the plane had nosed down again. A queasy, liquid feel began in his stomach, and the stench from the engine didn't help it any.

The engine chose that moment to quit. For a long time—it couldn't really have been more than a few seconds—the only sound was the whisper of air against the wings. Then the Nieuport stalled and plunged down among the trees. Branches snapped and the wings buckled. The Nieuport came to rest midway between the treetops and the ground. It dangled there, swaying a little in the gentle breeze. After a while, Farman thought to turn off the ignition, to reduce the danger of fire. After another while, he began to think about how to climb down.

He met Blake and half a dozen other men before he got out of the orchard. They went back to the Nieuport. Blake looked up at the wreck among the tree branches, made an angry noise that might have been a word, or it might not, and walked away.

Farman started to go after him, but then thought better of it. An-

other tree branch cracked and the Nieuport sagged a few feet closer to the ground. Farman looked up at the mess one more time, then turned away and followed Blake. It was a long walk back to the field.

Blake was given another Nieuport. The *escadrille* had several replacements ready—craft that had been sent down from an *escadrille* in the Somme region that had switched to Spads. The older Nieuports were still good enough for this less active section of the front. Blake spent the rest of the day and all the next with the mechanics, checking it out.

Farman spent the time poking around *Pika-Don,* trying to figure a way she could still be used. There was a space where a Vickers gun could be fitted if he took out the infrared sensor unit, but working out a trigger linkage was beyond him; every cubic inch inside *Pika-Don* was occupied by one or another piece of vital equipment. And at mach 2 an orifice the size of a .30 caliber muzzle might be enough to blow the plane apart.

The only other thing he could think of was that the radars were powerful enough to fry a man dead, but it didn't seem likely that Bruno Keyserling would hold still for the hour or two needed for the job.

He gave up. *Pika-Don* was useless. Reluctantly, he resigned himself to asking Deveraux for assignment to a flight school. It would mean swallowing a lot of pride, but if he was going to shoot Keyserling out of the sky, he'd have to learn how to fly a Nieuport.

When the *escadrille* came back from a patrol, he went out to talk with the Frenchman. Deveraux came toward him, helmet bunched in a still-gloved hand. "I am sorry, *M'sieu,"* he said gravely. He laid his empty hand on Farman's shoulder. "Your friend . . . your countryman . . ."

The patrol had run into a flock of Albatrosses, Keyserling in the lead. No one had seen Blake go down, but several planes had been seen falling, burning like meteors. When the dogfight broke off and the flight had reformed, Blake wasn't with them.

Farman's mind became like cold iron as he heard Deveraux recite the plain, inclusive facts. It shouldn't have struck him so hard, but Blake was a man he'd known, a man he'd talked with. All the other men here, even Deveraux, were strangers.

"Did anyone see a parachute?"

"M'sieu, such things do not work," Deveraux said. "We do not use them. They catch on the wires. For men in the balloons, perhaps such things can be used, but for us, our aeroplane is hit in its vitals, we go down."

"You shouldn't build 'em with so many wires, then."

Deveraux's reply was a Gallic shrug. "Perhaps not, *M'sieu.* But they are what hold our aeroplanes together."

"The German planes, too?" Farman asked in a suddenly different voice.

"Of course, *M'sieu*."

"Get me some kerosine," Farman said.

"Paraffin? Of course, M'sieu. And if you will show the mechanics where to fasten the machine guns they . . ."

Farman shook his head. "I don't need guns. Just get me the kerosine. I'll do the rest. And when I'm done with 'em on this front, I'll go up the line and clean out the rest of 'em."

"Of course, *M'sieu*," Deveraux said without irony.

Not that Farman cared. This time he'd do what he said he could do. He knew it. "Ten thousand gallons," he said.

Mid-August came, and *Pika-Don* was fueled again. Reports and rumors had been coming down from other sectors of the front that American troops were somewhere in the fighting.

Pika-Don lifted into a sky as clean as polished glass. Later in the day there might be a scatter of cumulus tufts, but it was not yet midmorning. "It is not a good day for fighting," Deveraux had said. "One can make use of the clouds."

It would be a good day for observation planes, though, so the German patrols would be out. And, Farman thought savagely, there'd be fighting enough. He'd see to that.

Once he'd shifted to lateral flight, he didn't try for altitude. *Pika-Don* would guzzle fuel faster at low levels, but he didn't figure the mission to take long. The German field was less than thirty miles away. He fixed its location on the map scope and sent *Pika-Don* toward it at full thrust. *Pika-Don* began to gain altitude, but at ten thousand feet, with the machmeter moving up past 1.75 he leveled her off and turned her downward along a trajectory that would bring her to ground level just as he reached the German field.

It was almost perfectly calculated. He saw the field ahead of him. It was small—he'd seen pastures that were bigger—and he started to pull out of his descent. He passed over the field with just enough altitude to clear the trees on the far side. It took less than a second—the machmeter said 2.5, and skin temperature was going up fast. He took *Pika-Don* a few hundred feet up and brought her around—lined her up on the field with the map scope's help—and brought her down again for another pass. This time she flew straight at the open mouth of a hangar in the middle of a row of hangars on the far side of the field.

He brought *Pika-Don* around one more time, but this time he stayed a thousand feet up, and kept off to one side of the field. He looked down and felt the satisfaction of a kid who'd just stomped an anthill. Wreckage was still flying through the air. He didn't need rockets. He

didn't need machine guns. All he had to have was *Pika-Don* herself.

He turned her south toward the Swiss border. He'd seen only a few planes on the ground, which meant that most of them were out on patrol.

Heading south, he took *Pika-Don* up to eighteen thousand feet. On a day like this, with no clouds to hide in, the best altitude for a German patrol would be up close to the operational ceiling. Even if no altitude advantage could be gained, at least the advantage would not be lost to a higher-flying French patrol.

The map scope showed the Swiss border. Farman brought *Pika-Don* around. The front was not hard to find. It was a sinuous gash across the land, like a bloodless wound. He followed it north, staying to the German side. He watched the sky ahead of him.

He flew the course to the Vosges Mountains at mach 1.5, partly to save fuel and to minimize the skin temperature problem; flying this low, the air was a lot thicker than *Pika-Don* was built to fly in. His main reason, though, was that even at mach 1.5 he was flying through a lot of airspace. With no more sophisticated target-finding equipment than his own eyes, he could pass within a mile or less of a German patrol without seeing it. Flying as slowly as he could improved his chances.

The mountains rose ahead of him. They weren't very high mountains; their crests lay well below him. He caught sight of the German patrol as he turned *Pika-Don* for another run south.

They were a few hundred yards higher than he was, and so small with distance he'd have thought they were birds except that birds didn't fly this high, nor did they fly in a neatly stacked Junck's row formation. They hung suspended in the sky, like fleck-marks on a window, and if it hadn't been for their formation he wouldn't have known their direction of flight. They were flying south, as he was now—patrolling the front, as he was.

And they were close—too close. If he turned toward them, they'd be inside the radius of his turn. He'd cross their path in front of them like a black cat, warning them. He mind-fixed their position on the map scope and turned away.

Come at them from eight o'clock, he decided. That would be the best angle. On the outward arc of his circle he took *Pika-Don* up to thirty thousand feet. Then, as *Pika-Don* started to come around for the approach, he started down, full thrust in all three engines. The machmeter climbed to 2.0, then 2.5. It edged toward 3.0, trembling. It would mean a heating problem in this soup-thick air, but it wouldn't be for long.

The patrol was almost exactly where he'd seen it before. There hadn't been time for it to go far. With only a small correction *Pika-*

Don was driving down toward it like a lance, target-true. The insect-speck planes became recognizable shapes, then rapidly expanded. They ballooned to their full size in a flash and he was almost on top of them.

At the last instant, he moved the controls just enough to avoid collision—passed behind them so close he had a glimpse of round knobs bulging from the cockpits just behind the upper wings—pilots' helmeted heads—and yes! at the bottom of the stack, leading the flight, the purple Albatross of Bruno Keyserling.

Then the whole flight was somewhere behind him. Farman reduced thrust and put *Pika-Don* into a steep climb, over on her back, and down again to level out into the airspace he'd flown through before.

It was all changed. The sky was full of junk, as if someone had emptied a barrel of trash. Fluttering wing sections, bashed fuselages, masses of twisted wreckage without any shape he could recognize. He saw a wingless fuselage falling a-tumble, like a crippled dragonfly. It was all purple, with bits of white on the shattered engine cowl. *Got him!*

And there wasn't a whole plane left in the sky. They hadn't been built to survive the impact of *Pika-Don*'s shock wave. Just like the hangars at their field which had exploded when he buzzed them.

He started to curve southward again. He'd tasted blood, wanted more. He'd hardly started the turn before a whump shook *Pika-Don* and the sky wheeled crazily and the engine function instruments erupted with a Christmas tree of red lights as if engine two had gobbled something that didn't digest too well. (Part of an airplane? Part of a man?) Some of the lights flashed panic, others glared firmly at his eyes. The horizon outside was tipping up on edge, falling over, tipping up again. The controls felt numb in his hands.

Farman knew the drill. When a plane as hot as this one went bad, you got out if you could. At mach 2 you could hit the ground in less than thirty seconds. He slapped the eject button—felt the rockets blast him upward. A moment later the instrument panel broke away and the seat's firm pressure on his back and thighs was gone. He was tumbling like a wobbling top in midair, suddenly no longer enclosed in several million dollars worth of airplane. There was the teeth-cracking shock of his chute coming open, and abruptly the confusion of too many things happening too fast stopped. He looked all around for some sign of *Pika-Don,* but there wasn't any.

He tugged at the shrouds to spill air from the chute and drift him westward toward the French lines. The wind was doing some of it, but not enough. A line of planes came toward him. He held his breath, thinking of a school of sharks nosing in toward a man cast overboard. But

then he saw the French markings on their wings and sides. They were Nieuports, and the pilot of the leading plane waved. Farman waved back. The flight came on. It circled him once and then curved off. They stayed in sight, though, following him down. When flak bursts started to puff around him, they went down to strafe the German trenches.

He spilled another dollop of air from his chute. He was over the French lines now. He could see the men in the trenches looking up at him. He floated down toward them, closer and closer. Then, very abruptly, he was down—down among the trenches and barbed wire of the French Seventh Army. He sprawled in the greasy mud of a shell hole. The chute started to drag him, but it caught on a tangle of wire and deflated.

He got to his hands and knees, fumbling with the parachute harness. A bullet snapped past his ear. He flattened. The Nieuports dove on the German trenches again.

He struggled out of the harness and started to crawl in the direction of the nearest trench. It wasn't far. He scraped the dirt with his belt buckle all the way. Bullets whipped past him like deadly mosquitoes. The soldiers in the trench reached out to pull him down.

They hugged him. They mobbed around him. There must have been thousands of men in that trench to celebrate the man who'd downed Bruno Keyserling. Someone pressed a cup of wine into his hands—a soldier in dirty clothes, with mud on his brow and a matted beard. Farman drank gratefully.

After a while, he sat down and just sat there, dead inside. He looked at the dirt wall a few inches from his eyes. The empty cup dangled from his hand. *Pika-Don* was gone, and nothing he could do would rebuild her. Suddenly, he was just an ordinary man. He couldn't even fly any more. *Pika-Don* was the only plane in this age that he knew how to fly, and *Pika-Don* was gone.

He wasn't aware of the passage of time, but only of the heat and dust and the smell of a trench that had been occupied too long by unwashed men. He didn't know what he was going to do. But after a time, the wine began to have its effect. A trickle of life came back into him.

Slowly, he got to his feet. The start of a smile quirked his mouth. On second thought, no, he wasn't just an ordinary man.

The war would be over in a few months. Maybe he didn't know what he'd do, but . . .

The soldier who'd given him the wine was standing a few feet away. Farman held himself crisply erect. It occurred to him the man probably didn't know a word of English.

"How do I get back to America?" he asked, and grinned at the soldier's incomprehension.

A man from the future ought to have *some* advantage over the natives! ■

Null Zone

by Joe Poyer

Could be that there is a darned good use for garbage—
if it's the right kind of garbage, planted in the right place . . .

Illustrated by Kelly Freas

Crouched deep into the thick stand of young bamboo First Lieutenant Phillip Schmittzer very carefully eased the safety off the silenced .445 Colt automatic. Then he waited, breathing as softly as possible. On the other side of the bamboo three green clad North Vietnamese regulars moved slowly into the tiny clearing. Schmittzer watched narrowly as they spread out to examine the open area.

The minutes dragged by. Sweat trickled down his back and chest and the tiny red ants that always infest bamboo found his collar and began to probe southward. He ignored them and concentrated on the three North Vietnamese. One had not left the trivial shelter of the jungle, but remained in the shadows, down on one knee, Czech submachine gun ready across the other. The second soldier approached the bamboo clump slowly. Schmittzer raised the pistol and waited. He could barely see the man's face through the tangle of stalks and leaves. The North Vietnamese peered intently into the clump, then resumed his search without seeing the black muzzle pointed at his face. The two soldiers reached the far edge of the clearing without finding a trace. One waved and the guard came trotting past and all three disappeared into the jungle.

Schmittzer remained frozen. Twenty minutes later, the ants were just beginning to fan out along his belt, when he caught a flicker of movement on the far side of the clearing; just the tiniest patch of too-dark green. The movement resolved itself into a battered hat and a North Vietnamese uniform.

The guard stepped back into the clearing, looked around carefully, and whistled. Seconds later the other two joined him. Grinning and talking loudly they squatted down and broke open ration packs. Their dialect was unfamiliar to Schmittzer, but he caught enough to follow the gist of their conversation. So, he thought, they were convinced that there were no intruders in their area, that their C.O. was having nervous fits again. Great! Tremendous! Then why did they keep their weapons in one hand while they ate with the other.

"You boys are taking a mighty big chance to convince me that you've given up," he muttered to himself. Schmittzer allowed the barest of sighs and resigned himself to the rest of the day and all night in the bamboo.

Damn those red ants!

Just before dawn, Schmittzer came out of a half sleep. The night sky was clouded over with monsoon promises. He listened for a long while, hearing nothing but the usual cautious pre-dawn animal sounds. Either those North Vietnamese were exceptionally good, he thought, or they were gone.

He decided to risk it. He still had one more area to check out before the helicopter picked him up the following dawn. Stiffly, but silently, he came to his feet and spent several minutes working his way through the springy bamboo and into the jungle behind. Once well away from the clearing, he stopped for a precautionary check.

Mist was rising from the damp ground, intensifying the rotting vegetation stench that was always present. Tiny drops of water fell silently from the jungle canopy sixty feet above his head. For all he knew, it could be raining heavily above the dense tree-top foliage. He had once spent four hours in a Thai jungle during a two-hour downpour without getting wet until the rain stopped. Then he had stayed wet for two days while it dripped steadily through the foliage to create a secondary drizzle. Schmittzer waited patiently off the trail until he was satisfied that no one was following closely. That he was being trailed was certain, but at least he was still several jumps ahead.

By late afternoon, he had moved eight miles east and north of the bamboo thicket, well into Laos and now was waiting in his own ambush. The sun had finally broken through the cloud cover an hour earlier and the sky had cleared off quickly. He judged the temperature to be well into the high 90s and the greenish-gold light filtering through the rain forest only served to intensify the opacity of the light mist that still wrapped the undergrowth.

Schmittzer had prepared his ambush site well. The dense Laotian jungle had shaded very quickly to the slightly more open rain-forest as he had climbed into the highlands that ridged the Thai-Laos border and ran south to Cambodia. The foliage canopy overhead was no less dense, but the undergrowth had thinned to small widely scattered clumps of grasslike bamboo. For the rest, the rain forest resembled open parkland. To his left, the ridge of hills climbed another thousand feet, then dropped sharply to the Mekong River. On the other side of the river slash, the terrain rose steeply to broken hills covered with the same type of rain forest and open plain all the way to the Ia Drang valley of South Vietnam. The area between was the baili-

wick of the Meo tribesmen and their American advisors. The main branch of the Ho Chi Minh trail passed down this side of the Mekong into Cambodia and from there down into the Mekong delta.

Before him, a narrow game trail used by deer and their predators as well as porters and troops moving south, wound through the hushed cathedral created by the giant trees. At this point, visibility was clear for several hundred yards in either direction. Sunlight filtered down, stippling the young bamboo and dead leaves covering the ground, with pale gold. Visibility was clear, but seeing because of the light was difficult. In spite of the last, it was an unlikely place for an ambush because of its openness. Schmittzer counted on this. No matter how good you were, you could not watch everywhere at once.

On either side of the trail, five yards from the center, he had buried four hand grenades. He kept the fifth and last in reserve. The Colt lay in front of him safety off and he himself was less than twenty yards from the buried grenades and only ten yards from the trail. The meager clump of wisteria that was his hiding place did not deserve a second glance. In casting back and forth along the glade, he had missed it twice before seeing its possibilities. So now he lay with his face close to its roots, barely covered with rotted vegetation. Hidden beneath the ground cover were two wires that ran to the grenades and thin loops of thread pulled from his shirt held the pinless handles down.

Daylight jungle noises surrounded him like the pale mist. The low, continous murmur of cicades, an occasional call from a bird high above the trees. Once, a monkey chattered. Otherwise, it was as quiet as churches.

He heard them long before they came into sight. First the soft scrape of a boot against a stone, then a carbine stock clicked against a knife sheath. Twice during the day, Schmittzer had doubled back and twice he had seen signs of his three shadows. He had been right, back in the bamboo. The North Vietnamese did suspect there was somebody operating in the area. He had tried every trick he knew to shake them, but they knew where he was going as well as he. It was only a matter of time until they caught him unless something was done about it. And both parties were professional enough to know that.

The first trooper came into sight, walking carefully on the north side of the trail. His eyes were on the ground, probing for booby traps. Immediately behind, as Schmittzer had hoped, the second followed, watching the jungle on either side and ahead. Thirty yards to the rear, the third followed—his friend the guard again—watching in all directions.

As the first two passed no more than an arm's reach away, not even

a breath escaped from Schmittzer. They moved abreast of the bush he had picked as a marker and his finger twitched gently, pulling the thread away from the handles of the two silent fuse grenades. Not a movement was discernible.

One . . . two . . . three . . . four . . . K-whamm!

Schmittzer calmly and methodically picked up the pistol and shot the third guard as he dove for the side of the trail. A loud scream told him the bullet had hit something, then a burst of submachine gun fire probed along the trail. Thanking his lucky stars that he had decided to stick close to the ground, he sighted carefully on the campaign hat behind the racketing carbine and squeezed the trigger. The hat spun away to rest in the center of the path. He turned his attention back to the two men caught by the grenades and waited. Both had been hit squarely by the blast of the twin bombs and hurled a dozen feet. Neither moved. After several minutes he was sure they were not going to and ran swiftly to check the third soldier. His first bullet had struck him in the left forearm, the second in the forehead. The other two soldiers had been torn up badly by the blast and both had died instantly.

Schmittzer wasted no time. He retrieved the other two grenades and dragged the three bodies and their weapons deep into the jungle, then returned to cover the ambush site thoroughly. It was then that he discovered that a bullet had torn through his shirt and cut a shallow gash across his ribs. Chuckling, more with relief than amusement, he stripped off his shirt and powdered the wound with disenfectant. At that point, he suddenly felt weak and sat down heavily, his head between his legs and arms dangling limply across his knees. After a while he looked up. The three bodies lay ironically in a patch of late afternoon sunlight slanting down in long hollow shafts through the nebulous mist.

The helicopter came for him at dawn. He had found a clearing the night before near the crest of the ridge above the river where he could watch for both sampan activity on the Mekong and foot traffic inland. Occasionally, through the long night he had seen a flicker of movement, the glowing coal of a cigarette, and knew that North Vietnamese and Pathet Lao parties were traveling the Ho Chi Minh trail to the Mekong Delta in defiance of the armistice.

Just after midnight, fifteen men trotted silently along the same trail where he had ambushed his trackers. Each carried boxes of ammunition on pack boards. They came from the north, heading for the Cambodian frontier. Schmittzer dropped back and followed them for half a mile to the frontier and managed to sneak in close enough to photograph in fine detail infrared

film a Cambodian officer being paid to let them across the frontier. Then the North Vietnamese had resumed their tireless pace south. Shortly before sunrise, he was back at the clearing. He was as gray with fatigue as the overcast dawn.

Now the helicopter, homing in on his ultraviolet light source settled into the clearing, blades kicking up twigs and leaves with its sixty-mile-an-hour downdraft. He trotted across the clearing and climbed into the 'copter which bounced into the air before he was completely aboard. The machine gunner shoved a cup of hot coffee from a thermos at him and he crouched by the hatch, drinking the steaming liquid and watching the river and jungle slide away beneath. A few minutes later it began to rain, great slanting spears of water that obscured the jungle and hills below.

The helicopter, a Bell Huey, slanted down toward the strip at U Dorn Air Base in northern Thailand. The skids joggled against the concrete and the rotors whined to a stop. A jeep slid up, spraying rain slick and Schmittzer hopped down from the 'copter and shuffled over to the jeep.

"Look fella's, it's *Steve Canyon.* Hey *Steve,* bring any messages of goodwill from the Northland?"

Schmittzer replied with a dirty word and climbed into the jeep.

"Once around the park, slowly, Colonel. Easy on the bumps."

Colonel James Forely grinned and handed him a slicker. "Glad you're back, Phil. Have any trouble?"

"Some. Got trailed, so they know now, we're operating in the area."

Forely nodded as he steered the jeep across the runway towards the bachelor officers quarters. "It had to happen sooner or later."

He glanced at Schmittzer. The man was in shocking condition.

Schmittzer was half asleep by the time they pulled up in front of the cement block dormitory that served as bachelor officers quarters. Forely aimed him in the direction of the bed and said, "Get! You got four hours." Then he went into the other room and dialed General Hunt's office.

"General, Forely here. He's in. No, he's all right but pretty exhausted. We should be ready by 1300 hours. In the meantime, I'll run through his notes and get the film developed."

Hunt agreed to recall the meeting for 1300 and broke the connection. Then Forely dialed Security and asked for a messenger.

Forely stopped beside the bed and looked down at the sleeping lieutenant, noting the drawn face, not yet relaxed in sleep. Schmittzer's uniform and the skin on his hands and face were lacerated with long, thin cuts from the saw-edged bamboo grass. A black edged bullet hole was almost hidden by the camouflage pattern of the blouse. When

he unbuttoned the shirt, he saw a long, shallow scratch across the ribs. Traces of sulfa powder still stuck to the half scabed wound and it showed no traces of inflammation. He pulled Schmittzer's boots off and went into the kitchenette to put on a pot of coffee.

By the time he finished sorting the contents of the pack and peeled the film from the Minox, the messenger was knocking at the door. Forely gave him the cassette and told him to be back in one hour, no longer. Then he returned to the living room, plunked down on the sofa, and dove into the pad of notes Schmittzer had made. By the time the messenger returned with the developed film and prints, a picture of the situation was beginning to emerge.

During the ten days Schmittzer had spent in what was euphemistically termed "the field" he had covered a total of two hundred and fifty miles in an area less than thirty miles square. Taking his starting point as the main path of the Ho Chi Minh trail, running at this point down a wide valley set back westward some nine miles from the Mekong, he had crisscrossed the trail, moving north from the Cambodian border. At least eight more, and a possible ninth, sub-trails had been identified. And not surprisingly they ran east toward Thailand as well as south to north. Then he got to work with the developed film.

About three and a half hours later, he sat back and winced at the cold dregs of coffee left in his cup and looked at his watch. "That's it," he muttered aloud and got up and went into the bedroom to wake Schmittzer. At the doorway he hesitated. Schmittzer lay in the same position as when he had fallen on the bed. His unshaven and dirt encrusted face appeared gaunt in the gray twilight filtering through the curtained window. Hating himself, he shook the exhausted man by the shoulder.

The north wall of the Security building conference room held a floor-to-ceiling map of the Indo-China Peninsula under a glass overlay. Only after one had digested the immense map, photographed in strips from a height of ten thousand feet and computer exposed and matched, did they notice that the soft colors under the map were not solid. As you moved throughout the room, there was no foreshortening. The map appeared flat from any angle. On closer examination, the map showed as a holograph in three dimensions. A magnifying glass revealed individual trees as well as the relief provided by mountains and valleys. Map grids, varicolored lines marking highways, railroad, and inhabited areas were superimposed, resting lightly above the terrain below.

The map was the focal point of the forty-by-sixty-foot room which was shrouded in soft darkness. A

curving desk, twenty feet long, and divided into individual consoles fronted the control area. In back of this, raised tiers of consoles extended to the south wall. The east and west walls were filled with giant radar screens. In total, the room resembled a scaled down version of the control command room at NORAD Headquarters in Colorado Springs.

The effect of this dimly lit cavern on Schmittzer was startling. People moved quickly throughout the center, telephones buzzed, and the faces were hideously illuminated by glowing consoles. After the silence and loneliness of the deadly jungle, a stomach-gripping tension hit him.

Forely found their consoles and handed the package of film and notes to an airman. "They are numbered in sequence," he explained. The young man nodded and disappeared.

Forely leaned back in his chair and rapped several keys on the console in front of him. A tweeter alarm sounded and the low-key murmur became an expectant hush. He glanced over at Schmittzer.

"Polish your vocal cords, boy. Here we go."

Forely played with the keys again. Immediately the large-scale map of the Indo-China Peninsula began to shift and contract in a flow of colors that reminded Schmittzer of Disney's "Fantasia." A more confined topographical map formed showing the junctions of North and South Vietnam, Laos, Cambodia, and Thailand.

Forely flicked on his microphone.

"Gentlemen, I am Colonel James Forely, Commanding Officer, *Operation Survey*. Beside me is First Lieutenant Phillip Schmittzer, my chief operative. If you are not familiar with the latest operational details of Lieutenant Schmittzer's mission, please refer to the notes on your console while I review *Operation Survey* for Senator Charles Engberg. The senator will make a personal report and recommendation to the President. So treat him kindly," he added.

He waited for the polite chuckles to die away, then continued. "As you gentlemen are aware, with the successful conclusion of an armistice in the South Vietnamese war four months ago, peace talks have been continuing in Geneva. You are also aware, I am sure, of the allies' vital interest in seeing a complete end to hostilities.

"But, in addition to ending the war, the allied nations are just as concerned that proper safeguards be instituted to prevent its reoccurrence next month, next year, or in ten years. Let me again emphasize what we all know. The essence of Communist strategy in Southeast Asia is not to force a major confrontation across a *null* zone but rather to circumvent and bypass the null zone whenever possible. The null zone in this case was the six-mile-wide Demilitarized Zone. The

bypass route was the Ho Chi Minh Trail. Only in the latter stages of the war did confrontations across the DMZ evolve.

"A great deal of conflicting opinion exists regarding this trail and its importance. The basic trail was first established by General Nugyen Vo Giap, North Vietnam's Chief of Staff, as a supply route prior to Viet Minh operations against the Japanese in 1944. It can be stated categorically that the Ho Chi Minh Trail, by providing a relatively secure communications route from China throughout the eastern side of the Indo-China Peninsula, contributed heavily to the defeat of the French by the Viet Minh in 1954. The trail is, and always has been, nothing more than a supply and infiltration route. However, its importance to the North Vietnamese is such that their entire military efforts in South East Asia must collapse if this route is successfully interdicted."

As Forely talked, he began keying in red lines to weave a net that grew from Ha Tinh in North Vietnam to spread south and west to the North Vietnamese/Laotian border. To this point, the red line was a solid bar until it crossed the border. Turning west thirty miles above the DMZ it then moved into the Laotian rain forest for a short distance before again swinging south. Here the line began to subdivide itself. Schmittzer watched, fascinated as the arterials spread in glowing red web from the main artery, reaching ever southward, paralleling the entire length of South Vietnam to the Mekong River delta. The eastern portion of Cambodia from Streng Treng south to Kampot on the Gulf of Siam became a woven net of wetly glistening blood.

"Gentlemen," Forely continued as the web completed its growth, "that is the Ho Chi Minh Trail in its entirety as of February, 1967—or so we thought. In February '67 we suddenly discovered that the volume of supplies and men moving into South Vietnam was nearly twenty-two percent greater than we were monitoring. Watch!"

Forely slapped a key. It snapped down with a sound like a pistol shot. A network of blue lines suddenly sprang onto the map, half the volume of the red.

"And another!" A green line that Schmittzer immediately recognized as part of his route, tunneled down the Laotian side of the Mekong River weaving into the red and blue. Laos was suddenly cut in two with a tight crisscross of pathways across the troubled southern provinces.

"The point is this, gentlemen," Forely stated heavily, "the Red survey was completed in January, 1967—the blue in July, 1968. We have now completed the Green Survey.

"The Ho Chi Minh Trail is not a single entity—but close to three hundred fifty separate pathways

and trails. Obviously, it is impossible to interdict every variation in the trail-flow without stationing one million troops in a line down South Vietnam's border through Laos to Northern Thailand. A land distance of nearly one thousand miles.

"From mid-1965 on as American troop commitments grew, the Viet Cong came to depend more and more on North Vietnamese troops and supplies for support. Intelligence estimates in mid-1967 showed that out of a total of two hundred eighty thousand armed Viet Cong, one hundred sixty thousand are informally organized full or part-time neighborhood guerrillas, and only one hundred twenty thousand or so are well trained and highly organized 'Main Force' or Local Force fighting companies or battalions. Of this one hundred twenty thousand hard core, it is estimated that only thirty-six percent or forty-three thousand are North Vietnamese regular army soldiers. However, by mid-1967, between seven and ten thousand fresh troops of the North Vietnamese Army were entering South Vietnam every month until they had eventually built up an army of nearly four hundred thousand troops.

"It takes a lot of supplies, arms, ammunition, uniforms, and food to supply four hundred thousand fighting men. As allied successes drove back the Viet Cong, the burden of supply was methodically shifted from the local area to the north. Supply tonnages were slowly raised by the Soviet Union and Red China until just over sixty percent of all logistics were being supplied from North Vietnam and moved south on the Ho Chi Minh Trail. The successful interdiction then of the Ho Chi Minh Trail is essential to the security of South East Asia whether or not peace terms are arranged in Geneva. Comments?"

There was silence in the room for a moment. Then a voice asked, "What you are saying then, Colonel, is that: One, it is imperative but impossible to interdict the Ho Chi Minh Trail. Two, that the Ho Chi Minh Trail is the keystone to further Communist aggression in Southeast Asia because it is the main infiltration and supply route south, east, and west. Three, therefore, the allies should not conclude a peace treaty with the North Vietnamese and Viet Cong unless something is done about the Ho Chi Minh Trail, because we will only have to deal with them again at some future date. Do I state your position accurately?"

Schmittzer had craned forward to see who was speaking, but was only able to identify him as a civilian. "Who's that," he nudged Forely.

"Senator Engberg," Forely whispered back, "watch out for him." Then into the microphone: "You are correct on points Two and Three, Senator. However, point Number One: 'It is impossible to

interdict the trail,' is only partially right."

Engberg bent forward to peer down the curving line of consoles and said sarcastically, "I hope you are right, Colonel. Please continue."

"Thank you. I believe we are correct when we say the trail can be interdicted. Sitting next to me is First Lieutenant Phillip Schmittzer of the Special Forces. For the last ten days he has been exploring the area you now see on the screen. This is the fourth such mission Lieutenant Schmittzer has carried out in the last three months. I think that I can state, without fear of contradiction, that outside of North Vietnam, Lieutenant Schmittzer is the greatest authority on the Ho Chi Minh Trail—particularly its terrain. I will now turn this conference over to Lieutenant Schmittzer and he will review the findings of his latest mission."

"Colonel?"

Forely recognized Engberg's voice again. "Yes, Senator?"

"Before the lieutenant begins, may I state for the record that you have so far shown me nothing that has not already been considered at the highest levels. We are already well aware of the fact that the Ho Chi Minh Trail is the lifeline on which Communist aggression in Southeast Asia depends. In fact, the network of trails—if your information can be depended on—only makes it clearer to me that it is impossible to halt the supplies from China and North Vietnam from reaching the south."

Engberg paused for a breath, and then continued, his voice rising in anger. He turned on General Hunt sitting next to him in the console. "General, you had me brought ten thousand miles from Washington only to have one of your staff members show me a ridiculous web of lines on a pretty map . . ."

"Senator," Hunt cut in smoothly, "perhaps we should hear Lieutenant Schmittzer out. Maybe you'll find your trip was not wasted at all."

Without waiting for a reply, Hunt called out, "Continue, Colonel."

Forely's voice was tinged with acid. "Thank you, General. I assure you, Senator, that our information is extremely reliable." Forely stopped and let a pregnant silence build for a moment. "To date, it has cost the lives of four operators to obtain . . . at least we think they are dead. Only one body was ever found . . . he had been tortured to death."

Engberg appeared startled for a moment, then grudgingly, "Go ahead, Lieutenant."

Forely reached over and flicked the microphone switch. Schmittzer hunched forward and began speaking.

"Thank you, Senator," Schmittzer said slowly. "Gentlemen, I think that we now have all the evidence we need to convince the Cambodian and Thai governments of the threat

to their security posed by the Communists. What Colonel Forely did not add to the trail system was that portion running into Thailand, Colonel."

Forely keyed in the web of trails in orange that ran across the portion of Laos held by the Pathet Lao, and Thailand. "Those dotted lines crossing the Thai border show where the Thai military forces have successfully coped with the infiltration. As you can see, there are many more solid lines than dotted lines by far. My first two missions were conducted in this area, the third in eastern Laos, and the last in the Mekong River area to the Cambodian-Laotian border."

Engberg leaned forward again and addressed Schmittzer. "Lieutenant, if I correctly understand the nature of your missions, they were primarily intelligence gathering trips. Is that correct."

"Yes, sir. Essentially they were. But more important, they were survey missions."

"Survey missions," Engberg asked innocently. "Surveying for what?"

"Senator," Forely spoke up.

"Just a moment, Colonel," Hunt interrupted with just the barest hint of warning in his voice. "Let Lieutenant Schmittzer explain in his own way."

Forely subsided, muttering.

"The survey was undertaken for two reasons. The first to develop a highway route to run from Cua Viet on the South China Sea to Tchepone in east-central Laos, northwest to Thakhek and Vientiane and finally, into Thailand to end at Nangkhai . . ."

"And the purpose of this road, Lieutenant?"

"To throw up a *null* zone that would cut North Vietnam off from any land route connections to the south. By fencing the road and mining the perimeter, calculations have shown that less than one infantry division would be needed to maintain the integrity of the road. This force could be reduced as major construction is completed. Mobile ground and air units could provide fast reaction support in the event of a major attack . . ."

"And the second reason, Lieutenant. You are not getting to the heart of the matter very . . ."

"The second reason, Senator," Schmittzer cut in, "was to identify the areas and routes where activity along the trail was heaviest as well as the location of main crossing points into Cambodia and Thailand. Two years will be needed to construct the road. The Ho Chi Minh Trail complex must be interdicted as soon as possible to prevent the build up of Laotian, Cambodian, and Thai guerrillas and to . . ."

". . . Show the North Vietnamese at the conference table that we can stop them at will," Engberg finished. "I've heard all the arguments before and I restate right now that not one . . ."

"Senator," Schmittzer growled, "if I seem a little short," he went on, his voice flat and dangerous, "It is because I have just spent ten days in the jungle and the only sleep I've had in the last forty-eight hours was limited to less than four. So, we can save a lot of time if you will take a moment to review the briefing sheets on your desk."

"An excellent suggestion for us all, Senator," Hunt added smoothly, picking up his briefing sheets. "This isn't the Senate floor, you know," he finished, smiling reproachfully at Engberg.

Engberg turned angrily, then thought better of it. "Continue, please," he snapped at Schmittzer.

"Gentlemen, let me restate our position. By the time the armistice was signed we already had the Ho Chi Minh Trail mapped out. The object of the mission was to survey the area for the proper placement of null zones. I commanded a twenty-man squadron to do the job. Naturally, the work had to be carried out under the strictest secrecy and that is why each man operated alone."

A four-star general asked, "Will you please define null zone for the senator?"

"Yes, sir. A null zone is an area blocked off by some means as to make it inaccessible to enemy troops. The theory holds that null zones can be effectively created along the Ho Chi Minh Trail by impassably blocking terminus points, border crossings, and other points of difficult traverse."

"A question, Lieutenant," Engberg spoke up. "After having carefully traveled through certain areas of Laotian and Thai jungles, do you still believe it will be possible to nullify these . . . ah . . . points of difficult traverse?"

"Yes I do, Senator."

"Would you amplify that statement, Lieutenant. I find it hard to believe."

"Very well." Schmittzer took a deep breath and closed his eyes. "At Dienbienphu in 1954, the French had a term for the Viet Minh. They called them *'Le aemete'*. They repeatedly said that Dienbienphu, ringed by mountains, would prove impregnable because the Viet Minh lacked artillery and in any case, it would be impossible to move artillery into the heights. History proves otherwise.

"First of all, the Viet Minh acquired artillery from the Chinese Communist government. Then they took the artillery apart and moved the pieces by bicycle—a bicycle can carry a six hundred pound load, Senator, if you handle it right—and moved the pieces mile after mile through the jungle and foot by foot up the mountains where they reassembled them and opened fire on the French fort below. *Le aemete* means ant. The ants beat the French army. The ants are still moving more tonnage today down

to the Mekong Delta than we can interdict. But, even ants need a path.

For example, sixteen miles north of the Cambodian border, and less than a mile from the Mekong River on the eastern bank, there is a valley eight miles long and less than half a mile wide. On the west is the Mekong River where it is impossible to move because of patrols. On the east is the valley between two steep ridges. The easternmost ridge climbs to a high plateau that stretches still farther east for thirty-four miles. The plateau is similar to the African veldt."

Schmittzer opened his eyes and stared directly at Engberg. He continued softly. "If they tried to move on the plateau, they would be exposed and subject to air attack. On the far side of the plateau is extremely rugged and densely jungled mountains and finally the Laotian/South Vietnamese border. That valley is the main route to Cambodia.

"They must," Schmittzer continued, pounding the console softly to emphasize his point, "use the valley if they are to move supplies into Cambodia and the Mekong. Otherwise, geography is against them in terms of moving tons of supplies. If we interdict the valley, nullify it in other words, we have stopped a main flow south. If you examine firsthand, the net of trails as we have done, there are one or more geographical features that can be made to work in our favor and against them."

Schmittzer's voice was hoarse with fatigue. "The trail can be interdicted and certain areas nullified before the construction of the road begins. We propose to accomplish this by dropping highly radioactive waste, encased in concrete from shielded aircraft into junctions and points along the trail premarked by beacons. These beacons will be placed by hand. Null zones have now been selected in unpopulated areas along sections of the trail where, because of the terrain, it is impossible to use any other route without major detours and consequent flow reduction. As the road building crews move towards these null zones, they can dispose of the radioactive waste."

Schmittzer paused. "We estimate that the maximum effectiveness of the null zones will approach ninety-two percent interdiction of total material and troops delivered in 1968, and the minimum will be seventy-seven point five percent. The point to remember is, there are both Pathet Lao, Viet Cong, and North Vietnamese operating in these areas, plus at least twenty more nationalists groups. All that ties them together into some measure of cooperation, are the supplies they receive from the Soviet Union and Red China via the Ho Chi Minh Trail. Cut these off and they'll fall apart and go back to being nationalists and finally bandits."

"Very nicely explained, Lieutenant," Engberg said in a kinder tone.

"However, I am afraid that you do not understand the political significance and the international repercussions that could result . . ."

"Pardon me, Senator, but very bluntly, I probably understand them better than you do." Without giving Engberg a chance to recover, Schmittzer hurried on. "There are a host of minor political choices that can be considered. However, I am sure that you will agree with me that an end to the war and an end to any possible reoccurrence in the future are of the very highest necessity."

"Well, of course, but . . ."

"In that case, Senator, if you show this photograph to the Cambodian authorities, they can easily identify the Cambodian Army officer." Schmittzer waved at the screen where the infrared photo he had taken the night before appeared. "The photograph was taken at the main border post on the Mekong, just above the village of Prang Naham. The other gentlemen in the photograph belong to the Eighth Division, Third Regiment, of the Republic of North Vietnam. After seeing this and questioning the officer in their own inimitable way, the Cambodian government will have no choice but to admit what they must already know."

Engberg nodded and sat down, still staring thoughtfully at the screen. "I believe they will, Lieutenant. I believe they will. My apologies."

An hour and a half later, Forely and Schmittzer left the Control Center and drove back to Forely's quarters.

"I never thought they would be able to move so fast," Schmittzer said at last.

Forely chuckled. "Neither did I, really. I think everyone was surprised."

He was silent for a minute and Schmittzer glanced over at Forely: "All right, what now?"

Forely hesitated a moment. "That valley appears to be the key to the whole southern route into Cambodia, doesn't it?"

Schmittzer nodded.

"If you can get the beacons into the right spots, the aircraft can start dropping the radioactive waste as soon as you get clear."

Schmittzer grunted, "If."

"Right, if." Forley pulled the jeep to a stop in front of the building and jumped out. He turned and grinned at Schmittzer. "I'm going with you."

"Like hell," Schmittzer growled. "I'd spend most of my time looking out . . ."

"That's an order, Lieutenant. Now, you have ten hours to get some sleep. We go in by parachute at 0400."

The C-130 Caribou circled over the barely visible jungle clearing two thousand feet below. The eastern horizon was showing the first blushes of dawn, but the land below was still wrapped in darkness.

Schmittzer gripped the two edges of the doorway and waited for the drop signal. The jump master shouted something encouraging at him, but the slipstream snatched the words away. The green light flashed, the jump master took his hand from his shoulder. Schmittzer kicked out and dropped. For a moment, there was only the dim gray fuselage sliding by. Out of the corner of his eyes he caught a glimpse of Forely leaving the aircraft. The jolt of the opening parachute, as always, took him by surprise. For a moment, he was a bouncing ball at the end of the shrouds. He twisted and caught sight of Forely again, above and behind.

Night drops always scared the hell out of him and this one was no exception. Their drop zone was a small clearing less than three hundred feet in diameter in the high rain forest twenty miles north of the Cambodian border. There could be anything from pungi sticks to half a company of Pathet Lao or North Vietnamese troops waiting for them.

Schmittzer and Forely landed within thirty feet of each other and beat it into the jungle where they buried their parachutes as fast and as silently as possible. Then they made a quick march north and west away from their objective. For an hour they crouched in ambush a mile from the drop zone until the sun was well up. High on the western side of the low ridge, the rain forest was sparse and the monsoon cloud cover had completely disappeared. Shortly after dawn, Schmittzer whistled softly and a few minutes later, Forely joined him. Together they struck out toward the valley lying between the two ridges. On the other side of the westermost ridge, lay the placid expanse of the Mekong. All over Laos, Northern Cambodia, eastern Thailand and western South Vietnam, other silent teams of men were parachuting toward what would shortly become null zones made so by deadly radioactive waste.

All afternoon, Schmittzer and Forely had quietly taken instrument readings to place exactly the radioactive waste in four locations along the eight-mile length of the valley. By sundown, they had worked their way to within a mile of Schmittzer's previous ambush site.

Forely unlimbered the radio pack and at 1940 contacted the military relay satellite, checked their position and passed on the coordinates. Twenty minutes later, Control Center was in touch with them again and had confirmed acceptance of the locations.

"That's it then," Schmittzer said. "Let's get to work."

While Schmittzer was the junior officer, Forely deferred to his superior knowledge of the terrain and accepted orders as easily as if the ranks were reversed. They laid out

the ultraviolet signal sources and set each in operation. The signal devices were battery operated UV light generators resembling sealed beam flashlights that would operate for thirty-six hours. At dawn, two specially rebuilt C-130s would seed the valley with six-by-six foot blocks of concrete encased phosphorous isotope. Each block of waste emitted one hundred sixty thousand roentgens of radiation, lethal within thirty-six hours to distances of five thousand feet each. The operation would continue over the next week, simultaneously with a concerted information campaign conducted by leaflet, radio, and loudspeaker broadcast warnings of the location and dangers of the null zones. Each block of radioactive waste was also equipped with a nuclear powered repeater system that monotonously broadcast the warning in Cambodian, Laotian, Vietnamese, Meo, English, Chinese, French, and Montanard, over and over.

By 0300, working as quickly and silently as possible, Schmittzer and Forely had planted and checked each signal source. Peering through the UV image converter from where he was standing halfway up the ridge, Schmittzer could see the brilliant pinpoint spots of light, two north of his position, and behind and to the south, six more.

"O.K.," Forely groaned, "it's a long way back to the clearing and we only have a couple of hours to get there." He stood up, stretched and lost his campaign hat. The crack of the rifle lashed at them. Both men hit the ground.

"This way," Schmittzer whispered fiercely, "and keep it quiet." He squirmed rapidly away.

The firing stopped. The night pressed down on the two men with its pre-dawn stillness. They had come armed with M.16 carbines each, since self-protection was now more important than concealment. Schmittzer motioned Forely farther down the slope and followed a few feet behind.

Suddenly, Forely held up a hand, then pointed off to his left at a patch of blackness several hundred feet away.

After a moment, something moved, very carefully, and inched forward.

"One or more," Forely murmured.

"Probably more. Look's like you haven't lost your touch after all."

They continued to work carefully downhill until both caught a faint clink of metal about fifty feet distant at the same time. As darkness had fallen the previous evening, faint patches of cloud had begun to move in, until by midnight, the sky was completely overcast and the night was as dark as only a jungle night during the monsoon season can be. Now, as the two hunted men tried to figure out how many men were hunting them and

where, it began to rain. With the peculiarity of the total monsoon, the sky opened and poured down sheets of water.

"Hot damn," Schmittzer gloated softly. "Listen. These guys are using their classic ambush technique . . . a small party ahead and to the side, the main party coming up fast behind. Any second there's gonna be a flare. Get down flat and keep your carbine ready. You start on the right, I'll take the left. One spray. Once you finish, watch for the guys up above. Let them close in before you open up. Got that."

Forely's answer was a whisper. Both men squirmed as low into the sparse vegetation as they could manage. *Damn jungle all around,* Schmittzer thought to himself, *except when you need* . . . Two flares exploded throwing the wet black rocks and scrub into sharp relief, even through the silvery haze of rain. Both men spotted and fired at the North Vietnamese at the same time. They were less than fifty feet away, crouched and peering upward. The sharp chatter of the two carbines blew away even the steady roar of the rain. Figures below exploded into awkward positions as the concentrated automatic fire lanced across the line of eight soldiers.

Forely swung around and caught sight of the two on the slope above almost in time. He fired first, but was killed instantly by a single bullet before both soldiers were flung away by the blast from his carbine.

"What about those . . ." Schmittzer slithered over to Forely's twisted body and pulled him over on his back. "Oh God . . . no . . . !"

The bullet had struck Forely in the neck severing the spinal cord as he rolled into the prone position, his carbine already firing.

Schmittzer took a last look around by the flare's diminishing light. Below eight bodies were crumpled about, a horrible tribute to the fire power of the M.16. Nothing else moved in the shimmering globe carved out of the rain. Working now almost by feel as the flare died. Schmittzer lifted Forely's body onto his shoulder and moved up the hill.

By 0500, the rain had died away to a drizzle and a few minutes later, Schmittzer heard the whup-whup of the Huey's rotor blades. He stood up cautiously from where he was crouching on the edge of the clearing and as the 'copter settled slowly, he picked up Forely's body and walked toward the aircraft.

At 0400, the next day a C-47 equipped with loudspeakers began orbiting the valley. For three hours it warned anybody in the valley out in seven languages, Vietnamese, Cambodian, English, Chinese, Laotian, Meo and Montanard. At 0700 the first of the specially rebuilt C-130s deposited its four-ton egg of concrete at the head of the valley. ■

"To Sleep, Perchance to Dream..."

. . . But not even Hamlet
had quite such a strange bourne
from which no traveler
returneth in mind!
The trouble with animation
suspension might be that
you didn't die . . .

W. C. FRANCIS

ILLUSTRATED BY KELLY FREAS

He felt rather than saw a flash of unbearably white light. Simultaneously, he heard a noise like the take-off roar of a huge rocket. *Like the sound of lift-off,* he thought . . .

Emptiness. A perfect void in his mind, deeper than the utter vacuum of space.

He heard a low but steady buzzing. It was red to match those dull flashes of light. But . . . how can a sound have color . . . ?

It was as if his body were floating in tepid water, but water that was not wet. He felt nothing but existence. Then, suddenly, a tingling sensation of warmth came from all directions, even from within. The warmth gave way to a dull, numbing sensation of cold that spread slowly from his hands and feet, through his arms and legs, into his body, and penetrated his innermost being, bringing blackness.

Why a train? a small part of his wandering brain, the reasoning part, asked. There was no answer, just the train, vivid in spite of the vast distance it was from him. He heard the whistle and smiled—or thought he did—as the pitch lowered slightly due to the Doppler effect, he thought, proud to remember that bit of physics without being able to recall his own name. In the distance, the train vanished in an obscuring mist.

Consciousness and nothing else. He felt no sensations except the passage of time. He was without the power of thought, so it didn't seem extraordinary. It didn't even seem ordinary. He saw nothing, felt nothing, heard nothing. He could not even sense the lack of sensations. Time made up his entire being.

It seemed like a day, but it could as easily have been a minute or a year. Then his brain began a sort of thought line. It was memory and it wasn't memory. His brain was reproducing the entire neural pattern of certain incidents within a certain pattern of events. He was actually living the period again, complete with all the thoughts and impressions that had passed through his head, conscious and subconscious. Consequently, he was incapable of independent thought. He was unable to do anything that he had not done before.

"Mr. McBlain," began one of the half circle of reporters that had been waiting, he guessed, all morning to ask him a few more questions.

"No, gentlemen, I'm not in the mood to answer any questions right now. Try to catch me at the press conference after my dinner with the President tonight."

They were reluctant to give him up, but before any of them managed to get a question off at him, he was out of range.

Robert William McBlain, public figure. He smiled wryly to himself.

All he had done to deserve his place in the spotlight was to be chosen for the first interstellar mission, out of a field of forty-two volunteers.

He was enjoying the pleasant weather—Washington always had pleasant weather now that weather control was successful—walking in the Mall between the Washington Monument and the Capitol building. Yes, he thought, the waiter was right, the cherry blossoms are very nice. McBlain unconsciously picked up the waiter's phrasing.

He was wondering what he would say to the President at the dinner. After all, McBlain had voted against him.

That was when he saw the man scurrying across the Mall with the pencil, pad, and rushed look of a reporter. The concept hit him then, suddenly, with all the impact it had.

He would never see Earth, as it is now, again.

Even if he did return from Beta Cassiopeia, Earth would be as alien as the inhabited planet of the Beta Cassiopeia system. The star was about forty light-years away, therefore a round trip would take nearly two hundred years. He wouldn't age, of course; he would be under suspended animation. He wouldn't change, but Earth certainly would.

He ignored the reporter, without using his usual "No comment" and ran toward the street. He waved at the first taxi he saw and got in before it could settle all the way to the street surface.

The neural reproduction stopped then and began again the next day in his memory. He sensed no break, however, because the memory was complete with remembrance of the missing period.

He lay in bed, listening to the sound of the waves breaking quietly against the white sand. A cooling breeze with a slight smell of salt came through the nylon screens on the open windows.

"Flight," he murmured to himself, remembering the gaudily colored charter plane with pilot to match, smiling at his own nervousness. He could relax, at last, now that he was away from the glaring spotlight of publicity. The flight had seemed to him frantic because of the sudden and pressing need to get away.

Then, without warning, McBlain became aware that something was wrong. Another sound mingled with the quiet surf in the gray dawn surrounding the motel: a soft squeak. McBlain looked around and discovered the source of the squeak. The rust-splotched doorknob was one of the few left in the motel that hadn't been replaced with a nylon plastic knob. The rusty knob was turning slowly.

McBlain rolled out of bed and landed silently on all fours. He stood up quickly, glancing around for a weapon. The door creaked and began to open. McBlain threw himself to the table and snatched up the knife that was there. He moved

behind the opening door, and, as the man stepped cautiously into the room, grabbed him from behind and put the knife to his throat.

"Don't move," McBlain growled.

The intruder disobeyed and in a few quick and effortless movements, disarmed the indignant McBlain. The man had reversed their positions and twisted McBlain's arm painfully until the knife clattered to the floor. Without releasing his grip, the man bent to pick up the knife. Then he released McBlain's arm.

"Sorry, McBlain," he said in an apologetic voice, "I didn't want to have to hurt you."

McBlain whirled. "Who . . ."

"*Shh*—be quiet. There's no need to yell." The man was tall and had an appearance of gauntness. He wore black-rimmed glasses and looked quite harmless.

McBlain obeyed, almost against his will. "Who are you?" he said in a voice that approached calm.

The man pulled up a chair and straddled it. "My name . . . well, you don't need to know that. I'm working for the government . . . Security, you know. Just checking."

"What right . . ." burst out McBlain.

"Very little, Commander, but you should have gone through channels if you had wanted to back out on this mission. And, by the way, sit down. You make me nervous hovering like a car at a red light."

"Channels?" McBlain sounded irritated but he sat down anyway. "You ought to know what channels mean. A couple of weeks of red tape. And I'm not quitting. I just wanted a vacation."

"O.K.," he said. "That's what I wanted to know. You need some money." It was a flat statement. He reached inside his jacket and withdrew a packet of bills. He tossed it to McBlain. "Enjoy yourself. We'll expect you to be at the cape at the scheduled time."

McBlain didnt' answer: he was convincing himself that they were really fifty-dollar bills.

The gaunt man got up to leave. "By the way, you may have noticed that the papers are still quoting your daily comments. We're covering up for you." He walked out of the door without waiting for McBlain's answer.

As McBlain began to make his answer, the neural reproduction ceased abruptly, inexplicably.

He heard a clock ticking, ticking endlessly. He waited for an alarm that never came, never interrupted the constant, endless ticking. On and on, for hours and days and weeks, monotonous ticking.

His entire existence was cherry blossoms; the sweetish smell; the pinkish white color; the feel of white velvet; the buzz of a bumble bee. His entire field of vision was pinkish-white. It darkened slowly to blackness, but he was still conscious and aware of nothing—that is, a

lack of anything. The silence could be felt, tasted and seen. Then, he felt as if he were being watched, watched by a thousand eyes. He saw eyes, nothing else, eyes of all types. Round and curious, slitted and sinister, slanted eyes, straight eyes. A pair of black-rimmed glasses. A thousand eyes, shimmering in darkness. He felt mechanical eyes watching him; watching his heartbeat, his breathing, his metabolism, his mind. Then, without warning, the sensations were gone.

A man's voice in the distance and a hand shaking his shoulder.

"Come on, Bob, wake up."

McBlain had half expected to see the gaunt man with the glasses again, but he saw the smiling, wrinkled face of Frank Renney. The wrinkles were sketched by the passing years and the repeated smiles.

"Bob," Renney said softly, "we're going out to fish today. Remember?"

McBlain was wondering whether or not to dismiss the Security man as a dream when he found the packet of bills in the bedclothes.

"Uh, Frank," he began as he sat up, "about the money . . ."

"I told you once, Bob, forget it. I'm more than willing to make a contribution to history. Are you going fishing, or not?"

McBlain thought that anyone else saying the same thing would sound angry. "I'm coming, Frank," he said, deciding to leave the bills in the mailbox or something.

Renney's boat was forty feet long and as utilitarian as it was beautiful. The smooth lines of trim were in light blue, contrasting the white fiberglass of the hull. There was absolutely no rust anywhere on her, because all the fittings, down to the nameplate with the silver letters *Tang,* were nylon or fiberglass.

Renney loved his boat and loved the charter business—the motel was more of a sideline to him—in spite of his protestations about a "damfool senile old man, without enough sense to quit when the fish get smarter than he is."

The fish, as a general rule, weren't smarter than Renney but this morning they were. McBlain waited in the soft chair with the rod in his hand and the hot sun beating down on him until the sweat made his clothes stick to him. The morning was unrelieved except by two teasing bites. The fish box remained empty.

At eleven, Renney remarked, "Fishing's unusually bad today. Let's have some lunch. Maybe we can catch a dolphin on a banana peel."

McBlain stood up, reeling in. "You'd be more likely to catch a monkey."

"I don't know. I heard of a fellow who caught a catfish with a pickle. He used it like a plug. On a bet. He didn't do it as a regular thing."

"I wouldn't think—" McBlain started

Suddenly, Renney shouted, "The other rod!"

McBlain dropped the one he had

in his hand and whirled, ignoring the clatter. The line from the outrigger was floating lazily down. McBlain snatched the rod from its socket and seated himself in the center chair. He waited until the line was almost taut, then heaved back on the rod to set the hook. There was an answering heave and the fish broke the surface of the water. It was a beautiful blue-gray fish, at least six feet long, McBlain guessed. After standing on its tail for a suspended second, the fish fell back and the deep green water closed over it.

"If you land it," Renney said softly, "it'll be the first marlin this season."

McBlain didn't land it. The marlin fought for an hour and twenty minutes, leaping and diving deep, running away or dashing toward the boat. On the seventh magnificent leap, the fish twisted in the air and the two men saw the red and yellow feathered hook fly from the marlin's mouth.

"Tough," was all that Renney said.

"I don't know," said McBlain, casually reeling the line in. "What would we do with it if we had it? I've got no place in the capsule for a six-foot stuffed marlin."

Renney laughed. "I could use it. Great tourist attraction. Look great in my lobby, too. I might even charge to let people look at it."

McBlain laughed. He could relax with Renney. Be his old flippant self, like he was before he knew about the mission. *Well,* he thought, *why can't I be that way anyway? I just have to relax again.*

As they rode in, Renney sat at the helm and McBlain sat in the chair looking at the boiling wake. They didn't say much.

Then, he didn't realize it at first, the neural reproduction was replaced by a dream. The sea darkened and changed color as the sky turned dark, violent red.

"Hey, Renney, look at this."

No answer.

He turned and looked. Renney was gone. There was a leak below, a big one that spurted a three-inch stream of red water. The sky darkened further; the land was out of sight in the distance. As he struggled in the violent seas—the boat had sunk—blackness rolled over him.

He heard the terrified scream of a falling man in the darkness.

Consciousness, and nothing else. He tried to explain it to himself, and failed. His education had no connection with what was happening. The only thing he could figure was that he was reliving the important events in his last few days on Earth. O.K., then the next one should be the last day, when . . .

"Good morning, sir," came the voice of Baker, the psychiatrist, as McBlain opened his eyes.

McBlain looked at the gray steel

walls of the Quonset hut for a moment before answering Baker.

"Have you been standing there just waiting for me to open my eyes, Mr. Baker?"

"No, sir."

McBlain looked at the man standing by the long, narrow window and thought that he wouldn't be able to stand up if it weren't for the starch in his uniform.

McBlain sat up. "You take life too seriously, Baker."

Baker didn't reply. McBlain couldn't decide whether he was searching for an answer or trying to figure out what it meant in terms of McBlain's morale.

McBlain smiled. "Baker, you even take taking life seriously seriously, and I'm not repeating myself. What's on the agenda this morning?"

"Final preparations for suspended animation, sir," Baker replied, looking the least bit relieved.

"Look, Baker," McBlain said, pulling on his shirt, "I've been briefed about everything from doughnuts to the devil's grandfather in the last two weeks, but nobody's said much about suspended animation. Exactly what is it?"

"I don't know, exactly," said Baker. McBlain thought that he was probably lying. Baker went on: "It's a method of slowing down all biological processes to a near stop."

"Oh. So I won't be able to . . ." said McBlain.

But Baker was going on. ". . . With the slowed metabolism, bodily needs are drastically reduced and the aging process is brought to a near halt. You won't seem more than a year older, even though the trip will take about a century."

"Like sleeping on a train," McBlain remarked as he buckled his belt. "But how am I going to wake up without a conductor to shake me at my stop?"

"There's a timing device coupled to an awakening system that will wake you in time to guide the capsule in the last few thousand miles."

"Great. You've thought of everything . . . I hope."

A couple hours later, McBlain and Baker were entering another pre-fabricated steel hut, Baker holding the door, his hand carefully avoiding the sign that read "Authorized Personnel Only." Baker steered McBlain into the second door on the right. McBlain, slightly irritated, disengaged his elbow from Baker's hand and pushed the door open. He held it for Baker to go through.

McBlain greeted the two men dressed in white. They nodded, concentrating heavily on their hands.

"I'm not dead, yet," said McBlain. "You might give me a hint as to what I'm supposed to do."

One of the doctors asked him to strip down to his shorts. He began to undress, then remarked, "Why just to my shorts? You afraid to be embarrassed?"

The three men looked at him in bewilderment.

"Oh, I get it," McBlain laughed. "I'm supposed to be brooding about leaving Earth for good. I got over that a month ago."

He sat down on an operating cart and watched one of the white-coated men take a hypodermic syringe from a small cylindrical sterilizing oven.

"If you'd lay down, Commander," said Baker.

" 'Lie' down, Baker, not 'lay' down," he said as he stretched out.

He watched one of the doctors tilt a small bottle up and fill the syringe with a colorless liquid. He felt the cold swab of alcohol on his arm.

"This won't hurt a bit," McBlain said.

He felt the needle bite into his arm and watched the syringe slowly emptying into him. He began to slip into a warm darkness. He heard a voice say, "Pleasant dreams." He didn't know whose voice it was, but he had a suspicion it might have been his own. Then blackness engulfed him.

A bedroom, the bedroom in his apartment, and his bed with covers turned down. The sound of his stereo playing chordal jazz, a brass combo, a high-flying saxophone solo. He sat down on the side of the bed and started to take his shoes off. Sudden complete blackness, with the sax solo still orbiting in the dark. He found the light switch and tried it twice. None of the four lights worked. *The odds against them all going off at once are fantastic, so I must be blind.* Then the stereo went silent. *I'm deaf, too,* he told himself and screamed silently to prove it. Intense dizziness hit him suddenly and then consciousness left him.

Then he woke up. He extricated himself from the sensors and moved forward to the control couch, and sat down. He turned on the viewscreen and looked at it. A planet like Earth was before him. He could see patches of green and blue between the white of clouds.

"At last," he muttered. He punched input buttons on the computer panel, asking for a landing spiral. Then he leaned back. *It's over,* he thought, *the dreams are over.*

"I wouldn't jump to any conclusions, if I were you," came a voice to the right of him.

He turned to face the voice. It came from a six-foot five-inch marlin that sat in a second contour chair.

"I said I didn't have room for you," he said.

The fish looked at him for a moment, and said, "O.K., if I'm not wanted," and vanished.

McBlain looked back at the control board and saw the flashing red light that said the computer was out.

"Oh, hell," he said, as other red lights came on.

The capsule plummeted down and smashed on the top of a five-thousand story apartment house.

He sat quietly in a wooden chair and thought. Fear overcame the thought before long and he got up to pace around. What was his mind's next maneuver to drive itself mad? He stood still, suddenly, when he heard the shrill, terrified scream of a falling man. He stood another minute before he realized that *he* was the falling man and he was about to scream his lungs out of his body. The air swept by him at an impossible rate. His stomach felt the peculiar sensation of weightlessness. He fell, on and on, for hours. It would be a pleasure to hit bottom, he thought, as darkness came.

He saw a near human face bending over him. As he opened his eyes, there was a burst of an indescribably alien language from the face over him. He sat up and looked around.

Centaurs, he thought. *Half-man, half-horse. They're out of place; they belong on Beta Centauri.* One of the centaurs walked over and put a weird looking helmet that he was sure he had seen before on his head.

"It is a telepathic translator," said the centaur.

"Oh." It was so fantastic that he couldn't think of anything else to say.

"We wish to welcome you to our planet, thing from beyond. We look forward to a profitable exchange of ideas."

"Yes, our people wish . . ." he began, but he was interrupted by a centaur in a purple uniform that burst into the room.

"Fuzon, a crisis!" the centaur burst out. "The swordsmen are approaching the city. There are more than enough to overwhelm our forces."

Then McBlain remembered the ultraviolet LASER in the capsule. "Is my ship all right?" he asked. "I have a weapon that could help you."

"I wouldn't jump to any conclusions, if I were you," came a voice accompanied by the sound of shattering glass. McBlain whirled. The being that had leaped through the window was like a satyr; half-man, half-goat, except that he (or it) had no hands. At the end of his arms there were a sword and a shield of a brown shade—the same color as the satyr's hoofs. McBlain snatched the blaster from his hip and fired; the satyr only laughed. The coruscant flames only danced around the swordsman ineffectually. Damn. They must have learned how to make personal screens in the last few days. Nothing but material weapons would reach them now. McBlain dropped the blaster and caught the double-bladed sword Fuzon tossed to him. He attacked the satyr, but was unable to get any opening. The swordsman was much too experienced for him, with that sword that was part of him.

"Back, McBlain," came a familiar voice at his side. "I'll handle this."

McBlain was glad to let the marlin take over the battle with the swordsman. After all, his sword was part of him, too.

Oh hell, he thought and slipped back into oblivion.

He was sitting in the center seat of a fishing boat. The reel in his hand screamed long and plaintively. He gave a hearty pull on the rod and a giant tuna leaped from the water to land on the boat and smash it to splinters. He was sinking slowly, struggling to swim upward to the light and air. The more he struggled, the faster he sank. His lungs convulsed and his body shook and he lost consciousness.

He was still asleep and he knew it. He struggled to open his eyes but they would not cooperate. It was if they were tied or sewn shut. He strained the muscles in his forehead for hours but his eyes would not open.

Consciousness and fear. He wouldn't be able to tell whether he was really awake or not when he was finally awakened. And fear . . . he thought, to Beta Cassiopeia. He was liable to fall apart, mentally, before then.

It began again.

He was standing on a hill, and could see nothing but grass as far as his eyes could reach in any direction.

"All right," he shouted. "Come get me."

Nothing happened. "C'mon, do your worst." Silence.

"O.K.," he said. "If you aren't going to do anything, that's O.K. with me."

And he began to relax. When his guard was down, the *thing* attacked. McBlain let loose a scream of concentrated terror and . . .

There was Baker's face looking down into his with an expression of genuine concern. "Are you all right, Commander?"

McBlain knew he was really awake, this time, because his first thought was, "Am I really awake?" Doubt was the only thing that made him sure. He was really conscious because he was *able* to doubt it.

"What are you doing here?" is what he said aloud. He tried to sit up in the low gravity of the accelerating ship—it wasn't his capsule—but was held back by the sensors that were attached to him. Baker was taking them off, one at a time, and there were two other men in the room. He recognized one of them from the Astronautics School.

"We just caught up with your capsule," said Baker. "Your encephalogram readings were going crazy."

"So was I." Then he sat up so hard he pulled the two remaining sensors off. *"Ow!* How in the name of the devil's doughnuts did you catch up to me? I thought I was

traveling at maximum acceleration."

"You were," remarked one of the other men, the one McBlain didn't know. "You were up to point eight light velocity when we found you. You see, a couple years after you left, a mathematician named Carlson carried Einstein's work on farther and found the key to an apparent velocity greater than light. It only took the physicists another year to make a drive unit."

"So Einstein was right; he just wasn't finished," McBlain mused, rubbing his head where the sensors had been torn off. "And I was gone only three years, right?"

Baker nodded.

"And if you hadn't found me, I would have gone crazy before I was near anything. Baker, I'm starving, but after I eat, so help me, I'm going to kill you."

Baker almost believed him. ■

In Times to Come

Next month Bruce Daniels presents a yarn—and Kelly Freas a delightfully misleading cover—about "The Baalim Problem."

Baalim was a planet—by no means desirable as real estate—which was all right in itself. But Baalim suddenly showed up with an automatic emergency beacon in orbit—and that beacon had not *been built by human hands. In a highly advanced technological culture covering many planets, it seems, it can be anything but easy to recognize the aliens living among you! So familiar you don't see them—until an emergency beacon starts sounding off . . .*

Also coming up is a highly interesting article by G. Harry Stine, Rocket Engineer, on "How The Soviets Did It In Space." Made up from photographs and reports which Stine collected himself on a trip last summer through the Soviet fringe countries in Central Europe.

There is considerable information that has not been generally available in an integrated fashion before this, and some excellent photographs showing the wide divergence between the USSR's engineering approach to the problem of space vehicles and the U.S. approach.

THE EDITOR.

Winkin, Blinkin and πR^2

R. C. FITZPATRICK

The deAngelis machines were sensitive—but, being machines, their limits and limitations could be calculated precisely by a competent engineer. The incalculable was the human operators who ran them . . .

Illustrated by Kelly Freas

"Give me the gun!"

"Why? Nothing went wrong."

"You still fail to understand? Very well, I must explain again—slowly. And you must listen to me—carefully. This was only a practice run, and yet, through mischance or the machinations of some *other* idiot, you might have drawn the attention of the authorities. How then would you explain the gun?"

"Nothing went wrong."

"You are mistaken—nothing will go wrong."

"But . . ."

"No, *BUT!* This is why we have practiced so assiduously; to avoid mischance, or idiotic machinations. This way there will be no last-minute furor, and nothing will be overlooked. For that way lies danger. And thus we can forestall anger and irritation. For that way lies disaster."

"I ain't irritated."

"I AM!"

In McKeesport, and Swissvale, and all the other precincts in the city, red lights flashed continuously on the deAngelis boards. Without a reading on the dial below, another occasional red light passed unnoticed. Too many other things also passed unnoticed.

Not a shot was fired the first time. No alarm rang. No beat cop, or scout craft, filed a report. In the evening the Downtown Branch of the Allegheny County National Bank had not quite five million dollars. In the morning it had $4,944,671.28 less than it had the previous evening. The second time it was the Sharpsburg Branch of the Pittsburgh Mercantile Savings & Loan. The second time was like the first . . . and the seventh like the sixth.

Pittsburgh had a crime wave.

"Wonder what he wants?" said Blaney. He hitched his chair to face

Matesic. "Why'd he call us here?" It was plain that Blaney was asking, *Why did he call me here?*

The captain had ordered all deAngelis operators to report to his office. Now the five of them were waiting, quietly or questioningly, according to their natures. Ken King was reading a book; Chuck Matesic sat stolidly with his arms folded across his chest; Charley Blaney was impatient; and the two rookies, Bill Hampton and Joe Zimmerman, were nervous and trying to hide it.

"What do you think, Chuck? What are we here for?" Blaney asked again.

Matesic turned his head without moving his body. "If I were the captain, I'd tell you," he said. "But since we're all deAngelis men, I figure it *might* be because of the deAngelis." He turned back to studying the opposite wall.

The deAngelis machine, deliberately never given a name, was an emotion-detecting device. It was not the "Mind-Reading Mechanical Brain" or the "Emotional Radar" of the tabloids. Nor was it the "All-Seeing Eye" feared by some politicians and most of the public. It was simply a machine based on human physiology, and—once installed—on human psychology as well. It acted on the principle that brain waves are similar to electromagnetic impulses; thus subject to the laws governing Wave Theory.

Any brain can be loosely termed an *electrical something*: transformer, generator, sender, receiver, relay or recorder. All thought and action are expressed in electrical impulses sent to and from the brain through the body. Most impulses are too weak to be detected without a direct connection to the skull, even through the skull. Some are undetectable even then. And some are so strong that the brain becomes an actual transmitter. In the latter case the deAngelis was designed as a radio set able to receive them.

Even though an extremely sensitive instrument, it was limited. Only strong emotion created impulses of sufficient strength; these created the broadcast band across which the deAngelis operated. The machine received these impulses and transliterated them two ways: dials that registered from 60 to 120, and lights of variable intensity ranging from the softest pink to the savage scarlet of fresh blood.

But the machine was only a machine, the men who operated it made it work. The dial's limit of 120 was not a limit; any emotion of stronger intensity would register 120—and 120 meant murder. But so did 110, 90 occasionally, and lower readings in rare cases. Sixty was a child being spanked, or a bookkeeper doing more than his share of the day's work. Sometimes.

And even this could not show a true picture. The human mind is too complex. The light above each dial was the second component; one man's 80 was a legitimate anger that

might burn a steady orange-red for weeks, the 80 of another might flare from orange to crimson and back again. It was the second 80 that deAngelis operators were trained to watch. But the first 80 might possibly be a man planning to murder his wife in a deliberate well-organized manner. And his light would burn its honest, steady, orange-red until the deed was done.

Operator, dial, light: each had its vital function. But of the three, the operator was the one component that could pick a lunatic from a loser —or pick the loser instead. And at any given time, in a city of two million people, how many are *almost* ready to punch someone in the mouth, or slam the door on the way out. All-Seeing Eye? Radar? A deAngelis machine on every block would hardly be adequate. And that many operators would never be sufficient.

Charley Blaney made his sixth visit to the water fountain.

King dog-eared a page in his book and closed it. "What is it with you, Charley? How long have you worked this precinct, four days or four years! They've got more right to be nervous than you have, only they aren't." He indicated the rookies by pointing his book. "If Old Knuckle-cracker wanted you on the carpet, the rest of us wouldn't be here. And if he meant you, you wouldn't have to wonder—you'd know!"

"You ain't very polite, Ken," Matesic said. "I'm gonna tell your sister."

King smiled.

Matesic stared at the wall. King reopened his book. And Charley Blaney sat down again. The two nervous rookies almost glowed; they were still nervous, but a favorable comment from Matesic, or King, meant more than a raise in pay.

"In!" said Old Knuckle-cracker. He had not opened the door, but the desk sergeant on the floor below nodded wisely to the officer beside him.

The five deAngelis operators filed in and gathered loosely around the captain's desk because he told them to. The desk was littered with newspapers and personnel records.

The captain waved a newspaper. "You heard about our crime wave? I have to switch the duty schedule, you'll have to work overtime. Sorry." The captain had to use his men in the same manner as a baseball manager. Some men were good in some areas, some in others. The present schedule called for Blaney to have the 0800 to 1600 watch (8:00 a.m. to 4:00 p.m.), Matesic from 1600 to 2400 (4:00 p.m. to midnight), and King from 2400 to 0800. The dangerous hours were usually from about nine in the evening until three in the morning.

"You two men are off day watch," the captain said to Zimmerman and Hampton. "Matesic, you go into plainclothes. You've been transferred downtown for temporary

duty." He waved the papers again. "Seven robberies in five months. All big, all clean, and all the same gang. These guys are real professionals, and those crime cameras you use don't show a thing. We're back to trying old-fashioned detective work for a while."

"King's had the same FBI training I have," Matesic said.

"King wasn't in Army Counterintelligence," the captain said. "And that's a free explanation! You think I'll lose both of you? Get out of here!"

"Nice try, Chuck," King said as Matesic went out. "Have a ball."

"Shut up!" said the captain. "Blaney! Zimmerman takes over the last four hours of King's watch. I want you to supervise." Zimmerman was the best of the two rookies. "Hampton, you take the midnight to four. King, you take Matesic's watch and supervise Hampton."

"That makes twelve hours of duty a day," said Blaney.

"Somebody tell you to add?" said the captain. "All right. All of you. You're not getting paid to stand around. Get back on duty."

Nothing changed in the next two months; three new bank heists and no new clues. But the newspapers stopped using restraint and began to really backhand the mayor. So the mayor began kicking the police commissioner. And the commissioner stomped on the precinct captains. And the precinct captains . . .

"Wipe off the blood," said King.

"Hoped it wouldn't show," said Hampton. He smiled weakly and looked at his watch. "Guess I had it coming."

King turned the deAngelis over to the younger man without further comment. He would not let his increasing respect for the rookie show. Bill Hampton had a wife and two children, and his wife was sick. It was sixteen minutes past midnight, and one of the few times the man had not been in at least twenty minutes before his turn on watch since King had supervised him.

"I think I might chase across the street for a bite, want something?" King asked. When Hampton said, "No," King headed for the captain's office. He walked in without knocking and told the captain what Hampton hadn't; that he'd a sick wife and was usually early. ". . . And I respect him for it. He called in two hours ago and said he might be late."

The captain was unimpressed. "If you think he needs an apology, you give it to him."

"No," said King. "But I thought you might want to know. The next time he's not here, I might have given him some time off."

"I give any time off around here."

"Then take the stripes off my arm. So long as I wear them I'll use them."

"Get out of here!" said the captain. "Go hold his hand."

"Yeah," said King and walked out.

It was the first time King had failed to say "Yes, sir" to the captain. And one of the few times the captain had ever let it pass. He mentally chalked-up two points for Hampton, one for the point he'd taken away—and two points for King.

The deAngelis operator forced himself to pick up coffee and sandwiches he no longer wanted. When he returned, Hampton had handled two routine 90s and ignored eight others. He was probably right: the eight 90s disappeared and were not heard from again; the first 90 was an angry wife, a baseball bat, and a husband and brother-in-law too drunk to know how close they were to be no longer wearing their heads; the second 90 was a youngster in a stolen air scooter who somehow managed to land in the air shaft of an old skyscraper.

"Here," said King, "don't tell me you bedded the kids, doctored your wife, and then ate." He laid a sandwich and coffee on the board.

"Thank you, sir," said Hampton. "No argument." He'd taken a bite from the sandwich when he noticed that a key slot below a dial in the third row was no longer vertical. "Hey! You've locked a circuit on. Something up?"

King looked at his watch. "It's taken you twenty-eight minutes to find that out. I don't give a damn if your grandfather just died—don't sit in that seat until you're ready to take full responsibility. Don't trust me, don't trust anybody—I may feel mean, I could be stupid, or I might even forget—it's your business to know the board. Not mine! You've taken the watch."

"Yes, sir. I won't forget again."

"Don't . . ." *Sir me,* King finished mentally. It was the nature of young men in uniform to *sir* older men in uniform. Telling them to stop was a waste of time. Only confidence in their own right to wear the uniform would stop them. King had *sirred* Matesic, and Matesic had *sirred* the captain.

"Is something up?"

"Read the log."

"Yes, sir."

"Don't . . ."

Hampton skip-read the log until he found the proper entry: *11:32: 0000:—locked circuit on 3/34 (third row, thirty-fourth dial) bright flash, no dial reading. Noticed previously at approx. 10:15 and 10:55. Hunch.*

There should have been three more digits and a letter on King's entry, the number/letter designation indicated time, estimated area and relation to previous alerts in the month, estimated intent and frequency of report. "A" meant intermittent, so it's omission meant King would not claim even that certainty. "Hunch" was strictly unofficial—the officialese for hunch was "Safety." Each operator had a special key—any circuit locked on by King could only be unlocked by King. Once a circuit was locked it was not an un-

erring "fix" to the mind of the sender: but it was now set so that only that particular brain pattern could activate it.

"I think I saw it, too."

"Imagination?"

"No, sir," said Hampton. "I'd be lying if I said I was positive, but I'm pretty sure I caught it."

"Remember when?"

"Yes, sir. Right after Gustafson dispatched the first beat cop."

"O.K.," said King. "Just keep it in the back of your mind."

Two hours later the alarm went off with a loud clang as one of the dials read 110. King was walking to the water fountain before Hampton could turn to him for advice.

"Gus! Emergency! Everything available to the 5400 block of Solway. Solway and Negley," said Bill Hampton.

"Done. But that's Squirrel Hill," said Gus. "Can you get it any closer?"

"Solway," said Hampton. "About a hundred, maybe two hundred yards up the block."

"That's about where I'd put it," said King. "Make it two hundred." He was lighting a cigarette and standing where he'd been before.

Squirrel Hill called in twenty minutes later. "No harm done. We got him." It was a burglary and the burglar had a knife and was very much annoyed that someone heard him. "Buy your deAngelis man a beer on us."

"Mark that down to remember, William," said King. "You saved some Harry Homeowner's life. It'll make up for a thousand hours when you'll be bored to death."

"It *is* a good feeling," said Hampton. "But I'd rather lock on to a ninety that everybody else would ignore."

"Not everybody," said King, thinking of Matesic.

Hampton turned his attention to the deAngelis and immediately said, "Hey!"

"I saw it, too," said King. Three/thirty-four had flashed vividly for an instant, and the needle on the dial below was still oscillating wildly. A true reading was impossible.

"Shall I log it?"

"Log 'em both. This one and the one you remember. I'll initial it." King reached over Hampton's shoulder for the telephone and punched a number. "Mrs. Blaney? Tell Charley to roll over for another four hours. I'm not tired. I might as well take it till eight. Yes. No trouble."

When Zimmerman assumed the watch, Hampton asked if he could stay. King shrugged his shoulders indifferently, and Zimmerman looked back in surprise. When he turned to the board he studied it intently, but failed to notice the key slot under 3/34 until an hour and a half into his watch. The bright On-Off red flash caught his attention. The exchange which followed almost duplicated King and Hampton's earlier conversation.

At 1600 King relieved Blaney. Blaney left, and Zimmerman and Hampton came in from the squad room waving newspapers. King stopped them both in mid stride with a look of annoyance. He set the de-Angelis' alarm down to come on the instant an 80 appeared and to go off the instant it disappeared. He told Rhodes, Matesic's audio controller, "I'll be right back, Dusty, the alarm's for me. Just ignore it."

Rhodes nodded and grimaced automatically. His expression was an instinct, but he no longer really cared; his name was Randolph, but it might have been Rumpelstiltskin for the good it did him—all Rhodes are *Dusty*.

"Thanks, Randy," King said with a grin.

"Thank you, Your Majesty," said Rhodes bowing graciously.

King herded the rookies back into the squad room.

"They hit the Bloomfield Trust . . ." both men said together.

"I know it," said King. "So what?"

"But it proves . . ."

". . . Nothing," said King. "Not one damn thing. If it did it wouldn't mean as much as one lousy fingerprint—you can't get a fix on a hot flash."

"But . . ."

King snapped: "You ready to tell the captain that's not a young wife getting used to her husband's rough spots, or a writer who keeps typing *s* for *a*? Come off it, Kiddies. We may have a lead—a real loose lead—but we wind up the string before we set the hook."

Both rookies appeared properly chastised.

"Your humility touches me," said King.

Both rookies grinned.

"You're here," King said to Hampton. "You might as well stay, you can knock-off at eight. But you're twelve hours early, Zimmerman, go get some sleep."

"I'd-like-to-stay-too," Zimmerman said.

"And-I-don't-want-to-leave-early-if-it's-all-right-with-you," said Hampton.

"We might not see anything for a month."

The rookies were silent.

"So suffer," said King. "But if you stay, you work. I'll supervise. Hampton takes the 1600-2400 and Zimmerman the 2400-0800."

"Yes, sir," said Zimmerman. "I learned more from you in four hours than Blaney's taught me in two months. He still doesn't know there's a circuit locked!" he added in disgust.

"Knock it off!" King snapped. "I don't want to hear that again! From either of you! When you wear as many stripes as Blaney, tell him how bad he is. Don't tell me!"

"Yes, sir," said Zimmerman.

"Don't sir . . ." said King.

"No, sir," said Zimmerman.

"Get to work!" said King. (He'd already spoken to Blaney about the watch. "The Kids need the work,

and I'm a nightowl anyway. You might as well get your sleep, Charley." Charley sneered, "O.K., Pappa," but he accepted with glee.)

"And don't initial the log," King finished to Zimmerman. "I will. This is strictly unofficial."

Twelve days later 3/34 flashed intermittently throughout the night. And the morning news report carried details of the twelfth big bank job.

"We'll need Matesic," King said to the captain. He explained about the quick flashes.

"It's probably only coincidence," said the captain. "And what good does it do? You can't even guess direction, let alone get a fix."

"Yes we can," said King. "I've hooked in a camera to photograph the sweep at each flash."

The sweep was a radarlike screen that covered the approximate area of each precinct and indicated direction for each dot. Each dot was a person. The trouble with a large city was the large number of dots—on any given night the screen had a triple case of measles, and unless the reading was well beyond the high 90s, it was impossible to pick the target dot from the others.

"How will that help?" the captain asked. "Nobody else has caught this phee-nomin-nomina."

"That's because this gang's been hitting in a random pattern. Our screen's only had it two or three times—we wouldn't get anything from Millvale or Monroeville—and only for those split seconds. I'm good, Captain," King said unaffectedly, "but I'm not all by myself. Phillips in Oakmont has noticed it, and so has Goldstein in Mount Lebanon, and Tabachnick downtown."

"So?"

"Get the ten best men—temporary transfers—and spot them in a grid pattern. My two youngsters are good enough to stand over anyone's shoulder, so that gives us at least two more. Once they see the second flash, they'll know which circuit to lock on. And the pictures will give us a straight line from the sweep. We're bound to have at least three precincts catching it—and they can triangulate. You couldn't get a more

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THE ANALYTICAL LABORATORY APRIL 1968

PLACE	TITLE	AUTHOR	POINTS
1. . . .	The Horse Barbarians *(Conclusion)* . .	*Harry Harrison*	1.94
2. . . .	Secret Weapon	*Joseph P. Martino*	2.91
3. . . .	Incorrigible	*John T. Phillifent*	3.41
4. . . .	Handyman	*Jack Wodhams*	3.97
5. . . .	Is Everybody Happy?	*Christopher Anvil*	4.11
6. . . .	Local Effect	*D. L. Hughes*	4.31

accurate fix if they called in and told you where they were."

"How do you know Hampton and Zimmerman are good enough?" the captain asked.

"They've put in extra time," said King.

"Yes, *they* have, haven't they," said the captain. He'd been aware of the change in watch status since King had put it in effect. "All right, it's worth a shot. I'll stick your neck out and talk to the commissioner."

"Thanks, Captain," said King, running a finger around the inside of his collar.

Eight days later, at 0342 in the morning, deAngelis bulbs lit up all over town. Five bank robbers were busily minding their own business when the police charged in from all directions. The burglars were armed and angry, but only the leader was infuriated enough to draw. And he was not that stupid. But the hate in his eyes was more eloquent than a string of curses.

"You incompetent!" he snarled at one of his men.

"Why him?" asked Matesic. He was on loan to Turtle Creek. The bank being robbed was only four blocks from the precinct house. Matesic joined in the finish as a rare reward.

"His job was to silence all alarms."

"We didn't get an alarm."

"Nonsense," snapped the leader. "You were here too quickly for any other cause."

"Quick as a wink," Matesic acknowledged. "But we nailed you with the deAngelis."

"Do you take me for a fool," the leader said haughtily. "I've controlled myself admirably. No deAngelis caught us."

"Glad to hear that," said Matesic. "I'll mention it to King. It might keep him from getting a swelled head."

Matesic went back to his own precinct, and the watch schedule returned to normal.

"That was a long shot, Ken," said Matesic. "How did you figure it."

"Hunch," said King. "Smell maybe. About all I could figure was somebody with a short fuse, but almost complete self-discipline."

"That's the way it did figure," said Matesic. "The guy was an electronics engineer with a greedy wife. He had it down to a science and he wouldn't tolerate any mistakes. He hand-picked his crew and took two years to set this up. Do you know he had every job figured before he started—including fourteen he didn't get a chance to pull?"

King nodded in surprised semi-admiration.

"Well," said Matesic, "it just goes to prove the value of good, old-fashioned detective work."

"Detective work?" said King, surprised.

"That's right," said Matesic. "Ask the engineer. The deAngelis didn't help at all!" ■

ICARUS and EINSTEIN

Robert S. Richardson

Icarus was supposed to have lost his wax-glued wings when he went too near the sun. Icarus, the asteroid, also swoops near the sun—and is of peculiar interest to Earthly theorists. One, it comes uncomfortably near our home planet; and Two, it offers a better check on Einstein's theories than Mercury!

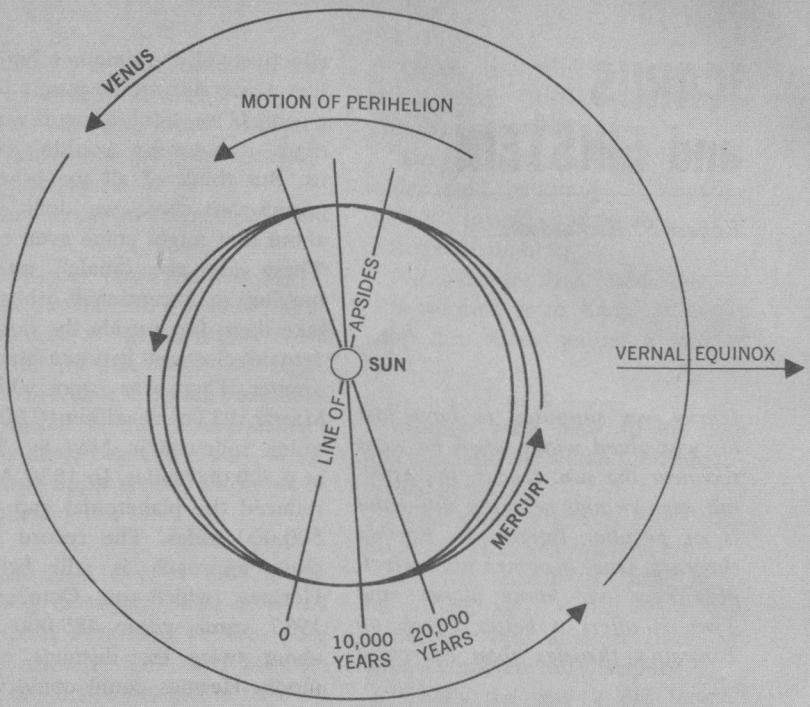
Some apprehension has arisen over asteroid (1566) Icarus, which on June 15, 1968, is scheduled to come within 4,000,000 miles of Earth. According to a usually reliable source a task force at MIT already has worked out plans for diverting Icarus in case a collision seems imminent. (Apparently they don't have much faith in the law of gravitation at MIT.) Most people with whom I have discussed the matter sound disappointed to hear that Icarus *won't* hit Earth.

What puzzles me is why all this sudden concern over Icarus? Why worry occasionally in a small way when you can worry so much more effectively all the time in a big way? Icarus was discovered purely by accident. If we didn't know it was out there, it naturally wouldn't bother us. But think of all the other asteroids out there we don't know about that might come even closer. These are the "male" asteroids moving in exceptional orbits that take them far outside the horde of females clustered between Mars and Jupiter. There was Amor which in March 1932 came within 10,000,000 miles, followed in May by Apollo at 6,500,000 miles. In 1936 Adonis reduced the planetoidal gap to 1,500,000 miles. The record for a close approach is still held by Hermes, which on October 30, 1937, came within 485,000 miles, about twice the distance of the moon. Hermes could come within 220,000 miles, which is closer than the moon.

Where are these asteroids now? Lost . . . hopelessly lost. They whizzed by so fast we never got sufficient observations to pick them up the second time around. Icarus is one of the very few close approaching asteroids for which we can boast a definitive orbit.

General Relativity Probe

Icarus besides moving in an orbit that brings it within 4,000,000 miles is unique in another way: it is the best body in the solar system for testing the general theory of relativity. Recently some new ways of using Icarus for this purpose



have been proposed which may not be familiar to you.

Oldest astrodynamical test of the general theory is found in the excess motion of the perihelion of Mercury's orbit. Readers will recall that about the middle of the last century Urbain J.J. Leverrier, famed co-discoverer of Neptune, announced that his investigation of old transit observations showed the perihelion of Mercury to be advancing 35 seconds of arc faster than could be explained by the gravitational attraction of all the planets. (Later found to be 43 seconds per century.) The nature of this motion is illustrated in Figure

Figure 1. The perihelion of Mercury is rotating in the same direction that the planet revolves in its orbit, at the rate of about 16 degrees in 10,000 years. Only 7.5 percent of this motion is attributed to general relativity; the remainder to planetary perturbations. Notice that the position of perihelion is difficult to locate, even though Mercury has second most eccentric orbit of major planets.

The orbit of Venus shown here is drawn slightly off-center from the sun. Can you locate its perihelion point? The orbit is so nearly circular that it is useless as test for relativity.

1. Leverrier believed the excess motion could be explained by a hypothetical planet, or group of planets, revolving within the orbit of Mercury. But Leverrier's hypothetical Intra-Mercurial planets only raised more problems than they solved, and his idea never won general acceptance. The anomalous motion of the perihelion of Mercury remained as the outstanding discrepancy between observation and Newtonian gravitation until 1915, when Einstein published his theory of general relativity.

General relativity predicts the advance in perihelion will be greater the smaller the semi-major axis of an orbit and the larger its eccentricity. Table 1 shows how these orbital elements interact.

Mercury is twice blest. Not only does it have the smallest semi-major axis of any planet in the solar system but also—except for Pluto—the largest eccentricity. For thirty-four years Mercury was without a rival as a test probe for the theory of general relativity. Its supremacy ended on the afternoon of Monday, June 27, 1949, when Walter Baade examined his 60-minute exposure on the Scorpius region taken the previous night with the 48-inch Schmidt camera.

Among the round star images an asteroid had left a streak so long that in eleven hours it would have moved the apparent diameter of the full moon. The trail was so exceptional that Baade got the two additional observations necessary for a preliminary orbit, which he turned over to Seth B. Nicholson and myself. Our measures and computations showed it to be a real prize: an object moving in an elongated cometlike path that brought

Table 1. Predicted Advance in Perihelion

PLANET	SEMI-MAJOR AXIS (A.U.)	ECCENTRICITY	PREDICTED ADVANCE PER CENTURY
Mercury	0.387	0.2056	43.0″
Venus	0.723	0.0068	8.6
Earth	1.000	0.0167	3.8
Icarus	1.078	0.8266	10.4
Mars	1.524	0.0934	1.4
Pluto	39.518	0.2486	0.00042

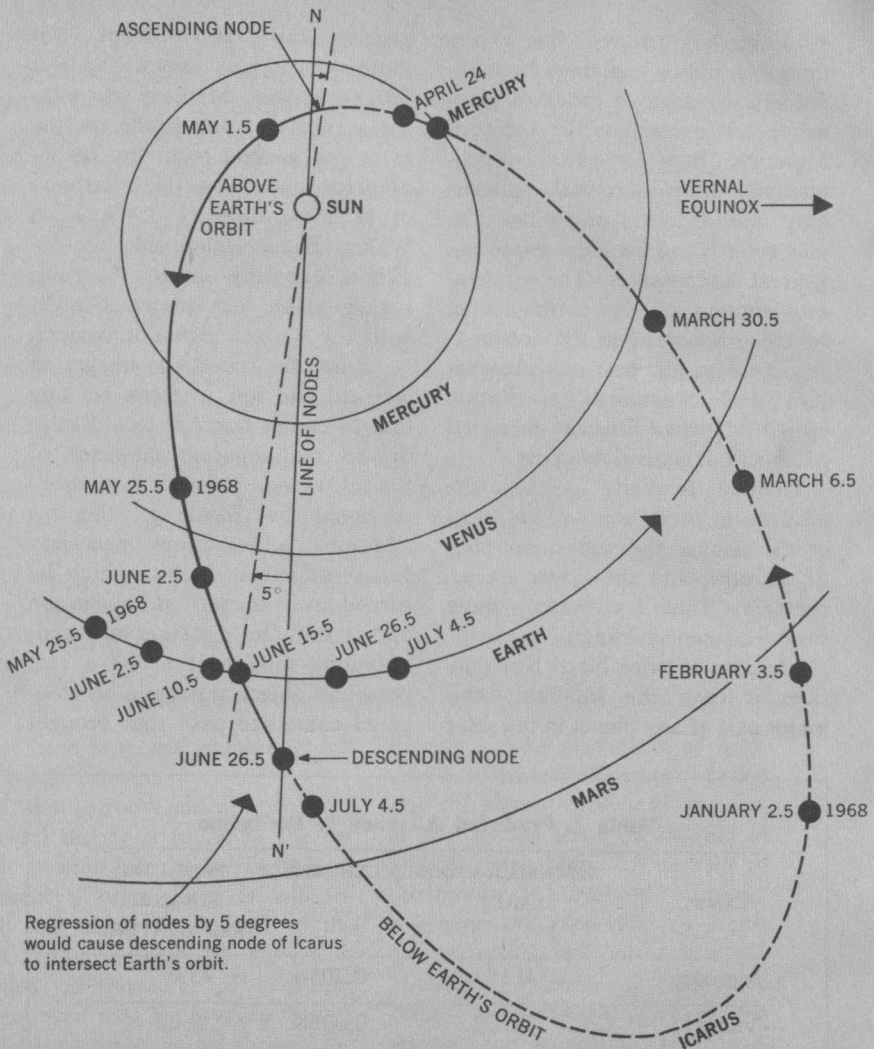


Figure. 2. Orbit of (1566) Icarus projected on plane of Earth's orbit. Although general relativity motion of perihelion for Icarus is only one-fourth of that for Mercury, its perihelion can be located with much greater precision, making it a superior test probe. Icarus moves above plane of Earth's orbit, or "surfaces," at ascending node, N, within orbit of Mercury. Icarus moves below plane of Earth's orbit, or "submerges," at descending node, N'. Collision with Earth could only occur if line of nodes were rotated, or regessed, by 5 degrees, until descending node intersects Earth's orbit.

it inside the orbit of Mercury at one end and about 35,000,000 miles beyond the orbit of Mars at the other. At perihelion it approached to within 21,000,000 miles of the sun, the only permanent member of the solar system known to come so close (Figure 2).

From Table 1 you might suppose that Icarus would not be especially valuable as a test probe for general relativity: its advance in perihelion does not much exceed that of Venus and is only one-fourth of that of Mercury. Yet eventually when observations have had time to accumulate it should afford us a more precise comparison with theory than Mercury. The reason is the high eccentricity of the orbit. The orbit of Icarus is so elongated that the position of the perihelion point can be located with great accuracy. The trouble with Venus is that its orbit is so nearly circular that for all practical purposes it *is* a circle. You wouldn't know Venus had a perihelion unless somebody told you.

How long will observations have to accumulate to afford a precise comparison between observation and theory? Oh, not too long . . . fifty or a hundred years perhaps. Aren't there any other astrodynamical consequences predicted by general relativity capable of observation now?

Mary Parmenter Francis[1] of TRW Space Technology Laboratories has called attention to one such effect that would seem to deserve serious consideration. It is not new. But the idea of looking for it is new.

Besides the slow advance in the perihelion point, general relativity also predicts a shrinkage in *size*. That is, the line joining the planet with the sun will be shorter as calculated from general relativity than for the same orbit in purely Newtonian motion. Eddington in 1923 developed an equation for the relativistic motion of a planet which includes this slight change in radius. We use the word "slight" advisedly. The maximum effect in the case of Icarus amounts to only 180 km, a change of 0.000061 percent in the radius (Figure 3).

The shrinkage depends directly upon the sun's distance *squared*, and hence is much greater when a planet is at aphelion than perihelion, in the ratio of 100/1 for Icarus. Unfortunately we cannot observe Icarus at the most advantageous times but have to catch it when we can. When closest this summer the difference between its positions as predicted by gravity and relativity will present an angle of 1.4 seconds of arc, about the apparent size of a penny at two miles.

Now astronomers regularly measure angles smaller than 1.4 seconds of arc. But here the problem is quite different from measuring the apparent separation, for example, of the components of a double star.

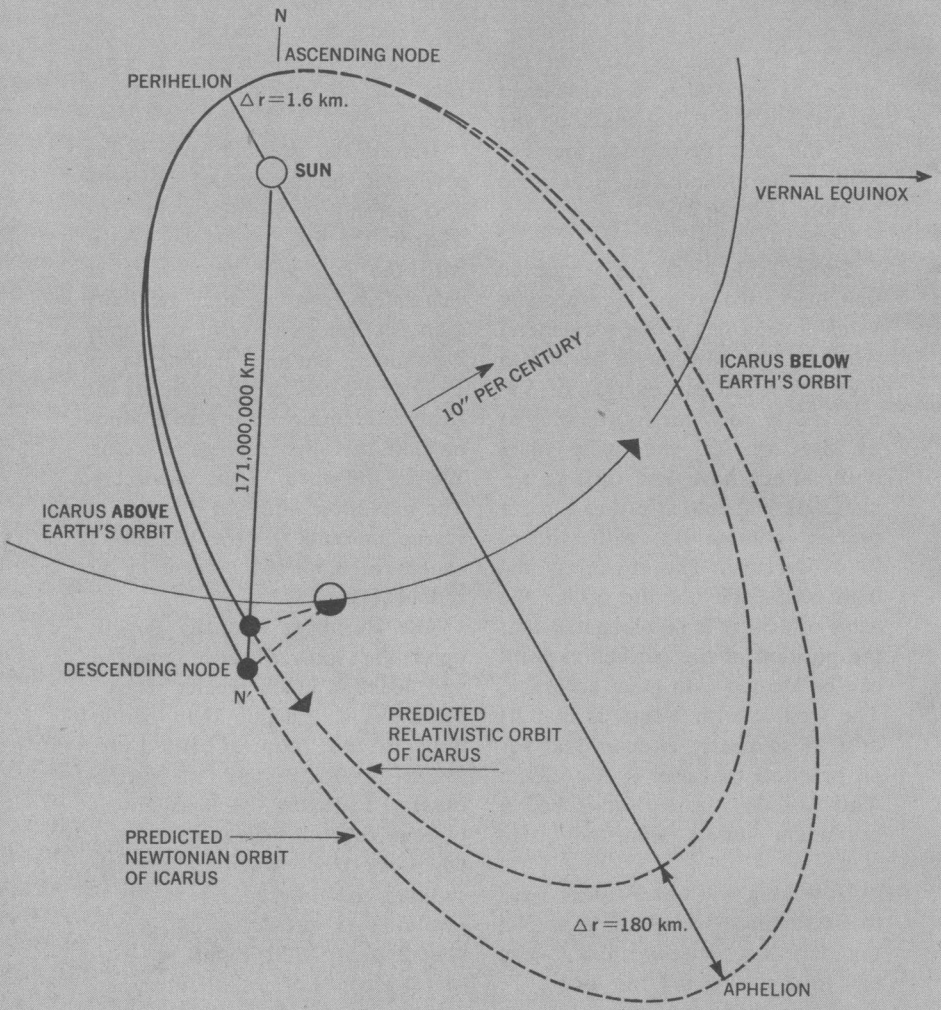


Figure 3. Shrinkage in radius vector of Icarus' orbit due to general relativity. (The effect has been magnified 200,000 times.) How effect would be measured by radar is shown in principle. Difference between observed position and position calculated from Newtonian theory would test prediction from general relativity.

The problems is to compare an observed position of a body with its position calculated from Newtonian gravitation. Assume for the moment that we can observe Icarus with the degree of accuracy required. Can we determine its position from gravitational theory with the necessary precision? Francis says it will mean taking into account the disturbing action of all the planets except Pluto. The disturbing action of the planets depends upon their masses. The masses of the planets from Mars and beyond are probably known with sufficient accuracy, and since 1950 the masses of Venus and Earth have been improved. But the mass of Mercury is still a highly uncertain quantity. In fact, we were planning to work the problem the other way around, and get the mass of Mercury from its disturbing effect on Icarus. There are technical difficulties also in the way which we shall mention in a moment.

Solar Oblateness?

Those forty-three seconds per century of excess motion in the perihelion of Mercury have become so firmly established as the best confirmation of general relativity that their position has come to be regarded as virtually impregnable. Recently R. H. Dicke of Princeton has dared to challenge this view.

Dicke[2,3] and others in a series of papers have shown how certain difficulties in the general theory can be removed by assuming that in addition to the tensor field required by Einsteinian gravitation, there is also a scalar field determined by the distribution of matter in the universe. Such a scalar field would have important consequences: for example, the gradual increase of the scalar field due to the expansion of the universe should be accompanied by a decrease in the strength of gravitation.

Now a theory does not carry much conviction unless it is capable of experimental verification. That was the problem: to find an experiment, or observation, capable of forcing a decision between Einstein's pure tensor theory of gravitation and the tensor-scalar theory. The best test available was the advance in the perihelion of Mercury. Einstein's theory predicted an advance of 43.0 secs/century; scalar-tensor theory 39.0 secs/century. Observations gave 43.1 secs/century. Clearly the advantage was all with Einstein. Observation and theory could hardly be closer.

But are the excess forty-three seconds due wholly to general relativity? Have we exhausted all the other possibilities? Dicke stresses possible errors arising from solar oblateness. He points out that if the shape of the sun departs from sphericity by only 5 parts in 100,000, it would be sufficient to account for 10 percent of the observed advance —and bring observation into agreement with the scalar-tensor theory.

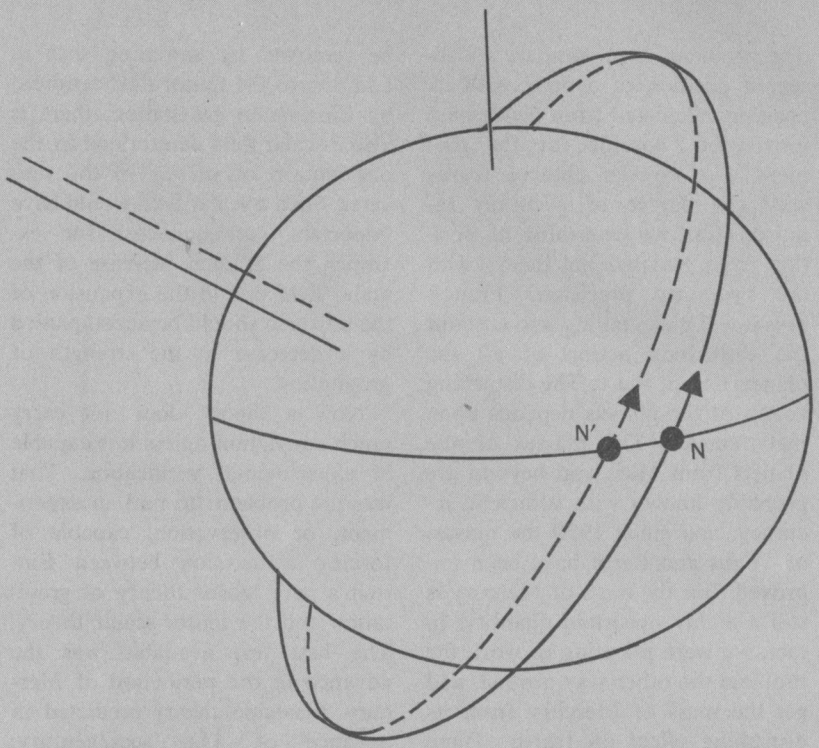


Figure 4. Equatorial bulge of planet causes orbit of satellite to shift toward west or regress, in opposite direction to revolution of satellite in orbit. Thus if satellite crosses equator at node, N, at one revolution, it will cross at N′ the next time around. Regression of nodes is often most sensitive method of detecting planet's oblateness.

How might we detect such a small solar bulge? Probably the best method would be from observations which at first glance would seem to have nothing to do with the shape of the sun.

A small body revolving around a much more massive oblate body may be thought of as moving in a gravitational field in which the force of attraction does not change strictly as the inverse square of the distance, as described by Newton's law. The effect of such a distorted gravitational field upon the body's motion is to change the orientation of its orbit, as shown in Figure 4. If the small body revolving eastward in the direction of the arrow crosses

the oblate body's equator from south to north at N, at the next revolution it will cross slightly to the west at N′. The point N where the body crosses the equator from south to north is called the *ascending node* of its orbit. The point opposite on the orbit—not shown—where it crosses the equator from north to south is the *descending node*. The progressive shifting of the crossing points westward is known as the "regression" of the nodes.

Regression of the nodes is a familiar effect in dynamical astronomy especially in satellite motion. Frequently it furnishes a more reliable means of determining the oblateness of a planet than is possible from direct visual measures. A good example arises in the case of the two tiny satellites of Mars, Phobos and Deimos. Analyses of their perturbations agree in giving a flattening for Mars of 1/192, whereas the numerous optical measures on the planet are not nearly so accordant.

If the sun has an equatorial bulge, it must be extremely small. You can see at a glance that Jupiter is bulged at the equator just from looking at it, but the sun shows no such obvious departure from sphericity. Neither is it manifest in the motion of any of the major planets. Mercury is not satisfactory for measurement since its orbital inclination is too small to provide a sensitive test. But the close approach of Icarus to the sun at perihelion together with its large orbital inclination make this asteroid ideal for probing the distorted gravitational field due to an oblate sun. A solar oblateness of 5/100,000 would cause the nodes of Icarus' orbit to regress at the rate of 3.6 seconds of arc per century.

According to Dicke, "Einstein's general theory of relativity is without a single definitive quantitative test until the possibility of a non-negligible solar oblateness is excluded. Owing to the fortunate circumstances that the orbits of Earth and Icarus nearly intersect, each close passage is capable of yielding a precision measure of the longitude of the node. It is to be hoped that a resolute effort will be made to determine an accurate position of the node at that time."

If you took photographs of the sun and measured the equatorial and polar diameters of the images, I am quite sure you would find them unequal. One day your measures would show the image slightly flattened like an orange. Another day slightly elongated like a prune. The next day a shape in between resembling some other fruit or vegetable. Practically every shape, in fact, except a *sphere*. But, of course, direct photography is far too crude for this type of investigation.

In January 1967 Dicke claimed to have found a small solar oblateness using a sensitive photoelectric scanning technique. One of the

most troublesome errors involved in such measures is differential refraction, or unequal bending of rays from the solar disk by our atmosphere. It is differential atmospheric refraction that makes the solar disk appear flattened near sunset, when the rays come to us through a long air path. Congratulations are in order if measures on Icarus' nodes confirm the direct observations of oblateness.

Now As To Size . . .

"How big is Icarus?"

"About a mile in diameter maybe."

"How do you know?"

There is no easy answer to that. We don't *know*. Yet we are not totally ignorant on the subject either.

How do we ordinarily find the size of a planet?

If we know the distance of a planet—which we always do from its orbit—and if it shows a disk in the telescope, then its diameter in miles or kilometers follows at once from a simple relationship. You can get a pretty fair value for the diameter of the moon with no other instrumentation than your naked eye. Catch the full moon some night when at about the same altitude as the two stars in the end of the bowl of the Big Dipper. These stars are about 5.5 degrees apart. How many full moons could you put between them? You guess about ten. That makes the angular diameter of the full moon 0.55 degrees. Take 240,000 miles for the distance of the moon. Inserting these figures in the formula* gives 2,300 miles for the moon's linear or "real" diameter, which is within 150 miles of the accepted value.

All the planets, except Pluto, show disks easily discernible in a large telescope under good seeing conditions. We got our earliest notion of the size of Venus nearly three hundred fifty years ago, when on 1639 November 24th (O.S.) Jeremiah Horrox, a young English clergyman, for the first time in history observed the planet in transit. Clouds interfered, but from glimpses of the planet silhouetted against the "bosom of the sun" he estimated its diameter at 0.024 degrees. Venus was distant 24,600,000 miles at this transit, although Horrox would not have known this since the scale of the solar system was still a matter of conjecture in his time. His estimate for the diameter would have made the diameter of Venus 10,000 miles, which is a third too large. It is seen that the method in principle is quite simple.

In practice it is beset by all sorts of troublesome errors. Recently an expert appraising various measures on the disk of Mercury, concluded that a diameter of 4,880±

*Linear diameter $= \frac{\text{Distance} \times \text{Angular diameter in degrees}}{57.3}$

15 km is "probably as good an estimate of the diameter of Mercury as may be made at present." As good an *estimate* . . . ! And this from measures over more than a century on a planet whose disk is easy in a six-inch! What chance do we have with an object like Icarus which never begins to show a disk?

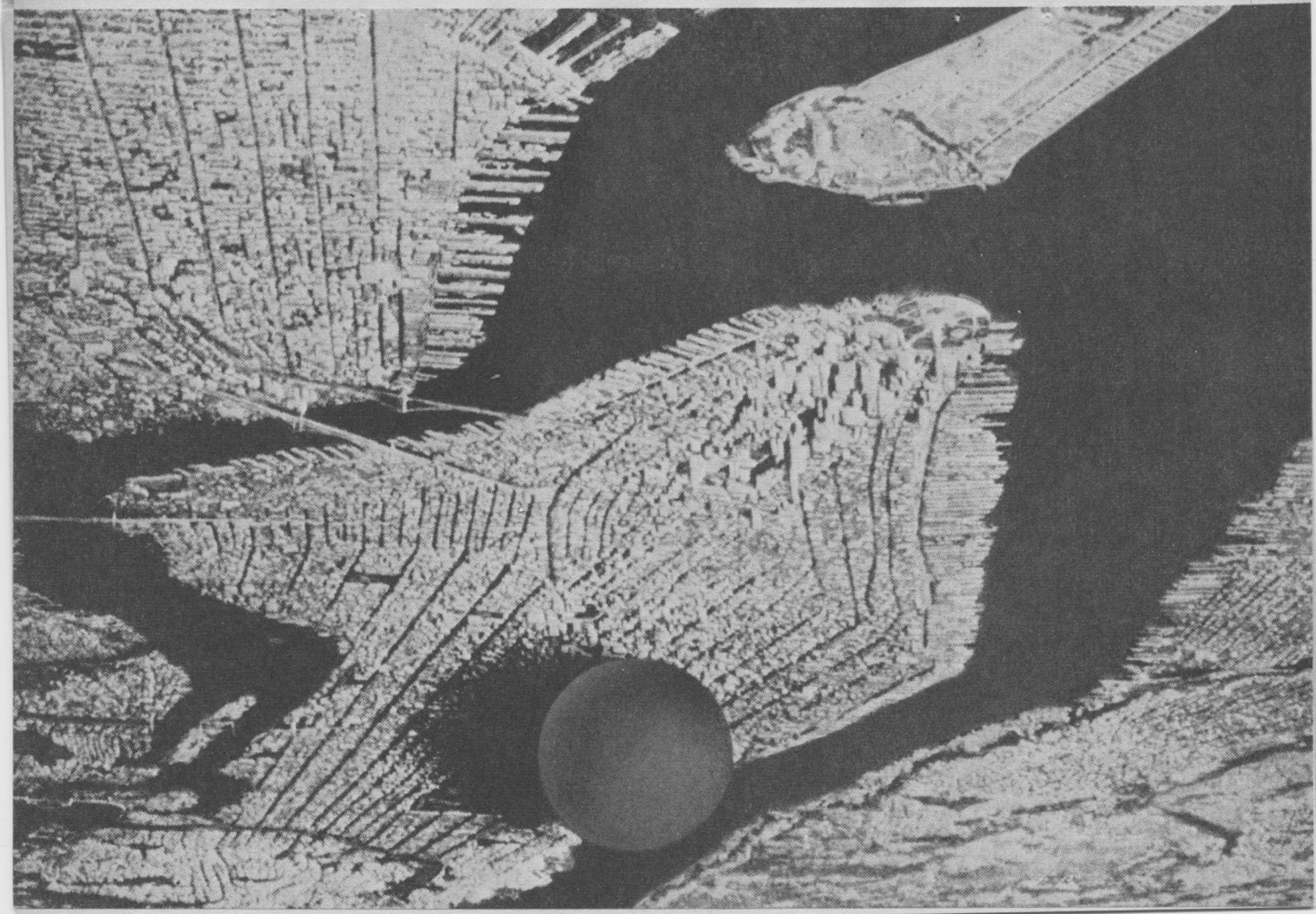
Is there anything we *can* measure about Icarus that will give us a clue to its size? Well, we can always measure its apparent brightness. Its brightness must depend on its size. So we ask: How big must Icarus be to appear as bright as it does at its known distance?

Naturally that will depend upon how well the surface of Icarus reflects the light of the sun falling upon it. This property of a body is measured by its albedo, a complicated function which we will not attempt to describe here. A planet that reflected all the light incident upon its surface would have an albedo of 1.0. Needless to say, no planet is known that approaches this ideal. Uranus and Venus have the highest albedoes of about 0.70. (Astronomers are always revising these values.) A planet that reflected none of the light incident upon it would have an albedo of 0.0. The moon and Mercury hold down this end of the scale with albedoes of about 0.06.

Now we can *measure* the albedoes of Mercury, Venus, and the moon. But we have to *assume* an albedo for a body like Icarus. And the diameter we get is very sensitive to this assumed value. A little thought should make it clear that the *smaller* we make the albedo the *larger* we are going to make the diameter. (The diameter will have to be larger to keep the observed brightness the same.) Conversely, the larger we make the albedo the smaller value we are going to get for the diameter. (Since the asteroid needn't be so big to reflect the same amount of light.)

Suppose we discovered that some inhabitants of Mars with a twisted sense of humor had painted Icarus with magnesium oxide bringing its albedo up to around 0.8 Such a high albedo would make a mini-planet out of Icarus—only about 500 feet in diameter, a body scarcely bigger than a meteorite. On the other hand, if they had applied a coat of lampblack bringing its albedo down to, say, 0.00002, they would have blown Icarus up to about 39 miles in diameter. Thus by varying the albedo we can make Icarus almost any size we like from the Queen Mary to the Matterhorn (Figure 5).

The first value for the diameter of Icarus we obtained from its photograph taken June 27, 1949, when distant 22,000,000 miles. Baade must have studied its image on the plate for all of ten seconds before pronouncing it magnitude sixteen. On the assumption that the asteroid has a reflecting surface like that of Mercury, the diameter inferred



from its apparent brightness is 0.9 miles, or about 4,800 feet. More accurate magnitudes have not significantly changed that figure.

Whether the general relativity effect in radius can be detected by radar depends upon the cross-sectional area of Icarus presented to Earth. An object only a mile in diameter is probably barely on the limit of observation. Francis has compared the radar detectability factor for Icarus at 4,000,000 miles with that of Mercury at 57,000,000 miles, and doubts that even the largest radar facilities would be able to track the asteroid. We have tacitly assumed the little body to be spherical, which it almost certainly is not. Perhaps Icarus will cooperate by facing us broadside on June 15th.

Hold That Node!

People tend to regard the major planets as good solid citizens plodding around the sun century after century in the same old orbits. No need to worry about *them*. But their attitude is quite different when it comes to the minor members of the solar system. They have an uneasy feeling they may cut loose from their orbits any time they take a notion.

Naturally this is all nonsense. They must conform to gravitation the same as Neptune or Jupiter. That is why we have no hesitation in saying that Icarus moving in its present orbit cannot collide with Earth. A glance at Figures 2 and 6 will show you why.

Figure 5. Icarus represented as sphere ¾ miles in diameter compared with model of New York City. (American Museum of Natural History.)

Think of the plane of the paper in which the Earth revolves as the surface of a vast level sea. Icarus is a flying fish, now skimming above the surface, now swimming below it. Unlike a flying fish, however, Icarus cannot dip and dive at will. It can only emerge from below the surface at its ascending node, N, and only submerge at its descending node, N′. The solid line indicates the portion of the orbit above the surface plane; the broken line the portion below it. We see that about 70 per cent of the orbit lies below the plane in which the Earth revolves (Figure 6).

Now it is impossible for Icarus to hit us unless moving in the same plane as the Earth. But this can only happen at one of its nodes. There is no chance for a collision at the ascending node, since it is inside the orbit of Mercury, where the Earth never penetrates. The descending node lies about 13,000,000 miles outside Earth's path. Let us examine the situation there.

The sun is so much more massive than all the other bodies in the solar system combined that the planets move almost as if under its attraction alone. But they do disturb one another slightly, producing

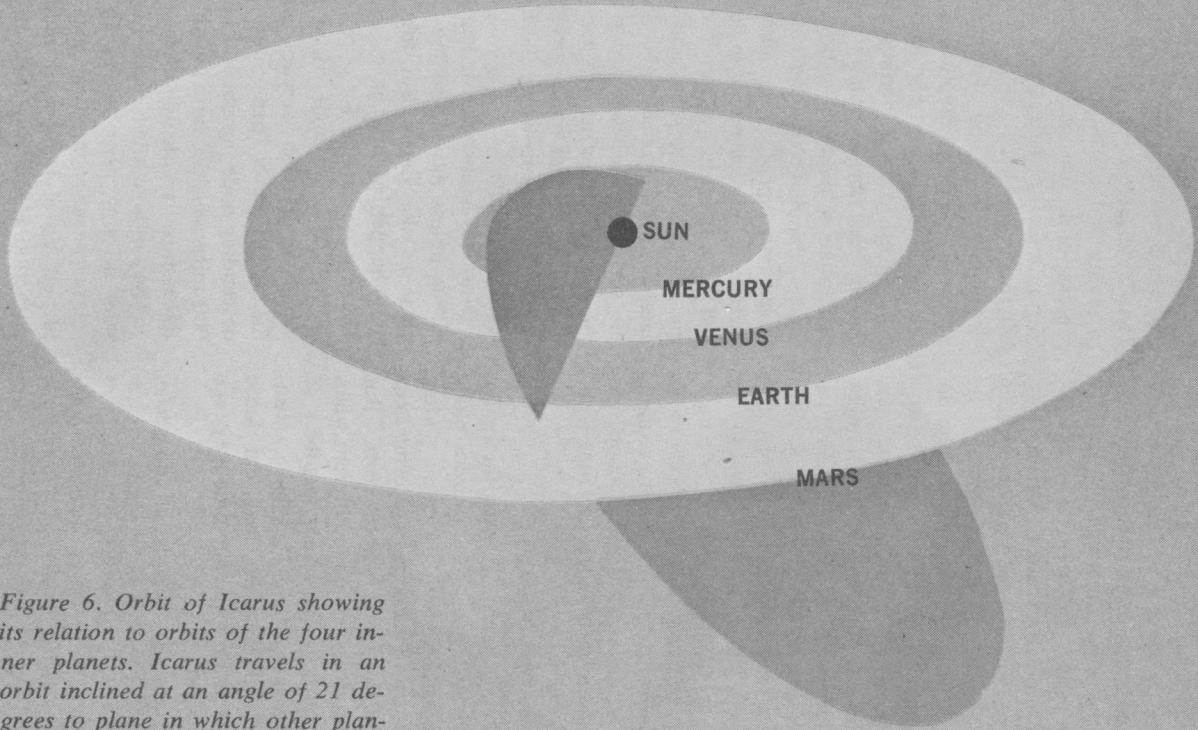


Figure 6. Orbit of Icarus showing its relation to orbits of the four inner planets. Icarus travels in an orbit inclined at an angle of 21 degrees to plane in which other planets revolve. (Sky and Telescope.)

changes in their orbits which progress in one direction for thousands of years, then swing back again. At present the orbit of the Earth is growing less eccentric and after twenty-five thousand years will be the most nearly circular in the solar system.

To have a collision it would be necessary for Icarus' descending node to intersect the Earth's orbit. This could happen only if the line of nodes were rotated clockwise by 5 degrees. Icarus would then pierce the surface at the point occupied by the Earth in its orbit each year on June 15th. The fact that Icarus intersects the *orbit* of the Earth, of course, does not mean that it intersects the *Earth*.

At present nobody knows whether the nodes of Icarus' orbit are regressing, or advancing, or what they are doing. Let us assume the worst, and suppose them to be regressing at ten times the rate corresponding to an oblateness of 5/100,000. Then to bring the descending node into coincidence with the Earth's orbit would take fifty thousand years. No need to panic on that score.

But couldn't some catastrophic event such as a collision with another asteroid send Icarus hurtling Earthward? That is true. It is not particularly difficult to make Icarus collide with the Earth—on paper. If I were some evil genius plotting the destruction of mankind, I believe I would have arranged the event for January 2, 1968. At that time Icarus was on the opposite side of the sun from the Earth and safe from prying eyes.

The problem would be to give Icarus just the right jolt to make it hit the Earth 165 days later on June 15th. There are several ways of tackling such a job. One is to put Icarus at the desired point of collision on June 15th and then run it backward to January 2nd. We calculate Icarus' velocity on that date in its "collision" orbit and in its present undisturbed orbit. The difference between them tells us the velocity we must give Icarus to make it hit the Earth.

It was possible to do this—with a little tinkering here and there—by throwing all the change in velocity into one direction. Some readers may wonder how a body can be moving in more than one direction at once without coming apart. But it is happening to you right now. The rotation of the Earth is carrying you eastward at about 0.2 miles/sec. You are revolving around the sun at 18.5 miles/sec. And the entire solar system is moving toward a point in the constellation of Cygnus at 175 miles/sec. We could combine these motions into one if necessary, but it is convenient to think of them separately. Similarly, it is convenient to think of a planet at any moment as having three velocities at right angles to one another, V(x), V(y), V(z), as shown in Figure 7.

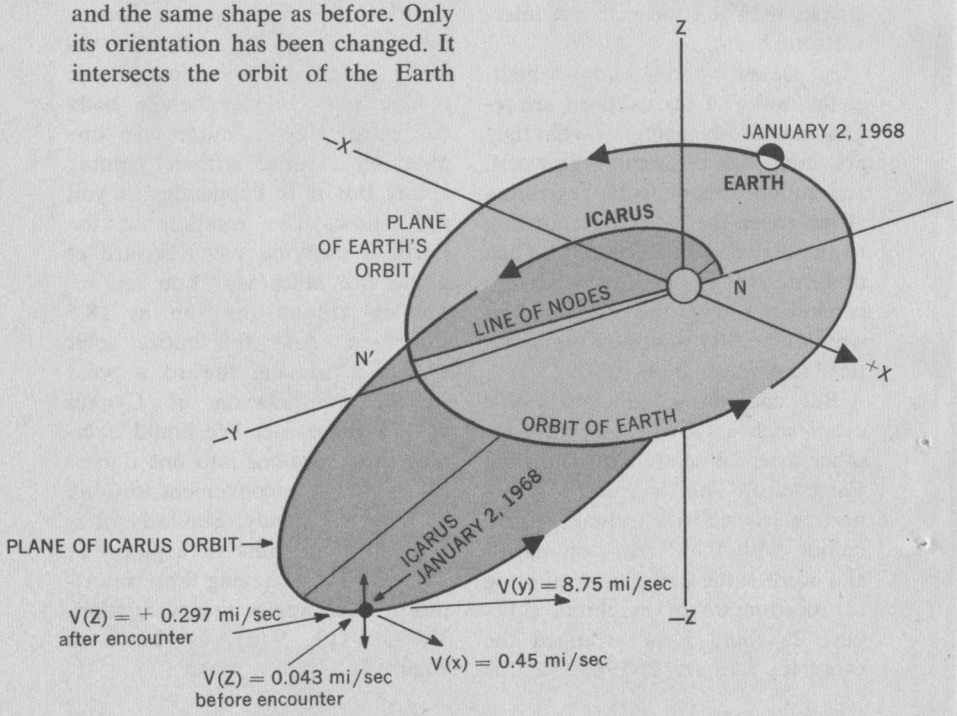
On January 2, 1968, practically all of Icarus' motion was in the directions of Y, with velocities of V(x) = 0.45 miles/sec and V(y) = 8.75 miles/sec. It was scarcely moving at all in the direction of Z with a velocity of V(z) = −0.043 miles/sec.

Now we conjure up a massive asteroid from the lower depths. It hits Icarus on the bottom changing its velocity in Z from −0.043 miles/sec to 0.297 miles/sec. The encounter is peculiar in that the velocities of Icarus in X and Y are scarcely affected.

The resulting collision orbit of Icarus is the same size as before and the same shape as before. Only its orientation has been changed. It intersects the orbit of the Earth now. A single tap of the finger was all that was necessary.

Instead of scaring you we hope this will fortify you against the rumors of impending disaster that are

Figure 7. Cutaway diagram indicating velocities of Icarus in X, Y, Z directions on 1968 January 2nd, before and after encounter with mythical asteroid. Asteroid changes velocity of Icarus toward south from −0.043 mi/sec to +0.297 mi/sec toward north. Change in V (z) swings orbit clockwise so that descending node, N′, intersects Earth's orbit. The possibility of such an encounter is extremely unlikely.



probably floating around. We said it was not particularly difficult to make Icarus collide with the Earth —*on paper*. But it is extremely difficult to imagine Icarus colliding with the Earth in fact. Practically all the asteroids revolve between Mars and Jupiter in about the same plane as the Earth's orbit. Very few have orbits with inclinations large enough to bring them near Icarus. To force Icarus into a collision orbit the encounter would have to occur in a very special sort of way. Any old smashup wouldn't do. Or putting it another way, there are few encounters that would make Icarus collide with the Earth, but many would make it *not* collide.

Some Questions and Answers

Where will Icarus be in the sky when closest in 1968?

On June 6th, Icarus will be in the constellation of Perseus, moving toward the North Star, and growing brighter. It will pass through Ursa Minor and on June 14th form an equilateral triangle with Zeta and Eta Ursae Majoris, the last two stars in the handle of the Big Dipper. The asteroid will then be at maximum brightness and moving the fastest. After closest approach it will start moving south and soon become observable in the southern hemisphere.

Will I be able to see Icarus?

Sorry—not a chance. Icarus at brightest will be about 13th magnitude. A star of magnitude 6 is about the faintest you can with your eye. A star of magnitude 13 is 630 times fainter than a star barely visible to your eye.

How big a telescope would I need to see Icarus?

A ten-inch should show stars down to the 13th magnitude. By sweeping in the predicted position of Icarus you could probably get it in your field of view. Then you would only need to identify Icarus among all the other stars that look just like it. You might "see" Icarus without being aware of the fact.

Couldn't I find Icarus from its motion?

The answer to that is like the answer to the old question of whether or not your check is good. Your check is good if it's good. The same is true of Icarus: you can find Icarus from its motion if you can find it. Talking about it in the daytime it sounds easy. But when you try it at the telescope . . . Well, it isn't much to look at anyhow.

How do astronomers identify close asteroids like Icarus?

Practically always as a matter of accident in the course of another investigation. Any astronomer who does much direct photography is sure to pick up some asteroids on his plates before long. During an exposure any moving object such as an asteroid will leave a trail on the

emulsion easily distinguished from the round star images. If the trail is exceptionally long, there is a good chance that it was made by an asteroid moving close to the Earth. But the converse of the proposition is not necessarily true. An asteroid can leave a very short trail or only appear as an elongated star image and still be quite close. You have to take into account its position relative to the sun. Remember your observations are made from a moving platform in space—the Earth. There are two points in an outer planet's path where the motion of the Earth will make it apparently stand still for a while. If you happen to catch an asteroid near one of its "stationary" points, you would probably not recognize it as a moving object unless you knew precisely where to look for it. Which in the case of an undiscovered object you wouldn't (Figure 8).

Back in the good old days when observations were all made by eye the discovery of a new asteroid was a noteworthy event. But after photography came in about 1891 they began discovering asteroids so fast there wasn't much fun to it anymore. We now have orbits for nearly two thousand *kleine planeten,* all about the same. There's no point in taking the time and effort to add another one to the list, when we have a thousand others just like it.

Is there any easy way of telling when Icarus will be close again?

It happens that there is. Earth, Icarus, and Mercury are like a troupe of actors who keep coming back regularly to put on the same old show again. Let us take a look at their periods of revolution around the sun.

Earth's period of revolution
..... 365.2564 days
Icarus' period of revolution
..... 408.65 "
Mercury's period of revolution
..... 87.9686 "

At first sight they seem to have nothing in common. But after a little arithmetic we find,

19 times Earth's period
..... 6,939.8 days = 19.000 years
17 times Icarus' period
..... 6,947.0 days = 19.019 years
79 times Mercury's period
..... 6,949.5 days = 19.026 years

We see that every nineteen years Earth, Icarus, and Mercury put on a repeat performance. That is, wherever they are in their orbits now they will return to those same positions nineteen years from now. Icarus was discovered in 1949. So in 1968 the cycle comes full circle with everything being done as it was in the beginning, and as it will be done again in 1987, 2006, et cetera.

Whether Icarus will be coming CLOSER each time . . . remains to be seen.

References
[1] Francis, M. P. 1965, *Astronomical Journal,* Sept., p. 449.
[2] Dicke, R. H. 1965, *Astronomical Journal,* August, p. 395.
[3] Dicke, R. H. 1967, *Physics Today,* January, p. 55.

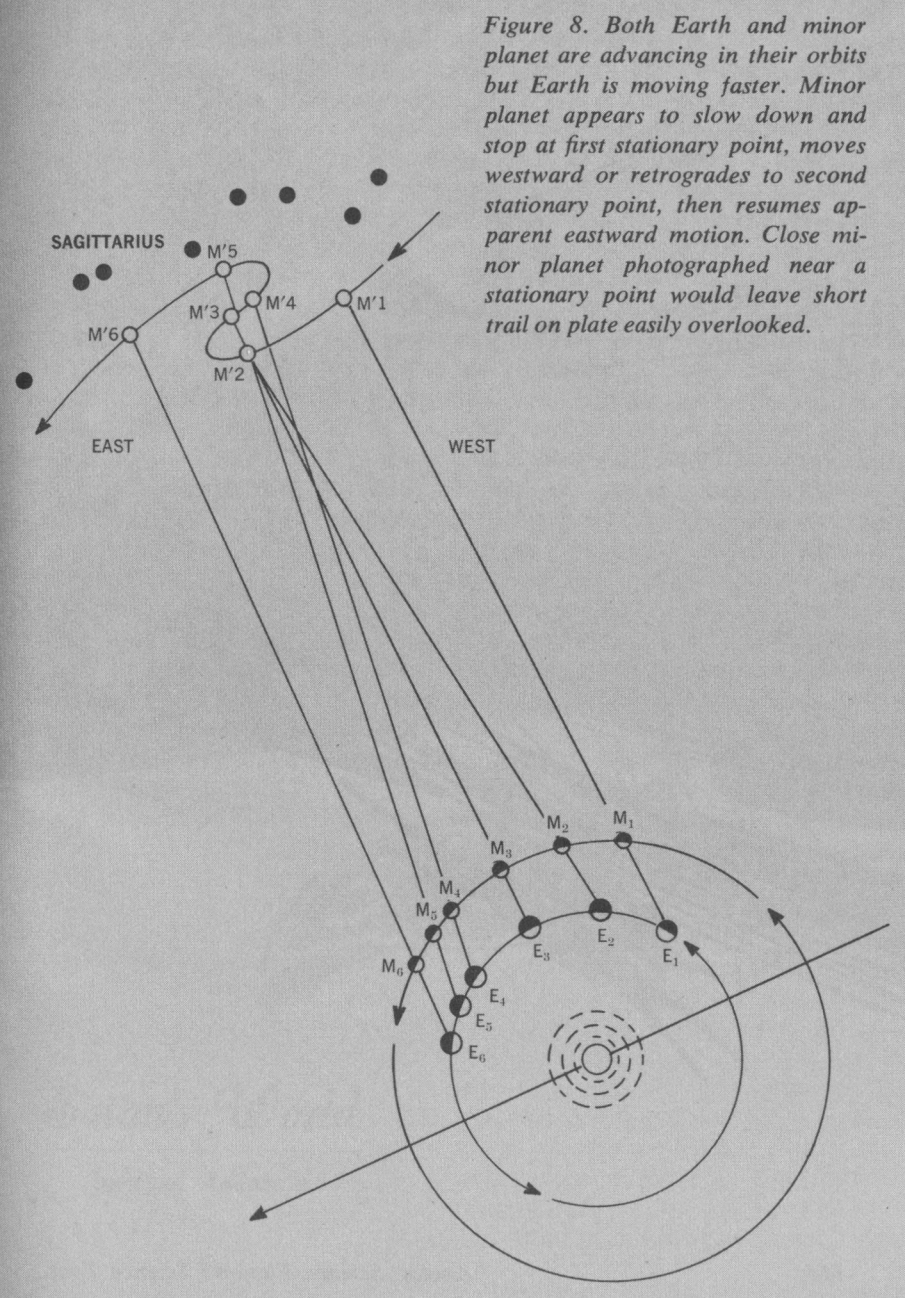
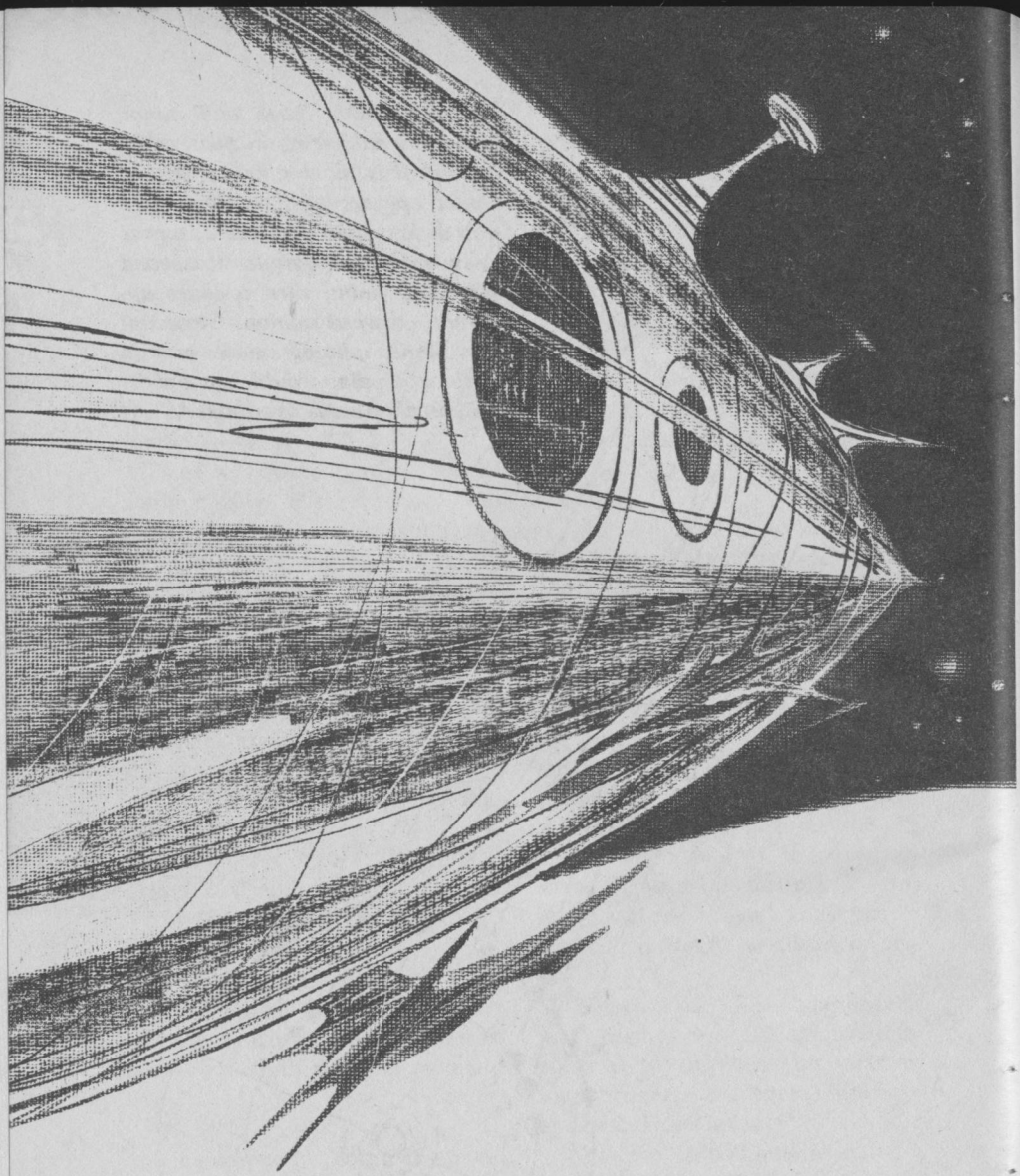
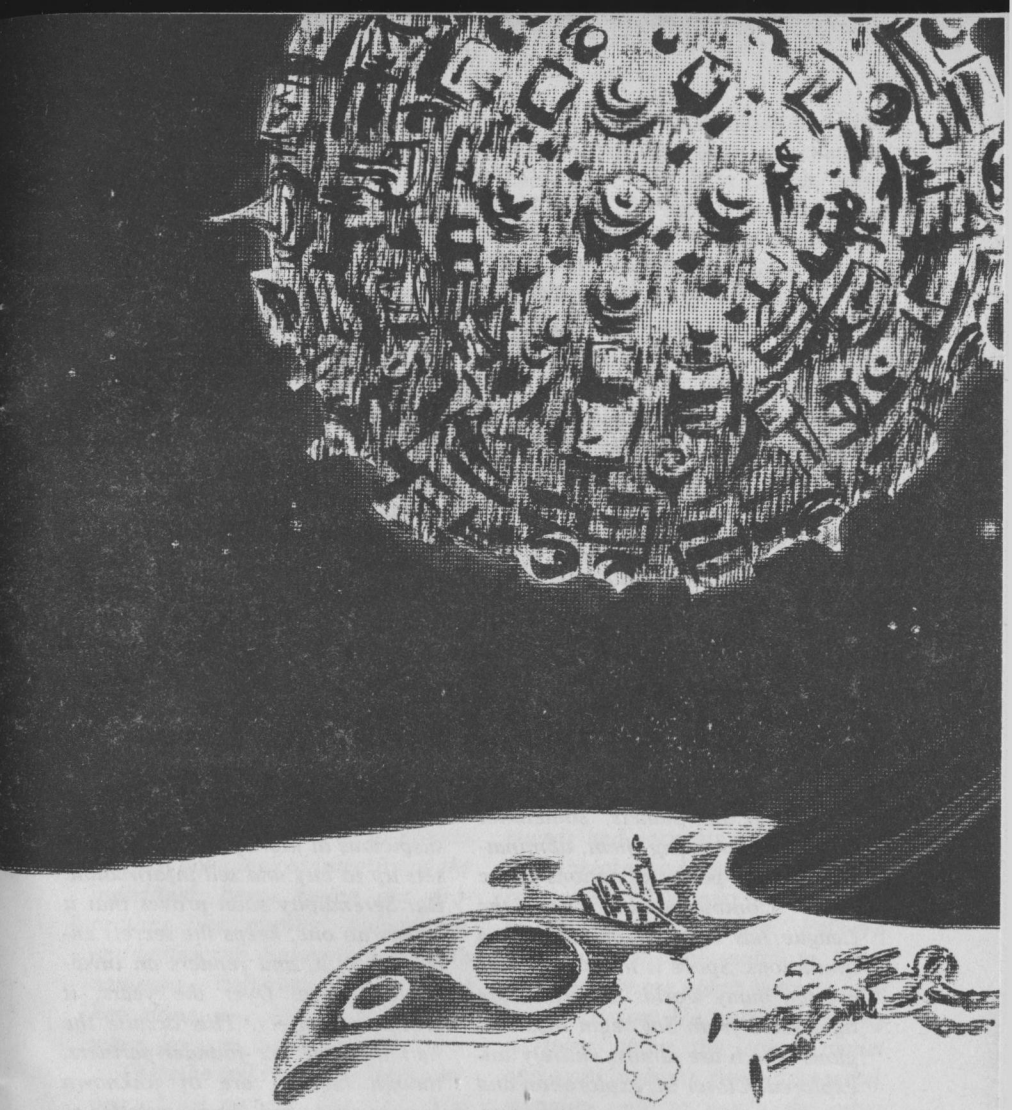


Figure 8. Both Earth and minor planet are advancing in their orbits but Earth is moving faster. Minor planet appears to slow down and stop at first stationary point, moves westward or retrogrades to second stationary point, then resumes apparent eastward motion. Close minor planet photographed near a stationary point would leave short trail on plate easily overlooked.





Satan's World

by Poul Anderson

Part III of IV.

The terrible heat of a blue-white giant sun, versus the terrible cold of a space-cold planet was only half of what made Satan's World deadly. The other half was an alien race almost equally cold—

Illustrated by Kelly Freas

SYNOPSIS

The Polesotechnic League is theoretically just a mutual-benefit organization of interstellar companies. In practice—given the scale of its operation and the spread of laissez-faire economics—it represents a kind of super-feudalism. Its members act like nearly independent barons, dealing with entire governments on the planets, sometimes making or breaking them, dominating even the powerful nations of the Solar Commonwealth. But the League has its own problems and limitations. Space is too huge; there are too many worlds. Several score light-years from Sol begin those regions which are almost entirely unexplored. Closer in, exploration and development are still incomplete. The sheer volume of data makes it impossible to understand the total situation at any given time, or to lay rational plans for the future.

A new enterprise, Serendipity, Inc., offers a partial solution. Its computers, advanced in this respect beyond any other known machines, do more than collect and correlate information. They search their memory banks along association chains beginning with a particular client or problem, somewhat as a living brain does but with vastly greater scope. Thus many a datum, recorded but then forgotten, is found to be useful to someone. Naturally, the highly competitive merchant princes of the League are suspicious at first of an outfit which sets up to buy and sell information. But Serendipity soon proves that it favors no one, keeps the secrets entrusted to it, and renders an invaluable service. Over the years, it grows immensely. This despite the fact that the six founder-partners, though human, are of unknown background and keep strictly to themselves. After all, Technic civilization has a high regard for privacy, and eccentrics are common.

David Falkayn, born on the autonomous colony planet Hermes, takes a vacation in the Solar Sys-

tem. While there, he decides to visit Serendipity's office in Lunograd on the Moon, and see if it can turn up anything for him. He is a trade pioneer for Nicholas van Rijn's Solar Spice & Liquors Company. His job is to discover new sources and new markets in space, which can then be quietly exploited before the competition learns about them. But through various exploits, he has become somewhat prominent. A girl who calls herself Veronica has latched onto him. He can tell that she is a commercial spy, out to learn what she can about van Rijn's operations so that the rivals of the latter can get the jump on him. Such attempts are taken for granted, along with bribery, blackmail, burglary, and much else. Falkayn isn't worried. Competition is not literally cutthroat; it is regulated by the covenant of the League so as to protect the psychobiological integrity of the individual, hence ruling out procedures like murder, kidnapping, and brainscrub. Enjoying Veronica's company, Falkayn simply jollies her along, and leaves her behind when he goes to Serendipity, Inc.

There he talks to Thea Beldaniel, one of the owners. She leads him to an isolation room where he consults a computer. The machine associates him with his discovery, some years ago, of planets freakishly captured by a blue giant star. No other case has ever been found. But nonhuman explorers did come upon one analogous oddity. A sunless "rogue" planet is approaching the B-type star Beta Crucis, some two hundred light-years hence. It will pass by in a tight hyperbolic orbit and recede into space. The explorers saw no significance in this cosmic accident, and their report never reached the Solar System until the ceaseless information-gathering activity of SI chanced to net it. Even then, the machine did not "think" of the matter until Falkayn's presence "reminded" it. Now it suggests that here may be the greatest bonanza in galactic history. Absolute secrecy should be preserved. Falkayn agrees.

Emerging, he finds Thea Beldaniel friendlier than before. She invites him to visit her and her partners in their Lunar Alpine castle, to discuss a mutually profitable idea. Since no one but nonhuman guards and servants has ever been there before, and since the cenobitical owners of SI may change their minds at any moment, Falkayn leaps at the opportunity to learn something more about their by now key operation. He postpones doing anything about the rogue planet and goes straight from Lunograd, stopping only to notify the other members of his trade team.

These are nonhuman themselves: the small, quick, short-tempered Cynthian xenobiologist Chee Lan, and the gigantic, placid, dragonlike planetologist Adzel from Woden. They fret a little at the delay, but

not too much. Veronica frets more, since Falkayn has stood her up; her interest in him has become personal rather than professional.

At the castle, Falkayn meets three other SI stockholders: Kim Yoon-Kun, Anastasia Herrera, and the wife of Hugh Latimer. Latimer himself, and Thea Beldaniel's sister, are absent "on business." Though his hosts try to prevent it, he sees the lift-off of an interstellar ship that he is certain contains those two. It becomes plain that he was invited here simply to get him out of the way while something else happens. Thea tries to allay his suspicions with a story about the background of her group—their shipwreck as children, their adoption by kindly nonhumans who want to stay outside of Technic civilization but who did send them back with a grubstake of rare metals and later supplied them with computer parts. This only makes Falkayn warier. When he declares that he will leave, he is taken prisoner.

Chee Lan and Adzel try repeatedly to call him in the following days. At last they are granted an audiovisual contact. Falkayn tells them he is quitting Solar S & L, joining SI, and marrying Thea. His comrades are convinced that he has been made a puppet by brainscrub techniques. Getting no satisfaction from the Lunar police—who much favor well-behaved SI over the rowdy remainder of the League—they appeal to Nicholas van Rijn. He agrees that Falkayn probably is controlled. Formal action will take too long to organize. A rescue mission, therefore, will be extremely illegal. Van Rijn can stall off the authorities for a while. But Chee and Adzel must risk their lives and liberty to get their friend back.

Using their fast, well-armed exploratory ship Muddlin' Through, *they succeed. Adzel breaks in and seizes Falkayn, then Chee pulls both of them out. In the course of the raid, several castle guards are killed. Van Rijn orders Chee to take Falkayn away into space. She can cure him with equipment already loaded aboard, and go investigate whatever it was he learned at SI. Clearly his supposedly private conference with the computer there was spied on, and the facts revealed were so tremendous as to force SI into actions that the League would never tolerate. Doubtless the information brokers have been spies all along for some unidentified but hostile power. Latimer and Thea's sister are known to have left the Solar System, surely to carry word to their masters. Speed is vital.*

Adzel has gathered proof that Falkayn was indeed brainscrubbed. Van Rijn does not show it to the police. Instead, he lets Adzel be arrested. Meanwhile he uses the evidence to bargain with the SI owners still in Lunograd. He forces them to sell their holdings to a trustworthy group—paying him a fat commission—and assist in con-

cocting a story which gets Adzel freed. All but Thea promptly leave. She remains, to help negotiate the sale and later guide van Rijn to a rendezvous. There, on the advice of her associates, her masters may or may not come parley with him. He agrees to preserve secrecy for the time being; he doesn't trust any government, or the League as a whole, to deal with a situation as dangerous as this, at least not until it has been made less obscure.

Restored, but deeply embittered by his experience, Falkayn arrives with Chee Lan at Beta Crucis. They find the rogue planet. It is approaching periastron. Under the rays of the blue giant, its cryosphere is boiling into gas and water. Conditions are so chaotic and hazardous that Falkayn names it Satan; and violence waxes hourly. After gathering and integrating a vast amount of data in orbit, Muddlehead—the ship's computer "brain"—does manage to land. This will soon be impossible because of storms, and remain that way for years, until the planet has moved far back toward interstellar space.

Nonetheless, Satan is potentially of fabulous worth: as a site for the large-scale industrial synthesis of rare isotopes. Having verified that, Falkayn and Chee are about ready to go home. Then Muddlehead detects a sizable flotilla of spaceships, coming in fast from the unexplored Circinus region.

They must belong to SI's masters, responding to Latimer's report. It seems unlikely that Muddlin' Through *can either hide until they leave, or outrun them once she herself is detected. But her hyperdrive "wake" can cover that of a message capsule, sent back toward Sol with an account of what has hitherto been learned. Falkayn and Chee dispatch such a one, and go on out to meet the strangers.*

Part 3

XIV

Stars glittered in their prismatic colors and multiple thousands, Beta Crucis little more than the brightest among them; the Milky Way spilled around crystal darkness; the far cold whirlpools of a few sister galaxies could be seen: when the League ship made contact with the strangers.

Falkayn sat in the bridge, surrounded by outside views and engine murmur. Chee Lan was aft, in the fire-control center. Either one could have been anywhere aboard, to receive information from the computer and issue it orders. Their separation was no more than a precaution in case of attack, and no wider than a hull permeated by light-speed electronic webs. But loneliness pressed in on Falkayn. The uniform he wore beneath his space armor, in place of a Long John, was less a diplomatic formality than a defiance.

He stared through his helmet, which was still open, first at the screens and then at the instruments. His merely flesh-and-blood organism could not apprehend and integrate the totality of data presented, as the computer could. But an experienced eye took in a general picture.

Muddlin' Through was plunging along a curve that would soon intercept one of the fleet's outriders. She must have been detected, from the moment she went on hyperdrive. But none of those vessels had altered course or reckless pseudospeed. Instead, they proceeded as before, in a tighter formation than any Technic admiral would have adopted.

It looked as if the alien commander wouldn't grant his subordinates the least freedom of action. His entire group moved in a unit, one hammer hurled at target.

Falkayn wet his lips. Sweat prickled along his ribs. "Damnation," he said, "don't they want to parley? To find out who we are, if nothing else?"

They didn't have to, of course. They could simply let *Muddlin' Through* pass between them. Or they might plan on a quick phase-match and assault, the moment she came in ready range—so quick that her chance of shifting the phase of her own quantum oscillations, thus becoming transparent to whatever they threw at her, would be slight.

"They may not recognize our signal for what it is," Chee Lan suggested. Her voice on the intercom made Falkayn visualize her, small, furry, and deadly . . . yes, she'd insist on operating one gun by hand, if battle broke—

"They know enough about us to establish spies in our home territory. So they know our standard codes," Falkayn snapped. "Give 'em another toot, Muddlehead."

Viewscreens flickered with the slight alterations in hypervelocity imposed by the outercom as it modulated drive vibrations to carry dots and dashes. That system was still new and crude—Falkayn could remember when, early in his career, he had been forced to turn his engines themselves on and off to transmit a message—but the call was simple. *Urgent. Assume normal state and prepare for radionic communication on standard band.*

"No response," the computer said after a minute.

"Cease transmission," Falkayn ordered. "Chee, can you think of any motive for their behavior?"

"I can imagine quite a number of different explanations," the Cynthian said. "That's precisely the trouble."

"Uh, yeh. Especially when they are not apt to be right. One culture's rationality isn't quite the same as another's. Though I did think any civilization capable of space flight must necessarily—No matter. They obviously aren't going to detach a ship for talkie-

talkie. So I don't propose to steer into a possible trap. Change course, Muddlehead. Run parallel to them."

Engines growled. Stars swung around the screens. The situation stabilized. Falkayn gazed toward the unseen strangers. They were crossing the clouded glory of Sagittarius . . . "we may learn a bit by analyzing their 'wake' patterns, now that we're close enough to get accurate readings," he said. "But we hardly dare follow them clear to Satan."

"I don't like accompanying them any distance," Chee said. "They travel too bloody-be-gibbeted fast for this kind of neighborhood."

Falkayn reached out an ungauntleted hand for the pipe he had laid on a table. It had gone cold. He made a production of rekindling it. The smoke gave tongue and nostrils a comforting love-bite. "We're safer than they are," he said. "We know more about the region, having been here a while. For instance, we've charted several asteroid orbits, remember?"

"You don't believe, then, they had a scout like ours, who paid a visit before we arrived?"

"No. That'd imply their home sun —or at least a large outpost of their domain—is nearby, as cosmic distances go. Now the Beta Crucis region isn't what you'd call thoroughly explored, but some expeditions have come through, like the one from Lemminkainen. And explorers always keep a weather eye out for signs of atomic-powered civilizations. I feel sure that somebody, sometime, would've identified the neutrino emission from any such planet within fifty light-years of here. True, conceivably those nuclear generators weren't yet built fifty years ago and the neutrinos haven't arrived yet. But on the other hand, voyages have been made beyond this star. Altogether, every probability says these characters have come a considerable ways. The messenger ship from Luna must barely have had time to notify them about the existence of the rogue."

"And they committed a whole fleet immediately—with no preliminary investigation—and it's roaring down on goal as if this were clear one-hydrogen-atom-per-cc. space —and not even trying to discover who we are? *Ki-yao!*"

Falkayn's grin was taut and brief. "If a Cynthian says an action is too impulsive, then by my battered halidom, it is."

"But these same beings . . . presumably the same . . . they organized Serendipity . . . one of the longest-range, most patience-demanding operations I've ever heard of."

"There are parallels in human history, if not in yours. And humans —more or less humans—were involved in our case . . ."

The computer said: "Incoming

hypercode." The display screen blinked with a series that Falkayn recognized: *Request for talk acknowledged. Will comply. Propose we rendezvous ten astronomical units hence, five hundred kilometers apart.*

He didn't stop to inform Chee—the ship would do that—nor shout his own astonishment, nor feel it except for an instant. Too much work was on hand. Orders rapped from him: Send agreement. Lay appropriate course. Keep alert for treachery, whether from the vessel that would stop and parley or from the rest of the fleet, which might double back under hyperdrive.

"The entire group remains together," Muddlehead interrupted. "Evidently they will meet us as one."

"What?" he choked. "But that's ridiculous."

"No." Chee's voice fell bleak. "If twenty-three of them fire on us simultaneously, we're dead."

"Perhaps not." Falkayn clamped the pipe more firmly between his jaws. "Or they may be honest. We'll know in another thirty seconds."

The ships cut off their quantum oscillators and flashed into the relativistic state of matter-energy. There followed the usual period of hastily calculated and applied thrust, until kinetic velocities were matched. Falkayn let Muddlehead take care of that and Chee stand by the defenses. He concentrated on observing what he might about the strangers.

It was little. A scanner could track a ship and magnify the image for him, but details got lost across those dimly lighted distances. And details were what mattered; the laws of nature do not allow fundamental differences between types of spacecraft.

He did find that the nineteen destroyers or escort pursuers or whatever you wanted to call them were streamlined for descent into atmosphere: but radically streamlined, thrice the length of his vessel without having appreciably more beam. They looked like stiffened conger eels. The cruisers bore more resemblance to sharks, with gaunt finlike structures that must be instrument or control turrets. The battleship was basically a huge spheroid, but this was obscured by the steel towers, pillboxes, derricks, and emplacements that covered her hull.

You might as well use naval words for yonder craft, even though none corresponded exactly to such classes in the League. They bristled with guns, missile launchers, energy projectors. Literally, they bristled. Falkayn had never before encountered vessels so heavily armed. With the machinery and magazines that that entailed . . . where the devil was room left for a crew?

Instruments said that they employed force screens, radars, fusion power—the works. It was hardly a surprise. The unorthodox, tight for-

mation was. If they expected trouble, why not disperse? One fifty-megaton warhead exploding in their midst would take out two or three of them directly, and fill the rest with radiation. Maybe that wouldn't disable their computers and other electronic apparatus—depended on whether they used things like transistors—but it would give a lethal dose to a lot of crewfolk, and put the rest in hospital.

Unless the aliens didn't mind X-rays and neutrons. But then they couldn't be protoplasmic. With or without drugs, the organic molecule can only tolerate a certain bombardment before it shatters. Unless they'd developed some unheard-of screen to deflect uncharged particles. Unless, unless, unless!

"Are you in communication with any of their mechanisms?" Falkayn asked.

"No," Muddlehead answered. "They are simply decelerating as they would have had to sooner or later if they wish to take orbit around Satan. The task of matching velocities is left to us."

"Arrogant, aren't they?" Chee said.

"With an arsenal like theirs, arrogance comes easy." Falkayn settled into his chair. "We can play their game. Hold off on the masers. Let them call us." He wondered if his pipe looked silly, sticking out of an open space helmet. To hell with it. He wanted a smoke. A beer would have been still more welcome. The strain of wondering if their weapons were about to cut loose on him was turning his mouth dry.

An energy blast would smite before it could be detected. It might not penetrate the armor too fast for *Muddlin' Through* to go hyper and escape. That would be determined by various unpredictables, like its power and the exact place it happened to strike. *But if the aliens want to kill us, why bother to revert? They can overhaul us, maybe not their capital ships, but those destroyers must be faster. And we can't stay out of phase with nineteen different enemies, each trying to match us, for very long.*

Yet if they want to talk, why didn't they answer our call earlier?

As if she had read her companion's mind, Chee Lan said: "I have an idea that may account for parts of their behavior, Dave. Suppose they are wildly impulsive. Learning about Satan, they dispatch a task force to grab it. The grabbing may be away from members of their own race. We don't know how unified they are. And they can't have learned that Serendipity's cover is blown. Nor can they be sure that it isn't.

"Under those circumstances, most sophonts would be cautious. They'd send an advance party to investigate and report back, before committing themselves substantial

ly. Not these creatures, though. These charge right ahead, ready to blast their way through any opposition or die in the attempt.

"And they do find someone waiting for them: us, one small ship, cheekily running out to make rendezvous. You or I would wonder if more vessels, bigger ones, aren't lying doggo near Satan. Our first thought would be to talk with the other. But they don't emote that way. They keep on going. Either we are alone and can safely be clobbered, or we have friends and there will be a battle. The possibility of retreat or negotiation isn't considered. Nor do they alter any vectors on our account. After all, we're headed straight for them. We'll bring ourselves in killing range.

"Well, we fool them, changing over to a parallel course. They decide they'd better hear us out; or, at least, that they might as well do so. Maybe it occurs to them that we could perhaps get away, bring word back to Earth, in spite of everything. You see, they'd have to detach one or more destroyers to chase us down. And their formation suggests that, for some reason, they're reluctant to do this.

"In short, another lightning decision has been made, regardless of what may be at hazard."

"It sounds altogether crazy," Falkayn objected.

"To you, not me. Cynthians are less stodgy than humans. I grant you, my people—my own society—is forethoughtful. But I know other cultures on my planet where berserk action is normal."

"But those're technologically primitive, Chee. Aren't they? Hang it, you can't operate an atomic-powered civilization that way. Things'd fall apart on you. Even Old Nick doesn't have absolute authority in his own outfit. He has to work with advisers, executives, people of every kind and rank. The normal distribution curve guarantees enough naturally cautious types to put the brakes on an occasional reckless—"

Falkayn broke off. The central receiver was flickering to life.

"They're calling us," he said. His belly muscles tightened. "Want an auxiliary screen to watch?"

"No," Chee Lan answered starkly. "I'll listen, but I want my main attention on our weapons and theirs."

The maser beams locked on. Falkayn heard the report, "Their transmission is from the battleship," with half an ear. The rest of him focused on the image that appeared before him.

A man! Falkayn almost lost his pipe. A man, lean, with gray-speckled hair, smoldering eyes, body clad in a drab coverall . . . *I should've guessed. I should've been prepared.* Scant background was visible: an instrument console of obviously non-Technic manufacture, shining beneath a hard white light.

Falkayn swallowed. "Hello, Hugh Latimer," he said most softly.

"We have not met," the accented, unemotional Anglic replied.

"No. But who else might you be?"

"Who are you?"

Falkayn's mind scrambled. His name was a hole card in a wild game. He wasn't about to turn it up for the enemy to make deductions from. "Sebastian Tombs," he replied. The alias was unoriginal, but Latimer would scarcely have come upon the source. Mere chance had put those books in the library of Duke Robert for an inquisitive boy to find, and thus discover that ancient languages weren't all classics and compositions but were sometimes fun— "Master merchant and captain in the Polesotechnic League." Asserting his rank should do no harm, and possibly a little good. "Are you in command of your group?"

"No."

"Then I'd like to speak with whoever is in charge."

"You shall," Hugh Latimer told him. "He has ordered it."

Falkayn bridled. "Well, connect him."

"You do not understand," said the other. Still his voice had no inflection, and his eyes stared directly out of the hollow-cheeked, deeply-tanned face. "Gahood wants you to come here."

The pipestem snapped between Falkayn's teeth. He cast it aside and exclaimed, "Are you living in the same universe as me? Do you expect I'd—" He curbed himself. "I have a few suggestions for your commander," he said, "but I'll reserve them, because his anatomy may not be adapted for such things. Just ask him if he considers it reasonable for me, for anyone in my crew, to put himself at your mercy that way."

Did the least hint of fear cross Latimer's rigid features? "My orders have been given me. What value for you if I went back, argued, and was punished?" He hesitated. "You have two choices, I think. You can refuse. In that case, I imagine Gahood will start firing. You may or may not escape; he does not seem to care greatly. On the other hand, you can come. He is intrigued at the thought of meeting a . . . wild human. You may accomplish something. I do not know. Perhaps you and I can work out conditions beforehand that will give you assurance of being able to return. But we mustn't take long, or he will grow impatient. Angry." His fear was now unmistakable. "And then anything might happen."

XV

The danger in coming near the enemy was obvious. Not only an energy beam, but a material missile could hit before effective reaction was possible. However, the danger was mutual. *Muddlin'*

Through might be a gnat compared to the battlewagon, but she was every bit as mean. Falkayn didn't fancy leaving five hundred kilometers between him and her. He was dismayed when Latimer insisted.

"Do not forget, my life's work was learning everything I could about Technic civilization," the gaunt man said. "I know the capabilities of a vessel like yours. Besides an assortment of small arms, and several light guns for dogfights, she mounts four heavy blast cannon and carries four nuclear torpedoes. At close range, such armament makes us too nearly equal. Let a dispute arise, and we could doubtless kill you, but ships of ours might also perish."

"If my crew are too far off to strike effectively, what'll stop you from taking me prisoner?" Falkayn protested.

"Nothing," Latimer said, "except lack of motive. I think Gahood merely wants to interrogate you, and perhaps give you a message to take back to your masters. If you delay, though, he'll lose patience and order you destroyed."

"All right!" Falkayn said harshly. "I'll come as fast as I can. If I don't report back within an hour of entering, my crew will assume treachery on your part and act accordingly. In that case, you might get a rude surprise." He broke the connection and sat for a moment, clenching the arms of his chair, trying not to shudder.

Chee Lan padded in, squatted at his feet and looked upward. "You don't want to go," she said with uncommon gentleness. "You're afraid of being drugged again."

Falkayn nodded, a jerk of his head. "You can't imagine what it's like," he said through a tightened gullet.

"I can go."

"No. I am the skipper." Falkayn rose. "Let's get me ready."

"If nothing else," Chee said, "we can guarantee you won't be captured."

"What? How?"

"Of course, the price might be death. But that's one fear you've been trained to control."

"Oh-h-h," Falkayn breathed. "I see what you mean." He snapped his fingers. His eyes sparked. "Why didn't I think of it?"

And so presently he departed.

He wore an impeller on his space armor, but this was reserve. His actual transportation was a gravsled. He kept the canopy down, the cockpit filled with air, as another reserve; in case his helmet got cracked or something, he needn't spend time preparing this minimal, skeletal vehicle for departure. But atmosphere or no, he rode in ghostly silence, naught save a faint tug of acceleration making his broomstick flight feel real. The stars had dimmed and withdrawn in his vision. That was prosaically due to the panel lights, their greenish glow desensitizing his retinas. Nevertheless, he

missed the stars. He grasped his controls more tightly than required and whistled up a tune for company.

"Oh, a tinker came a-strollin',
A-strollin' down the Strand—"

It didn't seem inappropriate for what might be the last melody ever to pass his lips. Solemnity had no appeal. His surroundings, that mountain of a ship bulking closer and closer before him, furnished as much seriousness as anybody could want.

Latimer's radio voice chopped off his bawdy little ballad. "You will be guided to an air lock by a beam at 158.6 megaherz. Park your sled in the chamber and wait for me."

"What?" Falkayn gibed. "You don't aim to pipe me aboard?"

"I do not understand."

"You wouldn't. Forget it. I'm not ambitious to become a haggis anyway." Falkayn tuned in the signal and set the sled to home on it. He got busy photographing the battleship as he neared, studying the fortresslike superstructures himself, stowing every possible datum in memory. But part of his mind freewheeled, wondering.

That Latimer is sure one overworked chap. He acts like a kind of executive officer for Gahood, whatever Gahood is. But he also acts like the communications officer, boatswain . . . everything!

Well, given sufficient automation, you don't need much crew. The all-around Renaissance man has come back these days, with a battery of computers to specialize for him. But some jobs remain that machines don't do well. They haven't the motivation, the initiative, the organismic character of true sophonts. We—each civilized species man's encountered—have never succeeded in building a hundred percent robotic vessel for more than the elementary, cut-and-dried jobs. And when you're exploring, trading, conducting a war, anything that takes you into unpredictable situations, the size of crew you need goes up. Partly to meet psychological necessities, of course; but partly to fulfill the mission itself in all its changing complexity.

Look how handicapped Chee and I have been, in being just two. That was because of an emergency, which Gahood did not face. Why is Latimer the only creature I've spoken to in yonder armada?

His approach curve brought Falkayn near a cruiser. More than ever he was struck by the density of her armament. And those finshaped turrets were thinner than he had imagined. They were fine for instruments, with that much surface area, and indeed they appeared to be studded with apparatus. But it was hard to see how an animal of any plausible size and shape could move around inside them. Or, for that matter, inside the hull, considering how packed it must be.

The thought did not jolt Falkayn. It had grown in him for a while

and was quietly born. He plugged the jack on his helmet into the maser unit locked on *Muddlin' Through*. "You read me, Chee Lan?" he asked.

"Aye. What report?"

Falkayn switched to the Eriau they had learned on Merseia. Latimer would scarcely know it, if he had ways to monitor. The Hermetian described what he had seen. "I'm damn near convinced that everything except the battleship is strictly robot," he finished. "That'd account for a lot of things. Like their formation. Gahood has to keep closer tabs on them than he would on live captains. And he cares less about losses in battle. They're merely machines. Probably radiation-proof anyhow. And if he's got a single crewed ship, it'd be easy—even natural—for him to charge off the way he did. Of course, no matter how his race has organized its economy, a fleet like this is expensive. But it's more replaceable than several hundred or thousand highly skilled crew people. For a prize like Satan, one might well take the gamble."

"I-yirh, your idea sounds plausible, David. Especially if Gahood is something like a warlord, with a personal following ready to go anywhere at any moment. Then he might not have needed to consult others . . . I feel a touch more hope. The enemy isn't quite as formidable as he seemed."

"Formidable enough. If I don't report back to you in the hour, or if you have any other reason to suspect something's fused, don't you play Loyal Retainer. Get the devil out of here."

She started to object. He overrode her words with the reminder: "I'll be dead. Nothing you can do for me, except whatever revenge may come from getting our information home."

She paused. "Understood," she said finally.

"You have a fifty-fifty chance of eluding pursuit, I'd say, if there is any," he told her. "Nineteen destroyers can phase-match you by sheer random trying if nothing else. But if they're robots, you might outfox them first. Or at least send another message capsule off without their noticing . . . Well, I'm closing in now. Will be out of touch. Good faring, Chee."

He could not follow her answer. It was in an archaic version of her native language. But he caught a few words, like "blessing," and her voice was not altogether steady.

The battleship loomed sheer before him. He cut off his autopilot and proceeded on manual. As he left the shadow of a turret, light spilled blindingly into his view. It came from a circle big as a cargo hatch, the air lock he must be supposed to use. He steered with care past the thick coaming and outer gate. The inner valve was shut. Ship's gravity caught at him, mak-

ing it a little tricky to set down. Having done so, he cycled out through the cockpit minilock as fast as he was able.

Quickly, then, he unhooked the thing at his belt and made it ready. Held in his left hand, it gave him a frosty courage. Waiting for Latimer, he examined the sled's instrument panel through the canopy. Gravpull felt higher than Earth standard, and the scale confirmed this with a value of 1.07. Illumination was more than a third again what he was used to. Spectral distribution indicated an F-type home star, though you couldn't really tell them from fluorescents . . .

The inner valve opened. Little air whiffed through; the lock was compound, with another chamber behind the first. A spacesuited human figure trod in. Behind the faceplate, Latimer's austere features showed in highlights and darknesses. He carried a blaster. It was an ordinary pistol type, doubtless acquired on Luna. But at his back moved a metal shape, tall, complex, a multitude of specialized limbs sprouting from the cylindrical body to end in sensors and effectors: a robot.

"What a rude way to receive an ambassador," Falkayn said. He did not raise his hands.

Latimer didn't ask him to. "Precaution," he explained matter-of-factly. "You are not to enter armed. And first we check for bombs or other surprises you may have."

"Go ahead," Falkayn answered. "My vehicle's clean and, as agreed, I left my guns behind. I do have this, however." He elevated his left fist, showing the object it grasped.

Latimer recoiled. *"Jagnath hamman!* What is that?"

"Grenade. Not nuclear, only an infantry make. But the stuffing is tordenite, with colloidal phosphorus for seasoning. It could mess things up rather well within a meter or two radius right here. Much nastier in an oxygenous atmosphere, of course. I've pulled the pin, and counted almost the whole five seconds before driving the plunger back in. Nothing except my thumb keeps it from going off. Oh, yes, it spits a lot of shrapnel, too."

"But . . . you . . . . no!"

"Don't fret yourself, Comrade. The spring isn't too strong for me to hold down for an hour. I don't want to be blown up. It's just that I want even less to be taken prisoner, or shot, or something like that. You abide by the diplomatic courtesies and we won't have any problems."

"I must report," Latimer said thickly. He plugged into what was evidently an intercom. Emotionless, the robot checked out the sled as it had been ordered, and waited.

Latimer said: "He will see you. Come." He led the way, his movements still jerky with outrage. The robot brought up the rear.

Falkayn felt walled between them. His grenade was no defense

against anything except capture. If the others wished, they could maneuver him into destruction without suffering undue damage. Or their ship wouldn't be harmed in the least if they potted him on his return, after he was well clear.

Forget it. You came here to learn what you might. You're no hero. You'd one hell of a lot rather be quite far away, a drink in your grip and a wench on your knee, prevaricating about your exploits. But this could be a war brewing. Whole planets could get attacked. A little girl, as it might be your own kid niece, could lie in an atom-blasted house, her face a cinder and her eyeballs melted, screaming for her daddy who's been killed in a spaceship and her mother who's been smashed against the pavement. Maybe matters aren't really that bad. But maybe they are. How can you pass up a chance to do something? You've got to inhabit the same skin as yourself.

It itches. And I can't scratch. A grin bent one corner of Falkayn's mouth. The second lock chamber had been closed, pressure had been restored, the inner valve was opening. He stepped through.

There was not much to see. A corridor led off, bare metal, blazingly lit. Footfalls rang on its deck. Otherwise a quiver of engines, hoarse murmur of forced-draft ventilation, were the sole relief in its blankness. No doors gave on it, merely grilles, outlets, occasional enigmatic banks of instruments or controls. Another robot passed through a transverse hall several meters ahead: a different model, like a scuttling disk with tentacles and feelers, doubtless intended for some particular kind of maintenance work. But the bulk of the ship's functioning must be integrated, even more than on a human-built vessel; she was herself one vast machine.

Despite the desertion, Falkayn got a sense of raw, overwhelming vitality. Perhaps it came from the sheer scale of everything, or the ceaseless throbbing, or a more subtle clue like the proportions of that which he saw, the sense of masses huge and heavy but crouched to pounce.

"The atmosphere is breathable," Latimer's radio voice said. "Its density is slightly above Earth sea level." Falkayn imitated him with his free hand, opening the bleeder valve to let pressures equalize gradually before he slid back his faceplate and filled his lungs.

Except for the added information, he wished he hadn't. The air was desert hot, desert dry, with enough thunder-smelling ozone to sting. Other odors blew on those booming currents, pungencies like spice and leather and blood, strengthening as the party approached what must be living quarters. Latimer didn't seem to mind the climate or the glare. But he was used to them. Wasn't he?

"How big a crew do you have?" Falkayn asked.

"Gahood will put the questions." Latimer looked straight before him, one muscle twitching in his cheek. "I advise you in the strongest terms, give him full and courteous answers. What you did with that grenade is bad already. You are fortunate that his wish to meet you is high and his irritation at your insolence slight. Be very careful, or his punishment may reach beyond your own death."

"What a jolly boss you've got." Falkayn edged closer, to watch his guide's expression. "If I were you, I'd've quit long ago. Spectacularly."

"Would you quit your world—your race and everything it means—because its service grew a little difficult?" Latimer retorted scornfully. His look changed, his voice dropped. "Hush! We are coming there."

The layout was not too strange for Falkayn to recognize a gravshaft rising vertically. Men and robot were conveyed up a good fifteen meters before they were deposited on the next deck.

Anteroom? Garden? Grotto? Falkayn looked around in bewilderment. An entire cabin, ballroom big, was filled with planters. The things grown in them ranged from tiny, sweet-scented quasi-flowers, through tall many-branched succulents, to whole trees with leaves that were spiky or fringed or intricately convoluted. The dominant hue was brownish gold, as green is dominant on Earth. Near the center splashed a fountain. Its stone basin must have stood outdoors for centuries, so weathered was it. Regardless of the wholly foreign artistic conventions, Falkayn could see that the shape and what remained of the carvings were exquisite. In startling contrast were the bulkheads. Enormous raw splashes of color decorated them, nerve-jarring, tasteless by almost any standards.

Latimer led the way to an arched door at the end. Beyond lay the first stateroom of a suite. It was furnished—over-furnished—with barbaric opulence. The deck was carpeted in pelt that might almost have belonged to angora tigers. One bulkhead was sheathed in roughly hammered gold plate, one was painted like the outer compartment, one was draped in scaly leather, and one was a screen whereon jagged abstract shapes flashed in a lightning dance to the crash of drums and bray of horns. The skull of a dinosaur-sized animal gaped above the entrance. From several four-legged stands wafed a bitter smoke. Two of the censers were old: time-worn, delicate, beautiful as the fountain. The rest were hardly more than iron lumps. Seating arrangements consisted of a pair of striped daises, each with space for three humans to lie on, and cushions scattered about the deck. A lot of other stuff lay carelessly heaped in odd places or on shelves. Falkayn didn't try to

identify most of those objects. He thought some might be containers, musical instruments, and toys, but he'd need acquaintance with the owner before he could make anything except wild guesses.

And here we go!

A thick sheet of transparent material, possibly vitryl, had been leaned against the inner doorway. It would shield whoever stood behind, if the grenade went off. The someone would have been safer yet, talking to him via telecom. But no, Gahood didn't have that kind of mentality. He trod into view. Falkayn had seen more than his share of nohumans, but he must suppress an oath. He confronted the Minotaur.

XVI

No . . . not that exactly . . . any more than Adzel was exactly a dragon. The impression was archetypical rather than literal. Yet as such it was overwhelming.

The creature was a biped, not unlike a man. Of course, every proportion was divergent, whether slightly, as in the comparative shortness of legs, or grotesquely, as in the comparative length of arms. Few if any humans had so stocky a build. The muscles made different ripples across the limbs and bands across the abdomen from a man's. The feet were three-toed and padded, the hands four-fingered; and these digits were stubby, with greenish nails. The same tint was in the skin, which sprouted bronze hairs as thickly as the shaggiest of men though not enough to be called furred. Since the mouth, filled with flat yellow teeth, was flexible, but vestigial nipples were lacking, one couldn't tell offhand if the basic type was mammalian in a strict sense or not. However, the being was grossly male and surely warmblooded.

The head—comparisons between species from separate planets are nearly always poor. But that massive head—with its short broad snout, dewlapped throat, black-smoldering wide-set eyes under heavy brow ridges and almost no forehead, long mobile ears—was more tauroid than anthropoid, at least. Naturally, variances exceeded resemblances. There were no horns. A superb mane enclosed the face, swept backward, tumbled over the shoulders and halfway to the hips. Those hairs were white, but must have a microgroove structure, because rainbows of iridescence played across their waves.

Falkayn and Latimer were tall, but Gahood towered over them, an estimated two hundred thirty centimeters. Such height, together with the incongruous breadth and thickness and the hard muscularity, might well bring his mass to a couple of hundred kilos.

He wore nothing except a jeweled necklace, several rings and heavy gold bracelets, a belt support-

ing a pouch on one side and a knife, or small machete, on the other. His breathing was loud as the ventilators. A musky scent hung around him. When he spoke, it was like summer thunder.

Latimer brought his gun to his lips—a salute?—lowered it again and addressed Falkayn: "You meet Gahood of Neshketh." His vocal organs weren't quite right for pronouncing the names. "He will question you. I have already told him you are called Sebastian Tombs. Are you from Earth?"

Falkayn rallied his courage. The being behind the shield-screen was intimidating, yes: but hang it, mortal! "I'll be glad to swap information," he said, "on a two-way basis. Is Neshketh his planet, or what?"

Latimer looked agitated. *"Don't,"* he muttered. "For your own sake, answer as you are instructed."

Falkayn skinned his teeth at them. "You poor scared mamzer," he said. "It could go hard with you, couldn't it? I haven't such a terrible lot to lose. You're the one who'd better cooperate with me."

A bluff, he thought inwardly, tensely. *I don't want to provoke an attack that'd end with me getting blown up. How very, very, very much I don't want to. And Gahood obviously has a hair-trigger temper. But if I can walk the tightrope from here to there . . .* An imp in him commented: *What a majestic lot of metaphors. You are playing poker while doing a high-wire act above a loaded revolver.*

"After all, " he went on, into the dismayed face and the blaster muzzle, "sooner or later you'll deal with the League, if only in war. Why not start with me? I come cheaper than a battle fleet."

Gahood grunted something. Latimer replied. Sweat glistened on his countenance. The master clapped hand to knife hilt, snorted, and spoke a few syllables.

Latimer said: "You don't understand, Tombs. As far as Gahood is concerned, you are trespassing on his territory. He is showing rare restraint in not destroying you and your ship on the spot. You must believe me. Not many of his kind would be this tolerant. He will not be for long."

"His" territory? Falkayn thought. *He acts insane, I admit; but he can't be so heisenberg that he believes one flotilla can keep the Polesotechnic League off Satan. Quite possibly, getting here first gives him a special claim under the law of his own people. But his group has got to be only the vanguard, the first hastily-organized thing that could be sent. I imagine the woman—what's-her-name, Thea Beldaniel's sister—went on to notify others. Or maybe she's rejoined a different minotaur. Latimer's attitude suggests Gahood is his personal* owner *. . . I suspect I'm being counter-bluffed. Gahood's natural impulse likely is to*

squash me: which makes Latimer nervous, considering he has no protection against what's in my fist. But Gahood's actually curbing his instinct, hoping to scare me, too, so I'll spill information.

"Well," he said, "you being the interpreter, I don't see why you can't slip me a few answers. You aren't directly forbidden to, are you?"

"N-n-no. I—" Latimer drew a shaky breath. "I will tell you the, ah, place name mentioned refers to a . . . something like a domain." Gahood rumbled. "Now answer me! You came directly from Earth?"

"Yes. We were sent to investigate the rogue planet." A claim that *Muddlin' Through* had found it by accident was too implausible, and would not imply that the League stood ready to avenge her.

Gahood, through Latimer: "How did you learn of its existence?"

Falkayn, donning a leer: "Ah, that must have been a shock to you, finding us on tap when you arrived. You thought you'd have years to build impregnable defenses. Well, friends, I don't believe there is anything in the galaxy that we of the Polesotechnic League can't get pregnant. What's the name of your home planet?"

Gahood: "Your response is evasive. How did you learn? How many of you are here? What further plans have you?"

Falkayn: A bland stare.

Latimer, swallowing: "Uh . . . I can't see any harm in— The planet is called Dathyna, the race itself the Shenna. In General Phonetic, D-A-Thorn-Y-N-A and Sha-E-N-N-A. The singular is 'Shenn.' The words mean, roughly, 'world' and *'people.'* "

Falkayn: "Names like that do, as a rule."

He noted that the Shenna seemed confined to their home globe, or to a few colonies at most. No surprise. Clearly, they didn't live at such a distance that they could operate on a large scale without Technic explorers soon chancing on spoor of them and tracking them down.

It did not follow from this that they were not, possibly, mortally dangerous. The information Serendipity must have fed them over the years—not to mention the capability demonstrated by their creating such an outfit in the first place—suggested they were. A single planet, heavily armed and cunningly led, might best the entire League through its ability to inflict unacceptable damage. Or, if finally defeated, it might first destroy whole worlds, their civilizations and sentient species.

And if Gahood is typical, the Shenna might seriously plan on just that, Falkayn thought.

Too damned many mysteries and contradictions yet, though. Robotics won't explain every bit of the speed with which this group reacted to the news. And that, in turn,

doesn't square with the far-reaching patience that built Serendipity—patience that suddenly vanished, that risked the whole operation (and, in the event, lost it) by kidnapping me.

"Speak!" Latimer cried. "Answer his questions."

"Eh? Oh. Those," Falkayn said slowly. "I'm afraid I can't. All I know is, our ships got orders to proceed here, check out the situation, and report back. We were warned someone else might show up with claim-jumping intentions. But no more was told us." He laid a finger alongside his nose and winked. "Why should the League's spies risk letting you find out how much they've found out about you . . . and where and how?"

Latimer gasped, whirled, and talked in fast, coughing gutturals. The suggestion that Dathynan society had itself been penetrated must be shocking even to Gahood. He wouldn't dare assume it was not true. Would he? But what he'd do was unpredictable. Falkayn balanced flex-kneed, every sense alert.

His training paid off. Gahood belched an order. The robot slipped unobtrusively to one side. Falkayn caught the movement in the corner of an eye. With his karate stance, he didn't need to jump. He relaxed the tension in one leg and was automatically elsewhere. Steel tendrils whipped where his left hand had been.

He bounded into the nearest corner. "Naughty!" he rapped. The machine whirred toward him. "Latimer, I can let go this switch before that thing can squeeze my fingers shut around it. Call off your iron dog or we're both dead."

The other man uttered something that halted the robot. Evidently Gahood endorsed the countermand, for at his word the machine withdrew until it no longer hemmed Falkayn in. Across the room he saw the minotaur stamp, hungrily flex his hands and blow through distended nostrils—furious behind his shield.

Latimer's blaster aimed at the Hermetian's midriff. It wavered, and the wielder looked ill. Though his life had been dedicated to the cause of Dathyna, or whatever the cause was, and though he was doubtless prepared to lay it down if need be, he must have felt a shock when his master so impulsively risked it. "Give up, Tombs," he well-nigh pleaded. "You cannot fight a ship."

"I'm not doing badly," Falkayn said. The effort was cruel to hold his own breathing steady, his voice level. "And I'm not alone, you know."

"One insignificant scoutcraft—No. You did mention others. How many? What kind? Where?"

"Do you seriously expect the details? Listen close, now, and translate with care. When we detected you, my ship went out to parley because the League doesn't like fights.

They cut into profit. When fights become necessary, though, we make damn sure the opposition will never louse up our bookkeeping again. You spent enough time in the Commonwealth, Latimer, and maybe elsewhere in the territory covered by Technic civilization, to vouch for that. The message I have for you is this. Our higher-ups are willing to dicker with yours. Time and place can be arranged through any envoys you send to the League secretariat. But for the moment, I warn you away from Beta Crucis. We were here first, it's ours, and our fleet will destroy any intruders. Let me return to my ship, then go home yourselves to think it over."

Latimer looked yet more profoundly shaken. "I can't . . . address him . . . like that!"

"Then don't address him," Falkayn shrugged. Gahood lowered his ponderous head, stamped on the deck and boomed. "But if you ask me, he's getting impatient."

Latimer began stumblingly to speak to the Dathyman.

I suspect he's shading his translation, Falkayn thought. *Poor devil. He acted boldly on Luna. But now he's back where he's property, physical, mental, spiritual property. Worse off than I was; he doesn't even need to be chained by drugs. I don't know when I've watched a ghastlier sight.* The thought was an overtone in a voiceless scream: *Will they play safe and release me? Or must I die?*

Gahood bellowed. It was no word, it was raw noise, hurting Falkayn's eardrums. Echoes flew. The creature hurled himself against the barricading slab. It weighed a ton or better in this gravity, but he tipped it forward. Leaning upon it, he boomed a command. Latimer sprang, clumsy in his spacesuit, toward him.

Falkayn understood: *He'll let his slave in, lean the shelter back, and when both of them are safe, he'll tell the robot to go after me. It's worth a robot and the treasures in this room, to kill me who insulted him—*

And Falkayn's body was already reacting. He was farther from the arch, and must sidestep the machine. But he was youthful, in hard condition, accustomed to wearing space armor . . . and driven by love of life. He reached the slab simultaneously with Latimer, on the opposite side. It stood nearly vertical now, with a one-meter gap giving admittance to the room beyond. The ireful beast who upheld it did not at once notice what had happened. Falkayn got through along with the other man.

He skipped aside. Gahood let the slab crash into its tilted position again and whirled to grab him. "Oh, no!" he called. "Get him off me, Latimer, or he's the third chunk of hamburger here!"

Slave threw himself upon owner and tried to wrestle Gahood to a

halt. The Dathynan tore him loose and pitched him to the deck. Space armor clanged where it struck. But then reason appeared to enter the maned head. Gahood stopped cold.

For a minute, tableau. Latimer sprawled, bloody-nosed and semiconscious, under the bent columns of Gahood's legs. The minotaur stood with arms dangling, chest heaving, breath storming, and glared at Falkayn. The spaceman poised a few meters off, amidst another jumble of barbarous luxuries. Sweat plastered the yellow hair to his brow, but he grinned at his enemies and waved the grenade aloft.

"That's better," he said. "That's much better. Stand fast, you two. Latimer, I'll accept your gun."

In a dazed fashion, the slave reached for the blaster, which he had dropped nearby. Gahood put one broad foot on it and snorted a negative.

"Well . . . keep it, then," Falkayn conceded. The Dathynan was rash but no idiot. Had Falkayn gotten the weapon, he could have slain the others without dooming himself. As it was, there must be compromise. "I want your escort, both of you, back to my sled. If you summon your robots, or your merry men, or anything that makes my capture seem feasible, this pineapple goes straight up."

Latimer rose, painfully. "Merry men—?" he puzzled. His gaze cleared. "Oh. The rest of our officers and crew. No, we will not call them." He translated.

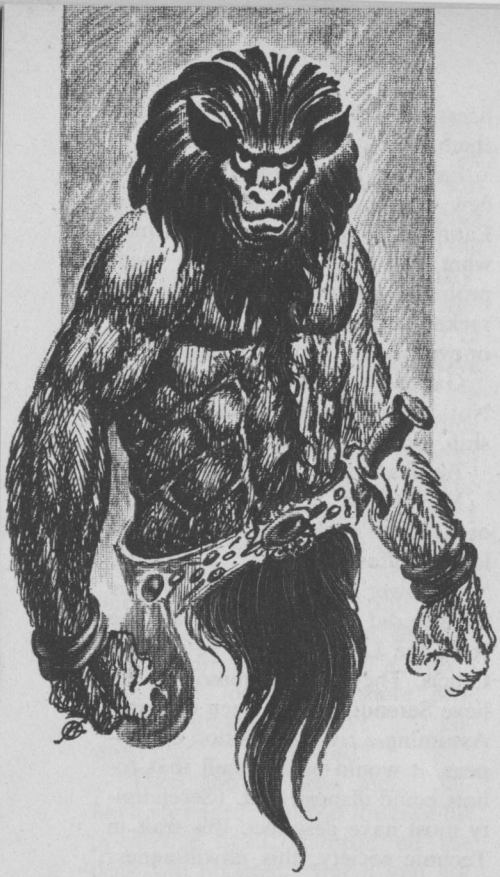
Falkayn kept impassive. But a new excitement boiled within him. Latimer's initial reaction confirmed what had already begun to seem probable, after no one heard the racket here and came to investigate, or even made an intercom call.

Gahood and Latimer were alone. Not just the other craft, the flagship, too, was automatic.

But that was impossible!

Maybe not. Suppose Dathyna—or Gahood's Neshketh barony, at least—suffered from an acute "manpower" shortage. Now the Shenna did not expect that anyone from the League would be at Beta Crucis. They had no reason to believe Serendipity had been exposed. Assuming a rival expedition did appear, it would be so small that robots could dispose of it. (Serendipity must have described this trait in Technic society, this unwillingness to make large commitments sight unseen. And, of course, it *was* the the case. No League ship except *Muddlin' Through* was anywhere near the blue star.) Rather than go through the tedious business of recruiting a proper complement—only to tie it up needlessly, in all apparent likelihood—Gahood had taken what robots he commanded. He had gone off without other live companionship than the dog-man who brought him the word.

What kind of civilization was this, so poor in trained personnel,



so careless about the requirements for scientific study of a new planet, and yet so rich and lavish in machines?

Gahood cast down the barrier. Probably robots had raised it for him; but none came in response to its earthquake fall, and the one in the cabin stood as if frozen. In the same eerie wordlessness, Falkayn trailed his prisoners: out the antechamber, down the gravshaft, through the corridor to the air lock.

There the others stopped and glowered defiance. The Hermetian had had time to make a plan. "Now," he said, "I'd like to take you both hostage, but my vehicle's too cramped and I won't risk the chances that Gahood's riding along might give him. You'll come, Latimer."

"No!" The man was appalled.

"Yes. I want some assurance of not being attacked en route to my fleet."

"Don't you understand? M-my information . . . what I know . . . you could learn . . . He'll have to sacrifice me."

"I thought of that already. I don't reckon he's anxious to vaporize you. You're valuable to him, and not simply as an interpreter. Else you wouldn't be here." *You had the name in the Solar System of being an uncommonly good spaceman, Hugh Latimer. And at the moment, though I hope he doesn't know I know, you're half his party. Without you, never mind how good his robots are, he's got big problems. He could return home, all right; but would he dare do anything else, as long as the possibility exists I did not lie about having an armada at my back? Besides—who knows—there may well be a kind of affection between you two.* "He won't attack a vessel with you aboard if he can avoid it. Correct? Well, you're already spacesuited. Ride with me as far as my ship. I'll let you off there. His radar can confirm that I do, and he can pick you up in space. If he does not spot you

separating from my sled, shortly before it joins my ship, then he can open fire."

Latimer hesitated. "Quick!" Falkayn barked. "Translate and give me his decision. My thumb's getting tired."

The truth was, he aimed to keep them both off balance, not give them a chance to think. The exchange was brief, under his profane urging. "Very well," Latimer yielded sullenly. "But I keep my blaster."

"And I our mutual suicide pact. Fair enough. Cycle us through."

Latimer instructed the air lock by voice. Falkayn's last glimpse of Gahood, as the inmost valve closed again, was of the huge form charging up and down the corridor, pounding the bulkheads with fists until they clamored, and bellowing.

The sled waited. Falkayn sent Latimer first through its minilock in order that he, entering afterward, would present the full menace of the grenade. It was awkward, squeezing one spacesuit past another in the tiny cockpit, and guiding the sled by one hand was worse. He made a disgraceful lift-off. Once in motion, he let the vehicle do as it would while he broadcast a call.

"David!" Chee Lan's voice shuddered in his earplugs. "You're free — *Yan-tai-i-lirh-ju.*"

"We may have to run hard, you and I," he said in Anglic, for Latimer's benefit. "Give my autopilot a beam. Stand by to reel me in and accelerate the moment I'm in tractor range. But, uh, don't pay attention when I first discharge a passenger."

"Hostage, eh? I undertand. Muddlehead, get off your fat electronic duff and lock onto him!"

A minute later, Falkayn could let go the main stick. The sled flew steadily, the ominous shape of the battleship dwindled aft. He glanced at Latimer, crowded more or less beside him. In the dim glow of stars and instrument panel, he saw a shadow bulk and a gleam off the faceplate. The blaster muzzle was poked almost in his belly.

"I don't imagine Gahood will shoot at us," he said low.

"I think not, now." Latimer's reply sounded equally exhausted.

"Whoo-oo. How about relaxing? We've a tedious ride ahead of us."

"How can you relax, with that thing in your hand?"

"Sure, sure. We keep our personal deterrents. But can't we take it easy otherwise? Open our helmets, light each other's cigarettes."

"I do not smoke," Latimer said. "However—" He undogged and slid back his faceplate concurrently with Falkayn. A sigh gusted from him. "Yes. It is good to . . . to uncramp."

"I don't bear you any ill will, you know," Falkayn said, not quite truthfully. "I'd like to see this dispute settled without a fight."

"Me, too. I must admire your courage. It's almost like a Shenn's."

"If you could give me some idea what the quarrel is about—"

"No," Latimer sighed, "I'd better not say anything. Except . . . how are they, back on Luna? My friends of Serendipity?"

"Well, now . . ."

Latimer shifted position and Falkayn saw his chance. He had been prepared to wait for it as long as need be, and do nothing if it didn't happen to materialize. But the sled had already gotten so far away from the battleship that no scanner could give a clue as to what went on in this cockpit. There was no contact in either direction, apart from Muddlehead's beam and Gahood's tracking radar. In the low weight of acceleration, Latimer's tired body had settled into his seat harness. The blaster rested laxly on one knee and the face lolled in its frame of helmet near Falkayn's right shoulder.

". . . It's like this," the Hermetian continued. *Here goes—for broke!* His left fist, with the grenade to lend mass, swept about, battered the gun barrel aside and pinned it against the cockpit wall. His right hand darted through the faceplate opening and closed on Latimer's throat.

XVII

The blaster flared once, while the man tried to struggle. Then both were still.

Panting, Falkayn released the judo strangle. "Got to work fast," he muttered aloud, as if to offset the hiss of escaping air. But that hole was sealing itself while the reserve tanks brought pressure back up. He stuffed the blaster into his tool belt and strained his eyes aft. Nothing stirred in the Shenn fleet. Well, it had always been unlikely that one little flash and brief puff of water mist would be seen.

Getting rid of the grenade was more tricky. Falkayn cut the main drive and swiveled the sled transversely to its path, so that the minilock faced away from the battleship. On this model, the valves had been simplified to a series of sphinctered diaphragms on either side of a rigid cylinder. It meant some continuous gas leakage, and comparatively high loss whenever you went in or out. But it compensated with speed and flexibility of use; and the sled wasn't intended for long hops through space anyway. Helmet reclosed, Falkayn braced feet against the opposite side of the cockpit and pushed head and shoulders out into the void. He tossed the grenade, flat and hard. It exploded at a reasonably safe distance. A few shrapnel chunks ricocheted off the vehicle, but no serious damage was done.

"Wowsers!" His left hand ached. He flexed the fingers, trying to work some tension out, as he withdrew to the interior. Latimer was regaining consciousness. With a bit of reluctance—rough way to treat a man—Falkayn choked him again. Thus the Hermetian won the extra few seconds he needed, undisturbed, to put his sled back on acceleration before

Gahood should notice anything and grow suspicious.

He placed himself with care vis-à-vis Latimer, leveled the blaster, opened his helmet, and waited. The captive stirred, looked around him, shuddered, and gathered himself for a leap. "Don't," Falkayn advised, "or you're dead. Unharness; back off to the rear; get out of your suit."

"What? *Logra doadam!* You swine—"

"Oink," Falkayn said. "Listen, I don't want to shoot you. Quite apart from morals and such, you've got a lot of hostage value. But you're most certainly not returning to help Gahood. I have my whole people to worry about. If you cause me any trouble, I'll kill you and sleep quite well, thank you. Get moving."

Still dazed, by his stunning reversal as well as physically, the other man obeyed. Falkayn made him close up the spacesuit. "We'll eject it at the right moment and your boss will think it's you," he explained. "His time loss collecting it is my gain."

A growl and glare through the shadows: "It is true what I was told about your sort, what I observed for myself. Evil, treacherous—"

"Desiccate it, Latimer. I signed no contract, swore no oath. Earlier, you types weren't exactly following the usual rules of parley. I didn't enjoy the hospitality I received in your Lunar castle, either."

Latimer jerked backward. "Falkayn?" he whispered.

"Right. Captain David Falkayn, M.M.P.L., with a hydrocyanic personal grudge and every reason to believe your gang is out for blood. Can you prove this is a pillow fight we're in? If it is, then you've put bricks in your pillow. Which led me to put nails in mine. Be quiet, now, before I get so mad I fry you!"

The last sentence was roared. Latimer crouched rather than cowered, but he was certainly daunted. Falkayn himself was astounded. *I really pushed that out, didn't I? The idea was to keep him stampeded, so he won't think past the moment, guess my real intentions, and become desperate. But Judas, the fury I feel!* He trembled with it.

Time passed. The enemy receded further, *Muddlin' Through* came nearer. When they were quite close, Falkayn ordered Latimer to shove the empty spacesuit through the minilock: an awkward job, eardrum-popping if one had no armor, but performed in tight-lipped silence.

"Haul us in, Chee," Falkayn said.

A tractor beam clamped on. The drive was shut off. A cargo hatch stood open to one of the after holds. No sooner was the sled inboard, protected by the ship's G-field from acceleration pressures, than Chee started off under full drive. The hum and bone-deep vibration could be felt.

She scurried below to meet the humans. They had just emerged, and stood glaring at each other in

the coldly-lit cavern. Chee hefted the stun pistol she carried. "Ah, s-s-so," she murmured. Her tail waved. "I rather expected you'd do that, David. Where shall we lock this klong up?"

"Sickbay," Falkyn told her. "The sooner we begin on him, the better. We may be hounded down, you see, but if we can launch our other capsule with something in it—"

He should not have spoken Anglic. Latimer divined his intention, screamed, and hurled himself straight at the blaster. Hampered by his spacesuit, Falkayn could not evade the charge; and he did not share the prisoner's desire that he shoot. They went to the deck, rolling over and over in their struggle. Chee Lan eeled between them and gave Latimer a judicious jolt.

He sprawled limp. Falkayn rose, breathing hard, shaking. "How long'll he be out?"

"Hour; maybe two," the Cynthian answered. "But I'll need a while to prepare anyway." She paused. "I'm not a psychotechnician, you realize, and we don't have a full battery of drugs, electroencephalic inducers, all that junk they use. I don't know how much I can wring out of him."

"You can get him to babble something, I'm sure," Falkayn said. "What with the stuff left over from curing me, and the experience you got then. Just the coordinates of Dathyna—of the enemy's home system—would be invaluable."

"Haul him topside and secure him for me. After which, if you aren't too shredded in the nerves, you'd better take the bridge."

Falkayn nodded. Weariness, reaction, had indeed begun to invade him. Latimer's body was a monstrous weight over his shoulders. The thin face looked tormented even in slumber. And what waited was a will-less half-consciousness . . . *Tough*, Falkayn thought sarcastically.

Coffee, a sandwich, a quick shower, grabbed while he related via intercom what had happened, made him feel better. He entered the bridge with his pipe at a jaunty angle. "What's the situation, Muddlehead?" he asked.

"As respects ourselves, we are bound back toward the rogue planet at maximum thrust," said the computer. It was the only way to continue the bluff of armed support. "Our systems check satisfactory, although a fluctuation in line voltage on circuit 47 is symptomatic of malfunction in a regulator that should be replaced when next we make port."

"Repaired," Falkayn corrected automatically.

"Replaced," Muddlehead maintained. "While data do indicate that Freeman van Rijn is describable, in terms of the vocabulary you instructed me to use, it is illogical that my operations should be distracted, however slightly, by—"

"Great Willy! We may be radioactive gas inside an hour, and you indent for a new voltage regulator! Would you like it gold-plated?"

"I had not considered the possibility. Obviously, only the casing could be. It would lead to a pleasing appearance, provided of course that every similar unit is similarly finished."

"Up your rectifier," Falkayn said. His teeth clamped hard on the pipe bit. "What readings on the enemy?"

"A destroyer has put a tractor beam on the suit and is bringing it near the battleship."

"Which'll take it aboard," Falkayn predicted without difficulty. Things were going as he'd anticipated . . . thus far. The Dathynan ships were delayed in their recovery operation by the need to get detailed instruction from Gahood.

They had electronic speed and precision, yes, but not full decision-making capacity. No robot built in any known civilization does. This is not for lack of mystic vital forces. Rather, the biological creature has available to him so much more physical organization. Besides sensor-computer-effector systems comparable to those of the machine, he has feed-in from glands, fluids, chemistry reaching down to the molecular level—the integrated ultra-complexity, the entire battery of *instincts*—that a billion-odd years of ruthlessly selective evolution have brought forth. He perceives and thinks with a wholeness transcending any possible symbolism; his purposes arise from within, and therefore are infinitely flexible. The robot can only do what it was designed to do. Self-programming has extended these limits, to the point where actual consciousness may occur if desired. But they remain narrower than the limits of those who made the machines.

To be sure, given an unequivocal assignment of the type for which it is built, the robot is superior to the organism. Let Gahood order his fleet to annihilate *Muddlin' Through,* and the contest became strictly one between ships, weapons, and computers.

Didn't it?

Falkayn sat down, drummed fingers on his chair arm, blew acrid clouds at the star images that enclosed him.

Chee's voice pulled him from his brown study: "I've got your boy nicely laid out, intravenous insertions made, brain and vagus nerve monitored, life support apparatus on standby, everything I can do with what's available. Should I jolt him awake with a stim shot?"

"No,wait a while. It'd be hard on his body. We don't want to damage him if we can possibly help it."

"Why not?"

Falkayn sighed. "I'll explain some other time. But practically speaking, we can pump him drier if we treat him carefully."

"They can do still better in a properly equipped lab."

"Yeah, but that's illegal. So illegal that it's a tossup whether anyone would do the job for us on the QT. Let's get what we can, ourselves. We're also violating law, but that can be winked at if we're well beyond civilization . . . Of course, we can't predict whether Gahood will give us the days you need for a thorough and considerate job of quizzing."

"You met him. What do you think?"

"I didn't get exactly intimate with him. And even if I knew his inner psychology, which I don't except for his tendency to make all-out attacks at the first sign of opposition—even then, I wouldn't know what pragmatic considerations he might have to take into account. On the one hand, we have his trusty man for a hostage, and he has at least some reason to believe we may have husky friends waiting at Satan. He should cut his losses, return, and report. On the other hand, he may be so bold, or so angry, or so afraid Latimer will reveal something vital to us, that he'll strike."

"Supposing he does?"

"We run like hell, I guess. A stern chase is a long chase. We may throw him off the scent, like in Pryor's Nebula. Or we may outrun his heavy ships altogether, and he recall his destroyers rather than—Whoops! Hang on!"

Muddlehead spoke what flickered on the 'scope faces: "They are starting after us."

"Rendezvous point?" Chee demanded.

"Data cannot yet be evaluated with precision, considering especially the velocity we have already gained. But." For an instant, it hummed. "Yes, the destroyers are lining out on courses effectively parallel to ours, with somewhat greater acceleration. Under such conditions, they will overhaul us in slightly less than one astronomical unit."

"Their shooting can overhaul us sooner than that," Chee stated. "I'm going ahead on Latimer."

"I suppose you must," Falkayn said reluctantly, half wishing he had not captured the man.

"Commence hyperdrive," Chee ordered from sickbay.

"Not right now," Falkayn said.

"Chi'in-pao?"

"We're safe for a little while. Keep driving toward Satan, Muddlehead. They might just be testing our bluff."

"Do you really believe that?" the Cynthian asked.

"No," Falkyan said. "But what can we lose?"

Not much, he answered himself. *I knew the chances of our coming out of this web alive aren't good. But as of this moment, I can't do anything but sit and feel the fact.*

Physical courage was schooled into him, but the sense of life's

sweetness was born in. He spent a time cataloguing a few of the myriad awarenesses that made up his conscious being. The stars burned splendid across night. The ship enclosed him in a lesser world, one of power-thrum, ventilator breath, clean chemical odors, music if he wanted it, the battered treasures he had gathered in his wanderings. Smoke made a small autumn across his tongue. Air blew into his nostrils, down into the lungs, as his chest expanded. The chair pressed back against the weight of his body; and it had texture; and seated, he nevertheless operated an interplay of muscles, an unending dance with the universe for his lady. A sleeve of the clean coverall he had donned felt crisp, and tickled the hair on one arm. His heart beat faster than usual, but steadily, and that pleased him.

He summoned memories from the deeps: mother, father, sisters, brothers, retainers, old weather-beaten soldiers and landsmen, in the windy halls of the castle on Hermes. Hikes through the woods; swims in the surf; horses, boats, aircraft, spaceships. Gourmet dinners. A slab of black bread and cheese, a bottle of cheap wine, shared one night with the dearest little tart . . . Had there actually been so many women? Yes. How delightful. Though of late he had begun to grow wistful about finding some one girl who—well, had the same quality of friendship that Chee or Adzel did. But hadn't he and his comrades enjoyed their own romps, on world after wild world? Including this latest, perhaps last mission to Satan. If the rogue was to be taken away, he hoped the conquerors would at least get pleasure from it.

How can they tell if they will? None of them have been there yet. In a way, you can't blame Gahood for charging in. He must be eager too, I think, to see what the place is like. The fact that I know, that I've already landed there already, must hone the edge of his impatience . . .

Wait! Drag that thought by slowly. You'd started playing with it before, when Chee interrupted—

Falkayn sat rigid, oblivious, until the Cynthian grew nervous and shouted into the intercom. "What ails you?"

"Oh." The man shook himself. "Yes. That. How're we doing?"

"Latimer is responding to me, but deliriously. He's in worse shape than I realized."

"Psychic stress," Falkayn diagnosed without paying close attention. "He's being forced to betray his master—his owner, maybe his god—against a lifetime's conditioning."

"I think I can haul him back into orbit long enough at a time to put a question or two. What about the enemy, Muddlehead?"

"The destroyers are closing the gap," reported the computer. "How

soon they will be prepared to fire on us depends on their armament but I would expect it to be soon."

"Try to raise the battleship by radio," Falkayn ordered. "Maybe they . . . he . . . will talk. Meanwhile, prepare to go hyper at the first sign of hostile action. Toward Satan."

Chee had evidently not heard him, or was too intent to comment. The mutter of her voice, Latimer's incoherence, the medical machines, drifted unpleasantly over the intercom. "Shall I revert to normal when we reach the planet?" Muddlehead inquired.

"Yes. Starting at once, change our acceleration. I want nearly zero kinetic velocity with respect to goal," Falkayn said.

"That, in effect, involves deceleration," Muddlehead warned. "The enemy will come in effective firing range correspondingly faster."

"Never mind. Do you think you can find a landing spot, once we're there?"

"It is uncertain. Meteorological violence, and diastrophism, appeared to be increasing almost exponentially when we left."

"Still, you've got a whole world to pick and choose from. And you know something about it. I can't guess how many billion bits of information regarding Satan you've got stashed away. Prepare to devote most of your computer capacity to them, as well as to observation on the spot. I'll give you generalized instructions—make the basic decisions for you—as we proceed. Clear?"

"I presume you wish to know whether your program has been unambiguously comprehended. Yes."

"Good." Falkayn patted the nearest console and smiled through his gathering, half gleeful tension. "We come through this, and you can have your gold-plated regulators. If need be, I'll pay for them out of my own account."

There was no perceptible change of forces within the ship, nor in the configuration of light-years-remote stars or the luridness of Beta Crucis. But meters said the ship was slowing down. Magnifying viewscreens showed the glints that were Gahood's vessels growing into slivers, into toys, into warcraft.

"I've got it!" ripped from Chee.

"Huh?" Falkayn said.

"The coordinates. In standard values. But he's spinning off into shock. I'd better concentrate on keeping him alive."

"Do. And, uh, don safety harness. We may dive right into Satan's atmosphere. The compensators may get overloaded."

Chee was quiet a moment before she said: "I see your plan. It is not a bad one."

Falkayn gnawed on his pipe. This was the worst part, now, this waiting. Gahood must have detected the change of vector, must

see what was like an attempt to rendezvous, must know about at least one of the communication beams on different bands that probed toward his flagship. But his fleet plunged on, and nothing spoke to Falkayn save a dry cosmic hiss.

If he'll try to talk . . . if he'll show any sign of goodwill . . . Judas, we don't want *a battle—*

Whiteness flared in the screens, momentarily drowning the constellations. Alarm bells rang. "We were struck by an energy bolt," Muddlehead announced. "Dispersion was sufficient at this range that damage was minimal. I am taking evasive action. A number of missiles are being released from the fleet. They behave like target-seekers."

Doubts, terrors, angers departed from Falkayn. He became entirely a war animal. "Go hyper to Satan as instructed," he said without tone. "One-tenth drive."

The wavering sky, the keening noises, the shifting forces: then steadiness again, a low throb, Beta Crucis swelling perceptibly as the ship ran toward it faster than light.

"So slow?" Chee Lan asked.

"For the nonce," Falkayn said. "I want to keep a close watch on what they do."

Only instruments could tell, the fleet being already lost in millions of kilometers. "They aren't going hyper immediately," Falkayn said. "I expect they're matching our kinetic velocity first, more or less. Which suggests they intend to start shooting again at their earliest opportunity."

"Whether or not we have reinforcements at Satan?"

"Whether or not. I imagine the battleship will bring up the rear, though, at a goodly distance, and wait to see how things develop before making any commitment." Falkayn laid his pipe aside. "No matter how hot-tempered he is, I doubt if Gahood will rush into an unknown danger right along with his robots. They're more expendable than him. Under present conditions, this fact works in our favor."

"Hyperdrive pulses detected," the computer said a few minutes later.

Falkayn whistled. "Can they normal-decelerate that fast? Very well, open up, flat out. We don't want them to overtake us and maybe phase-match before we reach Satan."

The engine pulse became a drumbeat, a current, a cataract. The flames of Beta Crucis seemed to stretch and seethe outward. The computer said: "All but one unit, presumably the largest, are in pursuit. The cruisers are lagging behind us but the destroyers are gaining. However, we will reach goal several minutes in advance of them."

"How much time do you want for scanning the planet and picking us a course down?"

Click. Click-click. "A hundred seconds should suffice."

"Reduce speed so we'll arrive, let's see, three minutes before the leading destroyer. Commence descent one hundred seconds after we're back to normal state. Make it as quick as possible."

The power-song dropped a touch lower. "Are you in your own harness, David?" Chee asked.

"Uh . . . why, no," Falkayn suddenly realized.

"Well, get into it! Do you think I want to scrub the deck clean of that clabbered oatmeal you call brains? Take care of yourself!"

Falkayn smiled for half a second. "Same to you, fluffykins."

"Fluffykins—!" Oaths and obscenities spattered the air.

Falkayn sat down and webbed in. Chee needed something to take her mind off the fact that in this hour she could do nothing about her own fate. It was a condition harder for a Cynthian to endure than a human.

Then they were upon the rogue. Then they flashed into relativistic state. Then engines roared, hull structure groaned and shuddered, while the last adjustments in velocity were made, within seconds.

They were not far out, just enough so that most of the daylit hemisphere could be observed. Satan loomed frightful, filling the screens, storm clouds, lightnings, winds gone crazy, volcanoes, avalanches, floods, mountainous waves raised on the oceans and torn into shreds of spume, air nearly solid with rain and hail and flung stones, one immense convulsion beneath the demon disk of the star. Momentarily Falkayn did not believe there was any spot anywhere on the globe where a ship might descend, and he readied himself for death.

But the League vessel sprang ahead. On a cometlike trajectory, she arced toward the north pole. Before reaching it, she was in the upper atmosphere. Thin it might be, but it smote her so the hull rang.

Darkness, lit with explosions of lightning, rolled beneath. Falkayn glanced aft. Did the screens truly reveal to him the shark-shape destroyers of Gahood? Or was that an illusion? Torn clouds whipped across sun and stars. Thunder and shrieking and the cry of metal filled his ship, his skull, his being. The interior field regulators could not handle every shock, as *Muddlin' Through* staggered downward. The deck pitched, yawed, swayed, fell away, rose savagely again. Something crashed off something else and broke. Lights flickered.

He tried to understand the instruments. Nuclear sources, behind, coming nearer . . . yes, the whole nineteen, stooping on their quarry!

They were meant for aerodynamic work. They had orders to catch and kill a certain vessel. They were robots.

They did not have sophontic judgment, nor any data to let them estimate how appalling these totally unprecedented conditions were, nor any mandate to wait for further instructions if matters looked doubtful. Besides, they observed a smaller and less powerful craft maneuvering in the air.

They entered at their top atmospheric speed.

Muddlehead had identified a hurricane and plotted its extent and course. It was merely a hurricane —winds of two or three hundred kilometers per hour—a kind of back eddy or dead spot in the storm that drove across this continent with such might that half an ocean was carried before it. No matter how thoroughly self-programmed, on the basis of how much patiently collected data, no vessel could hope to stay in the comparatively safe region long.

The destroyers blundered into the main blast. It caught them as a November gale catches dead leaves in the northlands of Earth. Some it bounced playfully between cloud-floor and wind-roof, for whole minutes, before it cast them aside. Some it peeled open, or broke apart with the meteoroidal chunks of solid matter it bore along, or drowned in the spume-filled air farther down. Most it tossed at once against mountainsides. The pieces were strewn, blown away, buried, reduced in a few weeks to dust, mud, atoms locked into newly forming rock strata. No trace of the nineteen warships would ever be found.

"Back aloft!" Falkyan had already cried. "Locate those cruisers. Use cloud cover. With this kind of electric noise background, they aren't likely to detect us fast."

A roll and lurch rattled his teeth together. Slowly, fighting for every centimer, *Muddlin' Through* rose. She found a stratospheric current she could ride for a while, above the worst weather though beneath a layer where boiled-off vapors were recondensing in vast turbulent masses that, from below, turned heaven Stygian. Her radars could penetrate this, her detectors pick up indications that came to her. The three cruisers were not supposed to make planetfall. Obviously, they were to provide cover against possible space attack. Their attention must be almost wholly directed outward. They orbited incautiously close, in inadvisably tight formation. But they were also robots, whose builders had more faith in strength than in strategy.

Falkayn sent off three of his nuclear torpedoes. Two connected. The third was intercepted in time by a counter-missile. Reluctantly, he ordered the fourth and last shot. It seemed to achieve a near miss and must have inflicted heavy damage, judging by what the meters recorded.

And . . . the cruiser was limp-

ing off. The battleship, whose mass made ominous blips on half a dozen different kinds of screen, was joining her. They were both on hyperdrive—retreating—dwindling toward the Circini region.

Falkayn whooped.

After a while, he recovered his wits sufficiently to order: "Get us into clear space again, Muddlehead. Barely outside the atmosphere. Take orbit, with systems throttled down to minimum. We don't want to remind Gahood of us. He could change his mind and return before he's too far off ever to catch us."

"What does he believe happened?" Chee asked, so weakly she could barely be heard.

"I don't know. How does his psyche work? Maybe he thinks we have a secret weapon. Or maybe he thinks we lured his destroyers down by a suicide dive, and we've got friends who fired those torps. Or maybe he's guessed the truth, but figures that with his fleet essentially gone, and the possibility that a League force might soon arrive, he'd better go home and report."

"Lest we outfox him again, eh?" Exhausted and battered though she was, Chee began to have a note of exultation in her voice.

Likewise Falkayn. "What do you mean, 'we,' white puss?" he teased.

"I obtained those coordinates for you, didn't I? Bloodiest important thing we've accomplished this whole trip."

"You're right," Falkayn said, "and I apologize. How's Latimer?"

"Dead."

Falkayn sat straight. "What? How?"

"The life-support apparatus got knocked out of kilter, by that battering we took. And in his weakened condition, with his whole organism fighting itself— Too long a time has passed now for resuscitation to mean anything." Falkayn could imagine Chee Lan's indifferent gesture, her probable thoughts. *Pity for us. Oh, well, we got something out of him; and we're alive.*

His went, surprisingly to himself: *Poor devil. I have my revenge. I've been purged of my shame; and I find it didn't really matter that much.*

Quietness grew around the ship, the stars trod forth, and she reentered open space. Falkayn could not stay sorry. He felt he ought to, but the knowledge of deliverance was too strong. They'd give their foeman an honorable burial, an orbit straight into yonder terrible, glorious sun. And they'd steer for Earth.

No. The realization struck like a fist. *Not that. We can't go home yet.*

The work of survival had barely been started.

XVIII

Well-established laws of nature are seldom overthrown by new sci-

entific discovery. Instead, they turn out to be approximations, or special cases, or in need of rephrasing. Thus—while a broader knowledge of physics permits us to do things he would have considered impossible, like traversing a light-year in less than two hours—Einstein's restrictions on the concept of simultaneity remain essentially valid. For no matter how high a pseudo-velocity we reach, it is still finite.

So did Adzel argue. "You may not correctly ask what our friends are doing 'now,' when interstellar distances separate us from them. True, after they have rejoined us, we can compare their clocks with ours, and find the same time-lapse recorded. But to identify any moment of our measured interval with any moment of theirs is to go beyond the evidence, and indeed to perpetrate a meaningless statement."

"Hokay!" Nicholas van Rijn bawled. He windmilled his arms in the air. "Hokay! Then give me a meaningless answer! Four weeks, close as damn, since they left. Couldn't need much more than two for getting at Beta Crosseyes, ha? They may be finding thawed-out glaciers of beer and akvavit, we haven't heard diddly-dong from them yet?"

"I understand your concern," Adzel said quietly. "Perhaps I feel a little more of it than you do. But the fact is that a message capsule is slower than a ship like *Muddlin' Through*. Had they dispatched one immediately upon arrival, it would barely have gotten to the Solar System by today. And they would not logically do so. For surely David, after he recovered, credited you with the ability to pry as much out of the SI computer as it gave him. Why, then, should he waste a capsule to confirm the mere fact of the rogue's existence? No, he and Chee Lan will first have gathered ample data. With luck, they need not have taken the trouble and risk of interception involved in sending any written report. They ought to be returning home . . . quite soon . . . if at all."

His huge scaly form got off the deck where he rested. His neck must bend under the overhead, his tail curl past a corner. Hoofs rattled on steel. He took several turns around the command bridge before he stopped and gazed into the simulacrum of the sky that made a black, bejeweled belt for this compartment.

The ship was on gravdrive, accelerating outward. Earth and Luna had shrunk to a double star, blue and gold, and Sol had visibly dwindled. Ahead glistened the southern stars. An X etched into the bow section of the continuous screen centered on a region near the constellation Circinus. But Adzel's gaze kept straying to another point of brilliance, second brightest in the Cross.

"We could return and wait," he

suggested. "Maybe Freelady Beldaniel can nonetheless be induced to withdraw her threat to cancel the meeting. Or maybe the threat always an empty one."

"No," said van Rijn from the chair he overflowed, "I think not. She is tough, I found out while we haggled. *Ja*, I bet she puts spaghetti sauce on barbed wire. And best we believe her when she says her bosses is not terrible anxious to talk with us anyways, and she can't guarantee they will come to the rendezvous, and if we do anything they don't like—or she don't like so she is not enthusiastic about telling them they should negotiate—why, then they go home in a huff-puff."

He drew on his churchwarden, adding more blue reek to that which already filled the air. "We know practicalistically nothings about them, they know lots about us," he went on. "*Ergo*, where it comes to meetings and idea exchanges, we is buyers in a seller's market and can't do a lot else than ask very polite if they mind using not quite so big a reamer on us. Q.," he finished gloomily, "E. D."

"If you worry about David and Chee," Adzel said, "you might get on the radio before we go hyper, and dispatch another ship or two for reinforcement to them."

"No pointing in that unless we get a holler for help from them, or a long time has gone by with no word. They are good experienced pioneers what should could handle any planet by their own selfs. Or if they got hurt, too late now, I am afraid."

"I was thinking of assistance against hostile action. They may encounter armed forces, alerted by the first two Serendipity partners who left several weeks ago."

"To fight, how much power we need send? No telling, except got to be plenty." Van Rijn shook his head. "They don't give out second prizes for combat, dragon boy. We send less fighting power than the enemy, we don't likely get none back. And we can't spare enough warcraft for making sure of victories over these unknown villains trying to horn us out of our hard-begotten profit."

"Profit!" Adzel's tailtip struck the deck with a thud and a dry rattle. Unwonted indignation roughened his basso. "We'd have plenty of available power if you'd notify the Commonwealth, so regular naval forces could be mobilized. The more I think about your silence, the more I realize with horror that you are deliberately letting whole planets, a whole civilization, billions upon billions of sentient beings, lie unsuspecting and unprepared . . . lest you miss your chance at a monopoly!"

"Whoa, whoa, horsey." Van Rijn lifted one palm. "It's not that bad. Look here, I don't make no money if my whole society goes down guggle-guggle to the bottom. Do I?

And besides, I got a conscience. Bent and tobacco-stained, maybe, but a conscience. I got to answer to God my own poor self, someday." He pointed to the little Martian sandroot statuette of St. Dismas that usually traveled with him. It stood on a shelf; candles had been overlooked in the haste of departure, but numerous IOU's for them were tucked under its base. He crossed himself.

"No," he said, "I got to decide what gives everybody his best chance. Not his certainty—is no such thing—but his best chance. With this tired old brain, all soggy and hard to light, I got to decide our action. Even if I decide to let you do the deciding, that is a deciding of mine and I got to answer for it. Also, I don't think you would want that responsibility."

"Well, no," Adzel admitted. "It is frightful. But you show dangerous pride in assuming it unilaterally."

"Who else is better? You is too naïve, too trusting, for one exemplar. Most others is stupids, or hysterics, or toot some political theory they chop up the universe to fit, or is greedy or cruel or— Well, me, I can ask my friend yonder to make interceding in Heaven for me. And I make connections in this life too, you understand. I am not playing every card alone; no, no, I got plenty good people up my sleeve, who is being told as much as they need to know."

Van Rijn leaned back. "Adzel," he said, "down the corridor you find a cooler with beer. You bring me one like a good fellow and I review this whole affair with you what has mostly waited patient and not sat in on the talks I had. You will see what a bucket of worms I must balance on each other—"

Those who are not afraid of death, even at their own hands, may get power beyond their real strength. For then their cooperation has to be bargained for.

The partners in Serendipity had not suffered total defeat. They held several counters. For one, there was the apparatus they had built up, the organization, the computers and memory banks. It would be difficult, perhaps impossible, to keep them from destroying this before its sale went through, if they chose. And more was involved here than someone's money. Too many key enterprises were already too dependent on the service; many others were potentially so; though the loss would be primarily economic, it would give a severe shock to the League, the Commonwealth, and allied peoples. In effect, while untold man-years would not be lost as lives, their productivity would be.

Of course, the system contained no information about its ultimate masters. A few deductions might perhaps be made, e.g., by studying the circuits, but these would be tentative and, if correct, not very

important. However, perusal of the accumulated data would have some value as an indicator of the minimum amount of knowledge that those masters had about Technic civilization.

Hence the partners could exact a price for sparing their machines. The price included their own free departure, with no one trailing them: a fact they could verify.

Van Rijn, in his turn, could demand some compensation for helping to arrange this departure. He was naturally anxious to learn something, anything concerning the Shenna—as he soon did worm out that they were called in at least one of their languages. He wanted a meeting between their people and his. Before Kim Yoon-Kun, Anastasia Herrera, and Eve Latimer left the Solar System, he got their promise to urge their lords to send a delegation. Where it would be sent they did not specify. Thea Beldaniel, who stayed behind, was to reveal this at the appropriate time if she saw fit.

Another mutual interest lay in preserving discretion. Neither Serendipity nor van Rijn wanted Technic governments directly involved . . . as yet, anyhow. But if either got disgusted with these private chafferings, that party could stop them by making a public statement of the facts. Since van Rijn probably had less to lose from any such outcome, this was a more powerful chess piece in his hand than in Thea's. Or so he apparently convinced her. She bought his silence initially by helping him get the information from the computers, about Beta Crucis and the rogue, that Falkayn had gotten earlier.

Nevertheless, negotiations between him and her dragged on. This was partly because of the legal formalities involved in the sale of the company, and tussles with news agencies that wanted to know more. Partly, too, it was due to his own stalling. He needed time— Time for *Muddlin' Through* to report back. Time to decide what word should be quietly passed to whom, and what should then be done in preparation against an ill-defined danger. Time to begin those preparations, but keep them undercover, yet not too well-hidden . . .

In contrast, Thea's advantage—or that of her masters—lay in making an early start for the rendezvous. This should not be too soon for the Shenna to have received ample warning from Kim's party. But neither should it give van Rijn more time to organize his forces than was unavoidable.

She told him that the Shenna had no overwhelming reason to dicker with anybody. Their spy system being wrecked, they might wish to meet with someone well-informed like van Rijn, feel out the changed situation, conceivably work toward an agreement about spheres of influence. But then again, they might not. Powerful as they were, why

should they make concessions to inferior races like man? She proposed that the merchant go unaccompanied to the rendezvous, in a spaceship chosen by her, viewports blanked. He refused.

Abruptly she broke off the talks and insisted on leaving in less than a week. Van Rijn howled to no avail. This was the deadline she and her partners had agreed on, when they also set the meeting place they would suggest to their lords. If he did not accept it, he simply would not be guided.

He threatened not to accept. He had other ways to trace down the Shenna, he said. The haggling went back and forth. Thea did have some reason for wanting the expedition to go. She believed it would serve the ends of her masters; at a minimum, it ought to give them an extra option. And, a minor but real enough consideration, it would carry her home, when otherwise she was doomed to suicide or lifelong exile. She gave in on some points.

The agreement reached at last was for her to travel alone, van Rijn with none but Adzel. (He got a partner in exchange for the fact that his absence would, he claimed, badly handicap the League.) They were to leave at the time she specified. However, they would not travel blind. Once they went hyper, she would instruct the robopilot, and he might as well listen to her as she specified the coordinates. The goal wasn't a Shenn planet anyway.

But she would not risk some booby trap, tracing device, clandestine message ejector, or whatever else he might put into a ship he had readied beforehand. Nor did he care to take corresponding chances. They settled on jointly ordering a new-built vessel from a nonhuman yard—there happened to be one that had just completed her shakedown cruise and was advertising for buyers—with an entire supply stock. They boarded immediately upon Solar System delivery, each having inspected the other's hand baggage, and started the moment that clearance was granted.

This much Adzel knew. He had not been party to van Rijn's other activities. It came as no surprise to him that confidential couriers had been dispatched from end to end of the Solar Spice & Liquors trading territory, carrying orders for its most reliable factors, district chiefs, "police" captains, and more obscure employees. But he had not realized the degree to which other merchant princes of the League were alerted. True, they were not told everything. But the reason for that was less to keep secret the existence of the rogue than it was to head off short-sighted avarice and officiousness that must surely hamper a defense effort. The magnates were warned of a powerful, probably hostile civilization beyond the rim of the known. Some of them were told in more detail about the

role Serendipity had played. They must gather what force they had.

And this was sufficient to bring in governments! A movement of Polesotechnic fighting units could not escape notice. Inquiries would be rebuffed, more or less politely. But with something clearly in the wind, official military-naval services would be put on the *qui vive*. The fact that League ships were concentrating near the important planets would cause those charged with defense to apportion their own strength accordingly.

Given out-and-out war, this would not serve. Then merchant lords must work as closely as might be with the lords spiritual and temporal that legal theory—the different, often wildly different legal theories of the various races and cultures—said were set over them in any of the innumerable separate jurisdictions. But in the immediate situation, where virtually everything was unknown—where the very existence of a dangerous enemy remained unproven—such an alliance was impossible. The rivalries involved were too strong. Van Rijn could get more action faster by flimflammery than by any appeal to idealism or common sense.

At that, the action was far too slow. Under perfect conditions, with everyone concerned a militant angel, it would still be too slow. The distances involved were so immense, lines of communication so thin, planets so scattered and diverse. No one had ever tried to rally all of those worlds at once. Not only had it never been necessary, it did not look feasible.

"I done what I could," van Rijn said, "not even knowing what I should. Maybe in three-four months—or three-four years, I don't know—the snowball I started rolling will bear fruit. Maybe then everybody is ready to ride out whatever blow will go bang on them. Or maybe not.

"I left what information I didn't give out in a safe place. It will be publicated after a while if I don't come back. After that, hoo-hoo, me I can't forespeak what happens! Many players then come in the game, you see, where now is only a few. It got demonstrated centuries back, in early days of theory, the more players, the less of a stable is the game.

"We go off right now, you and me, and try what we can do. If we don't do nothing except crash, well, we begun about as much battering down of hatches as I think could have been. Maybe enough. Maybe not. *Vervloekt*, how hard I wish that Beldaniel witch did not make us go away so soon like this!"

TO BE CONCLUDED

THE REFERENCE LIBRARY

P. Schuyler Miller

MORE FROM THE U.S.S.R.

The origins of "Path Into the Unknown: The Best of Soviet Science Fiction" (Delacorte Press, New York, 1967, 191 pp., $4.95) are obscure. No editor is named, although Judith Merril has written a short introduction. The book was published in England in 1966, and the English publisher, MacGibbon & Kee, acknowledge the help of an apparently Russian publisher, Novosti Publishing House. A number of translators appear to have been involved, and it may be that the eight stories in the collection have come from English-language editions of Soviet magazines or from Soviet English-language editions. (The two Collier paperback editions were unacknowledged reprints of collections published in English by the Foreign Languages Publishing House.)

Miss Merril calls this the fifth collection of Soviet science fiction for American readers. I recall only the Collier pair and the rather drab and limping "Russian Science Fiction" published by New York University, so I have apparently missed or forgotten one. At any rate, though the stories collected here and said to be more recent than in any of the other anthologies of Soviet S.F., I find them less interesting than the paperbacks, though better than the NYU selection.

This may be partly the effect of poor translation. The internal evidence—the "sound" of the stories—indicates that this was done by English-speaking Russians with an academic background some of whom were grounded in English English and some in American or Canadian, and none of whom were able to convert the pseudotechnical jargon of the original writers into anything that reads smoothly in American. Failing to understand the technical terms, or the process by which such words are coined in science, the poor academic tries to translate literally and comes up

with some very strange terminology.

Two short shorts by Ilya Varshavsky, "The Conflict" and "Robby," open the book. They are really vignettes in what seems to be a story-sequence about relationships between men and robots. It's an old theme to our writers, frequently made fresh by good writing, but in this case the translation is so bad that it is impossible to say whether this was true of the originals or if the Russians are still at a stage where such elementary development is considered advanced. If the stories have been culled from a Russian equivalent of one of our popular mass-circulation magazines such as the *Saturday Evening Post*, this simple treatment makes sense. Or could it possibly be that Varshavsky is daring to suggest an analogy between the robot that is always right and the Party that insists on the same status?

"Meeting My Brother," by Vladislav Krapivin, is a much better story, about an orphan boy with a space-faring brother, whose ship at last comes home from the stars. Sentimental, rudimentary, but closer to what we understand by modern SF.

"A Day of Wrath," by Sever Gansovsky, is one that seems to have been translated by someone familiar with American idiom. This is a variant on Wells' "Island of Doctor Moreau": a scientist has created a race of bear-people who are at war with the farmers and woodsmen of the region. A visit by a journalist brings the pot to a boil.

Arkady and Boris Strugatsky are probably the only writers in the book whose names will be familiar to American readers, as a result of the previously published collections. They also seem to be closest to the Analog model of the professional SF writer: men with technical background who write for exhilaration. "An Emergency Case," a collaboration, is really an Analog or Astounding-type story about the ship returning from Titan which suffers an "impossible" plague of flies. It is a scientific puzzle, solved scientifically, if not quite as plausibly as John Campbell requires. Arkady Strugatsky's very short "Wanderers and Travelers" is a parable or allegory which draws a gently suggested parallel between a biologist marking animals for study and some strange phenomena on a ship returning from the stars. This one wouldn't be out of place in any American magazine.

With "The Boy," by G. Gor, and "The Purple Mummy," by Anatoly Dneprov, we are back with a more rudimentary kind of SF, such as we saw in the days just before and just after the inauguration of *Amazing Stories*. To an experienced reader it is obvious that the boy of the story is recounting his own experiences as an immigrant to Earth. "Purple Mummy" is a gimmick story with a snapper ending that is simply too

pedestrian in its telling for present tastes.

We badly need an American or English editor who can read Russian well and who also knows science fiction well enough to separate the good from the ordinary. I suspect he could give us a collection that would show the present Soviet writers to much better effect than they are showing themselves in books like this.

QUICKSAND

By John Brunner • Doubleday & Co., Garden City, N.Y. • 1967 • 240 pp. • $4.50

One of the standard criticisms of much of science fiction—especially by columnists who don't read it—is that an ordinary western or adventure story is simply moved from the southwest to another planet, the Apaches colored green and given tentacles, their horses fitted out with six legs and fangs, and the story itself rammed through according to a venerable formula.

In this latest book by English novelist John Brunner we have a switch: a "straight" novel of character and neurosis turned into science fiction by making one character a time traveler.

This is something that almost had to happen, because with every book the author has been showing that he is mastering the "straight" format and doesn't or won't long need the SF crutch. Indeed, he may well be writing main-line novels that aren't published yet over here in the States, or that come out under a pen name. (English readers please inform us.)

The not-quite-antihero of "Quicksand" is Dr. Paul Fidler, a psychiatrist at a small English mental hospital, who is having marital trouble and is ridden by the fear that his employers and the townspeople will discover that he once spent a year in an institution himself. At times he drifts into fantasies that nearly become reality . . . and when "Urchin" appears out of the night, he begins to wonder whether he has gone over the borderline again. She is small, lovely, naked, and she has broken the arm of a drunken lummox who tried to rape her. She speaks no recognizable language, understands no English, and has never seen an automobile or many another artifact of our place and time. She is naturally locked up in Fidler's hospital, and the story follows his efforts to discover who and what she is and where she came from, and his increasing personal involvement with her and gradual alienation from his job and colleagues. The end is inevitable and by no means soap opera: Fidler is what he is and Urchin is what her future culture—in a forking time-stream—has made her.

When John Brunner has progressed to the point where his followers are trying to forget his science-fiction apprenticeship, this is one of the books they will cite as

transitional to his "real" novels. It won't be listed with great science fiction, or even with his own best SF.

TURNING ON

By Damon Knight • Ace Books. New York, • No. G-677 • 160 pp. • 50¢ • Doubleday & Co., Garden City ,N.Y. • 1966 • 180 pp. • $3.50

Since I let the Doubleday edition of this collection get itself mixed into a pile of unreadable reprints of British paperbacks, ground out in hard covers by an American publisher, the least I can do now is warn you to read the paperback edition. It is one of Damon Knight's best and most varied.

"Semper Fi," which opens the book, was called "Satisfaction" when it was published here in Analog in 1964. Call it a gentle projection of the step beyond TV, when everyone who has the money can live in a synthetic dreamworld. Damon doesn't slug you with the idea; he nudges—and keeps on nudging.

"The Big Pat Boom" is his now-classic little fable of the foibles of extraterrestrial collectors. And what do you collect? Swizzlesticks? Menus ? Autographs? Science fiction? Abstract art?

"Man in the Jar" is a malevolent switch on the genii-in-a-bottle story. "Mary" is a tender love story set in a rather grim and hopeless future. "Auto-da-Fé" brings mankind and dogkind to an end reminiscent of Clifford Simak's "City"—but with a difference. It is also becoming a classic.

In "To the Pure" we have a traditional soap-opera triangle with an alien as the third corner and a non-hero whose complete lack of humanity forces the inevitable break-up. "Eripmav," on the other hand, is the kind of blown-up outrage that Fredric Brown used to perpetrate with blithe insolence.

"Backward, O Time" makes almost believable in a few words what many a writer has tried—and failed—to put over at novel length: the man who lives backward, from grave to womb. Then, just to show he can, Damon sounds exactly ilke Bradbury in "The Night of Lies," and lets it trail off bitterly.

"Maid to Measure," being fantasy—unabashed fantasy, again in the Brown vein—will be of no interest to Analog readers. There is this witch, see . . . And the mood switches to sadness and the end of Man in "Collector's Item" . . . then goes zany and a bit too close to reality in a libelous picture of a SF writers' gathering, "A Likely Story." The book ends with a Padgettish exploit, "Don't Live in the Past."

Let's face it: this is one of *anybody's* best.

THE COMING OF THE TERRANS

By Leigh Brackett • Ace Books, New York • #G-669 • 157 pp. • 50¢

Once upon a time, many years

ago, there was a magazine called *Planet Stories*. Readers of this magazine—then known as Astounding Science Fiction—protested bitterly that it wasn't "science fiction," it wasn't respectable, it ought to be banned. And they tore off the lurid covers or sheathed them in plain paper and read them at night, in bed, an had one hell of a good time doing it.

This Ace pb belatedly assembles five of Leigh Brackett's gorgeous yarns about a Mars that couldn't have been when they were first published, and can never be now that we know what Mars is like. They show us a dying world rather like Edgar Rice Burroughs' "Barsoom," but depicted with a color and verve that Burroughs never managed after his first three books. There are strange races with strange powers; there are Earthmen-of-goodwill who cast their lot with the native Martians against their own exploiting breed; there is action; and hardship; and color that we rarely get any more except when someone like Samuel Delany, or Andre Norton, or Jack Vance, or Avram Davidson really lets go.

Enjoy! Enjoy!

CHTHON

By Piers Anthony • Ballantine Books, New York • No. U-6107 • 254 pp. • 75¢

This strange, ambitious, not entirely successful novel is supposed to have taken the author seven years to write. It is intricately structured, with past, present and future interwoven as carefully as the threads in an ancient Peruvian mummy wrapping. I confess that I haven't attempted to probe that structure as the author evidently feels I should, to relish the parallels between various parts of the threat of action. I am consequently left with the feeling that I have missed a lot, and that I should read the book again.

The three main threads that are woven into the book are three segments of the life of the man called Aton, some time in the far future when Man is among the stars. We meet him as a criminal, doomed to the hell of the prison planet Chthon. We look back into his past—into his boyhood—when he encounters the beautiful woman who he learns later is something called a "minionette," hated and feared by all mankind. We follow him as he encounters her again and again, and as the encounters warp his life and goals. We pick him up after he has escaped from the subterranean prison and resumed his quest. We shuttle back and forth bewilderingly among past, present and future, getting a hint here, a fact there, a contradiction somewhere else. It may help you to read the author's comments at the end before you start the story. Minor details annoy me no end—but I can't help but feel that a rereading would reveal a reason for them, symbolic or structural. You tell me.

THE PALACE OF LOVE
By Jack Vance • Berkley Books, New York • No. X-1454 • 189 pp. • 60¢

After a long lapse, Jack Vance has taken up the story of Kirth Gerson's vendetta against the five "Demon Princes" of Space who murdered his parents and destroyed his home world. The first two were hunted down in "The Star King" and "The Killing Machine." Now he goes after Viole Falushe, the galactic vice lord whose secret pleasure temple gives the book its name.

The new book is quite unlike the other two, less violently the revenge story and more a travelogue through some of the stranger corners of a strange interstellar society. It has an abundance of strange and strangely fascinating characters to go with the strange settings, and as might be expected they are truly creatures of their time and place.

I think Jack Vance is having fun with this series, and I hope he gets down to finishing off the other two Demon Princes before other more ambitious themes lure him away.

THE JEWELS OF ELSEWHEN
By Ted White • Belmont Books, New York • No. B50-751 • 172 pp. • 50¢

Ted White is the active fan—co-chairman, among other things, of the 1967 World Science Fiction Convention—who for some time has been Associate Editor of *Fantasy & Science Fiction.* I had passed up his two paperback novels about the world of Qar under the misconception that they were Conan-type fantasies. These I enjoy personally, but they are out of bounds for this department unless they are in the Tolkien category, or are reprints from *Unknown.*

I came on his juvenile, "Secret of the Marauder Satellite," more or less by accident and found it the best SF the publisher has had in years, and the best juvenile science-fiction yarn of the year, bar even André Norton. Just as I was reaching for the "Qar" duo, this new paperback came along.

A description of plot and gimmick can do nothing to convey the special quality of the book—a quality which is very likely to take the author right out of the science-fiction world, if only fashions in "mainstream" fiction change for the better and the literary world decides to accept real people in a real situation as legitimate candidates for critical status. The protagonists of the book—an off-duty cop and a small-town girl trying to make her way in New York—are as completely real as anyone anybody has put into a SF situation. You'll swear that you know them, and they are people you can care about—not the puppets who go through the paces of the usual story.

Arthur Ficarra and Kim Nemzek are in the same subway car, riding home after work, when the world begins to go wrong around

them. The other people in the car are dummies; the car itself is a mock-up; and when they get out of the subway, so is New York. But there are other people in the set, and when they try to make contact with these strangely dressed persons, worlds begin to spin around them. It turns out in the end that they are being shuttled through a series of alternate world streams, generated centuries ago by that Renaissance genius, Leonardo da Vinci—and that he can and will destroy his experiments, of which they are a part, as offhandedly as he destroyed the shell of a world in which they met.

Sure, it's been done before, though never quite in this way. But there have never been real people to make it believable. That makes the book unique.

THE ARSENAL OUT OF TIME
By David McDaniel • Ace Books, New York • No. G-667 • 156 pp. • 50¢

David McDaniel is touted by the publisher as the author of four of the dozen or more books written from scripts in the popular "Man from U.N.C.L.E." TV Series. On the strength of this enjoyable yarn, I intend to look up those other books.

What stands out is professional smoothness and ability to make a story move, however strongly you may feel that it is all formula stuff, the characters stereotypes, and so on. The hero is a young archeologist who suckers himself into becoming a member of an expedition to find and capture an ancient cache of weapons, buried under a mountain by a superrace of the distant past. As in our own nuclear bomb race, Earth wants the weapons to protect itself from the guys in the black hats, the Old Colonies, who will use the stuff to clobber the Old Country out of existence if they get there first. And the cache is on an Old Colony world . . .

Lawrence Edwards, hero-in-spite-of-himself, sets out under the wing of a veteran secret agent who is certainly no Flandry or Retief. Along the way they pick up a delightful if interfering redhead (female) who in an "U.N.C.L.E." yarn would probably have been at least a triple agent. There are kidnappings and escapes, searches and escapes, discoveries and escapes, and a space battle such as we haven't seen since Edmond Hamilton was tossing worlds at each other. It's all good, clean, fast-moving fun, and if you can take that kind of thing without bicarbonate I commend it to you.

SOME REISSUES

GLORY ROAD
By Robert A. Heinlein • Avon Books, New York • No. V-2202 • 288 pp. • 75¢

The book ends: "Got any dragons you need killed?" And that's its mood. Science fiction? Fantasy adventure? Decide for yourself.

STRANGER IN A STRANGE LAND

By Robert A. Heinlein • Avon Books, New York • No. V-2191 • 414 pp. • 75¢

This book, Heinlein's strangest, may turn out to be the most influential work of science fiction in our time. Avon brought out the original paperback edition in 1962, the year after the book originally appeared, but only in the last year has it become one of the "hippie" gospels. This reissue is doubtless intended to take advantage of the new demand . . . or, shall we say, to make it more readily available to those who need it and its strange "love-in" philosophy. If you haven't read it, do.

THE COMETEERS

By Jack Williamson • Pyramid Books, New York • No. X-1634 • 157 pp. • 60¢

This second in the "Legion of Space" series originated here in Astounding in 1936. It may be corny, but it has that Falstaff of the spaceways, Giles Habibula.

ONE AGAINST THE LEGION

By Jack Williamson • Pyramid Books, New York • No. X-1657 • 220 pp. • 60¢

And this was here in 1939 and was combined with "Cometeers" in the 1950 Fantasy Press hardback edition. Pyramid has made it a collector's item by adding a hitherto unpublished Legion of Space yarn, "Nowhere Near," as up-to-date as quasars in everything but mood and swing.

HIGHWAYS IN HIDING

By George O. Smith • Lancer Books, New York • No. 73-636 • 256 pp. • 60¢

Back in the "good old days" there was E. E. "Doc" Smith, and there was George O. They were both scientists, they were both prime story tellers, and they both wrote grand books. In this one, George O. switched from interplanetary communication ("Venus Equilateral") to telepathy and dirty work.

THE DAY OF THE TRIFFIDS

By John Wyndham • Crest Books, New York • No. R-1049 • 191 pp. • 60¢

And this goes on and on and on. Why shouldn't it?

NO BLADE OF GRASS

By John Christopher • Avon Books, New York • No. S-288 • 190 pp. • 60¢

SWEENEY'S ISLAND

By John Christopher • Fawcett Crest Books, New York • No. R-1029 • 207 pp. • 60¢

A reissue of this English writer's earliest (1956) and best "big" SF story of a world without grass and grain, and a paperback edition of one of his more recent (1964) and less successful yarns, about castaways on an island used for biological experimentation.

brass tacks

Dear Mr. Campbell:

There is an article in TIME for February 2, 1968 (page 49) which has interesting implications. It is entitled "Aerodynamics: Charged Aircraft," by Maurice Cahn and Gustav Andrew. Their idea is to project an electric field in front of a supersonic aircraft, which would charge the air and repel it, and thus prevent it from building up in front of the aircraft, preventing in this manner the sonic boom. Cahn goes on to say, "When supersonic traffic gets heavy, this could provide observers on the ground with a spectacular view at night." This in reference to the corona. Isn't that nice? What strikes me as being either ironic or humorous, is that several years ago I read the same thing in another book. Only in this case this idea was used to explain the reason why "flying saucers" do not produce sonic booms. What am I to think?

GORDON SERJAK

Room 311
2707 Rio Grande
Austin, Texas 78705

Think, "Hm-m-m—who knows? Maybe there's something in the idea!"

Dear Mr. Campbell:

Your magazine has been entertaining me since about 1932, and I have yet to miss an issue since that time.

Having only a basic high school education, including very elementary physics, chemistry, and math, I am willing, for the sake of the story, to accept a great many things put forward by your many authors.

In the "Horse Barbarians" I am even willing to accept a rubbery vine which evidently grows in five kilometer lengths as it is stated that there is a knot in the middle of the ten kilometer length required to lower the hero down the face of a cliff ten kilometers high. I am willing to accept that this marvelous vine is able to support its own

weight plus the unspecified weight of a large riding animal. Now, if this vine weighs only ONE ounce per foot, a ten kilometer length will weigh somewhat over 20,000 pounds. In the story this marvelous rubber band managed to jump off the pulley being used to lower various objects into the depths, and ONE MAN calmly replaces it back in the pulley grooves, evidently with one hand! THIS I refuse to believe.

My imagination is at least as elastic as anyone's, but this stretches it just a little bit too far. Now I know these guys are powerful, but according to the story this is on a one and a half G world! C'mon now!

If this sort of thing keeps up, I'll have to write in again in another twenty years and complain about something else.

SID DAVIES

3447 W. 63rd Place
Chicago, Illinois 60629

You know—I missed that one, and so did Harry Harrison!

Dear Mr. Campbell:

It's good to see P. Schuyler Miller supporting Kingsley Amis' and my views on science fiction in your issue of February 1968—and, of course, your own absolutely sound delight at the fact that Susan Sontag has decided to let it alone.

Miller wonders what we feel about William Burroughs. We did say quite a lot about him in an earlier *Spectrum* Introduction (*Spectrum III*). To take one of the milder comments:

> "The tone here, at once grandiose and subliterate, is typical of a new attitude parasitical on science fiction, in which it is clear that space travel, for instance, is being seen wholly from the outside, as a gltitering novelty, and picked up magpie fashion to variegate the décor of some muggy old nest."

It is indeed a good thing to keep modern "criticism" out of science fiction. And not only because science fiction is a special field in which the critics are applying inappropriate criteria. For, in the case of most of them, their criteria are misconceived even as to mainstream literature. Both Amis and myself have actually taught English Literature in universities—he for a good time and I for the odd year—and have written (between us) dozens of non-s.f. books—including criticism; and (come to that, I have been literary editor of one of London's leading weeklies, the *Spectator*).

We conclude from all this that that allegedly "rigorous" criticism machinery now in use is simply a pseudoscience, like phrenology. You need far more, and more sophistical dialectic to prove that nonsense is true than to demonstrate truth: e.g. the Baconians and their cipher mania. From this point of view, s.f. (in spite of the occasional lapse into attempts to please

the Lit. Crit. sophomores), is not only healthily keeping its head while all about are losing theirs, but is also an example to the rest of the literary scene.

I expect *Analog* to be flourishing when all this sterile—and, indeed, sterilizing—froth has been washed away.

ROBERT CONQUEST
4 York Mansions
Prince of Wales Drive
London, S.W. 11, England
All amurendations gratefully received!

Dear John:

Your recent editorial on the subject of dowsing has led me to some philosophical musings for which, as a scientist in training, I am probably not competent. But the urge is upon me, and you have yourself to blame for turning me on.

The development of our present perspective of nature has taken the form of progressive depersonalization of the external world in relation to man. While primitive man viewed each event, from the movement of the heavens to that of his bowels as driven by anthropomorphic forces which could be propitiated by virtuous behavior; the modern position, aside from quantum mechanical quibbling, places man in a world governed by discoverable rules whose sequence of cause and effect leaves no opening for cabalistic muttering. The modern view has to its credit rather greater explanatory power than the older, although some phenomenal—like dowsing—are apparently inexplicable. Psychologists of child development like Piaget take the position that the development of mental powers in infants and children follows a similar line. Thus, the infant is thought to equate control of its muscular function to control of the outside world, leading to both frustration at failure, and fantasies of success. The adult, on the other hand, is said to have learned his limitations, to know that wishing won't make it so, although striving in some areas may lead to increased control of some parts of the environment. The philosophical position of modern science, then, is to accept the notion

of adulthood in principal, but to probe the limits of this control in order to determine which are fundamental and which are due to a lack of knowledge. Please note that I have used the words primitive and modern to denote chronological order rather than relative merit, although it is quite clear that most people would assume the greater merit to attach to the modern position.

I would now like to examine the role of dowsing in both of these philosophical schemes. In the primitive view, there is a connection between an object and the concept of that object in our minds. Some people, either by inclination or by training are able to sense this connection. The nature of the connection may perhaps be studied scientifically—one might experiment using aluminum instead of steel in the dowsing rod—but our assumption that this is an intrinsically extra-scientific phenomenon dooms studies of this sort to begin with. How then, do we extend our capacities in the field of dowsing under the stated hypotheses? It would appear that the only ways are trial and error, searching folk tradition, or some sort of mystical devotion. For this reason, I suggest that even if the primitive view is consistent with some observations, like dowsing, which are excluded in modern science, we do not gain much by adopting it.

In the modern view, I think it is necessary to treat the two types of dowsing: divining and map-dowsing, separately. With regard to divining, we may, if we accept the existence of the phenomenon, attempt to explain it by analogy to other subtle sensory discriminations. Certainly, in the absence of any significant study of the problem, it is impossible to exclude this explanation. Alternatively, we might suppose that divining is the first indication of a human ability which depends on forces presently completely hidden from our comprehension. Because of the essentially conservative nature of science, it will be extremely difficult to get serious attention to this hypothesis. In passing, I would like to suggest that this conservativeness has probably prevented more wrong turns than it has suppressed correct ones. With regard to map-dowsing, I think it highly unlikely that subtle sensory discrimination could be sufficient to provide an explanation, and the hidden forces argument is mandatory.

In a cursory way, I would now like to explore the consequences of the hidden forces hypothesis. The statements about dowsing seem to imply that it is possible to distinguish between rather similar objects, such as gas and water pipes, Viet Cong tunnels and underground rivers, et cetera. In order for such discriminations to be made, it would seem to be required that there exist some emanation from each object

which identifies it as to a more or less detailed set of characteristics. The phenomenon of map-dowsing seems to imply that this emanation is characteristic not only of the object itself, but also of more-or-less faithful man-made representations of the object. A priori, there is no basis for placing a lower limit on the degree of complexity of objects producing such emanations, down even to the atomic limit, up even to the universe itself. Furthermore, an object may of itself be several different things, and should emanate separately that it is each of them. The problem of performing sensory discrimination of such a multitude of signals is obviously formidable. The problem becomes even more formidable when we inquire as to the mechanism by which, for example, iron ore coming from the ground is able to change its emanation to that of the water pipe or gas pipe into which it is made, without some direct influence of human will in specifying the purpose of the particular piece. One could extend such an exercise indefinitely, showing up all the difficulties it holds, though I am not sure I see to what purpose.

When the special theory of relativity was introduced, philosophers and classical physicists posed a variety of paradoxes which they claimed pointed to the unworkability of the theory, which has so far proved quite workable. Perhaps some similar reorientation of our point of view would do the same thing for the implications of dowsing. In the absence of such a reorientation, the mental gymnastics necessary to integrate the phenomenon into my world view are too complex.

One last comment. From your descriptions of how widely dowsing is used, it seems unnecessarily pessimistic to assume that it could not be studied by traditional scientific methods. Many useful observations could be made without expensive equipment, and the data obtained used to motivate further study.

BARRY BUNOW
25 Shattuck Street
Boston, Massachusetts 02115

I'd score you A+ for constructive, well-reasoned thinking on this little essay! You lack some data, but your thinking is straight—you'll make a real scientist!

The data you lack: the dowsing rods can be made of anything whatever—wood, nylon, aluminum. It makes no difference. Because the rods don't do it—the operator does; the rods are an indicator, not an operative mechanism.

The best analogy is that of pencil and paper, which obviously can't do mathematics, but without which most people can't multiply two three-digit numbers. Yet the pencil and paper can be replaced by a stick and some mud, or a chisel and stone.

You're one hundred percent right in saying the primitive philosophy

assumes a continuum relationship between "I" and the Universe, while Science insists on a complete dichotomy. And therein lies the error of both! We are part of the Universe; the Universe is obviously within us as well as outside. The dichotomy is improper—just as the primitive notion of no-difference is improper.

The essence of it is—subjective reality is something we experience within ourselves. No function can exist in the Universe that is not a function of the laws of the Universe. Therefore, Science is wrong in holding that subjective reality is only internal.

It is in that area that the "hidden forces" lie.

Agreed that conservativism is necessary—it's also necessary to reassess your postulates when something real and workable appears that does not fit your postulate-and-logic system.

There's an immense amount of data on dowsing readily and very cheaply available—it's used routinely by field engineers constantly. The problem is getting scientists to look!

Gentlemen:

I have read with interest and amusement the article in the February 1968 Analog by Mr. Baldwin, "Dowsers Detect Enemy's Tunnels." In the center of page 130 he says "The history of the coat hanger dowser dates back more than a year . . ." It is too bad that Mr. Baldwin and the Marine Corps engineers are so far behind the times. The foreman of our sewer repair crew was using this same method, to locate lost sewers, in 1950. It was not a new thing then.

In this same line of thought, I once saw a very interesting experiment tried on a well-known local water "dowser"—not the individual mentioned in the paragraph above. This fellow is a "forked apple-stick man." We took him one day to a location unfamiliar to him to look for water. He got himself set up and started to survey the general area. We urged him to pass over a high-pressure water main that we knew the location of, but we were quite sure that he did not know the thing existed. He found it at once and described it as a very large vein of water moving very rapidly and he thought at great pressure. He also said that the ledge (beadrock) must be shallower than he had thought for he did not see how such a flow could exist in earth.

This is not really "proof" of anything but I am quite sure there is a body of fact here that has been totally ignored by those who should be qualified to investigate.

SYLVESTER COX
R.F.D. #1
Lisbon Falls
Maine, 04252

Your old-style dowser did pretty well descriptively—even if he did

sort of miss an identification. After all, drill a well there and you'd get a real good flow of water!

Dear Mr. Campbell:

Regarding dowsing, some years ago, I participated in a comparison of the scientific method versus the dowsing method in a practical situation. The company I worked for had an option to purchase a fifty-acre site for a plant. The site was owned by the Maryland & Pennsylvania Railroad. The option was to be exercised only if an adequate supply of water for our process use could be found on the site. Location of the water to be paid for by the railroad.

Since we were substantial shippers the Maryland & Pennsylvania pulled out all stops and called in both a geologist from the State of Pennsylvania and a dowser from Lancaster County to pinpoint drilling locations. The dowser indicated fifteen spots to drill at which water would be found: The geologist five. Only one spot was indicated in common. Box score after drilling: Dowser 12, Geologist 2. Interestingly enough, no appreciable flow of water was found at the spot both picked in common. However, both indicated that there was not sufficient water on the property for our needs, and both were right so the option was not exercised.

The dowser was amazingly accurate in predicting the gallonage flow of water at each location where water was found, coming within a few gallons/ hour of what was actually metered after drilling.

I thought you might be interested in just another example of industry using what science says doesn't exist.

ROGER E. ALLEN
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Palos Verdes Estates
California 90274

Standard Authoritative reaction to the dowser's twelve out of fifteen: "See—he was completely wrong three times! That proves it was a hoax. The others were just coincidence."

Dear Mr. Campbell:

It is an unfortunate fact that

there exists, at all a controversy over substances which alter the subjective states of consciousness. The air is clouded with opinions, but mostly from those least qualified. As someone with little qualification I shall now do my bit for air pollution.

As a novice in my chosen field, biology, I have come across three truths which apply to biology (and, I believe, with some rewording to other fields):

I. The life process is remarkably and beautifully complex.

II. The life process is amazingly efficient.

III. What we don't know about the life process far outweighs what we do know.

These three clichés have the ring of a "cloud-land" speech whose next sentence will contain the famous "Per aspera ad astra" but, unfortunately for the literate sensitives, they are true. These statements can but lead us to one conclusion concerning the use of any sort of drug. That is, the only circumstances in which drugs should be used are those where the efficiency of the organism is impaired and that organism is unable to resume normal action without assistance. We work too well to justify control-tampering.

It is found that the field for which the so-called "psychedelic drugs" seemed to hold such promise, religion, has rejected drug-induced states as having little relevance (Smith, *Journal of Philosophy,* LXI, 1964). Indeed, it is difficult to see the difference between the man on an acid "high" who sees God and the one "down" on ethanol who sees pink elephants.

There can be little doubt that lysergic acid acts in interference rather than enhancement of the nervous system. It is known that lysergic acid is associated with the production of the neurohormone, serotonin. Under normal conditions serotonin works for ordinary function of the nerves. In the excess produced by drugs, unusual, distortive effects result.

I am "appalled" at the naivety of anyone who calls these effects "mind-expansion and "mind-cleansing." These are the babblings of an immature mind (which does not preclude mature opinions) in a rut (which does).

Mr. Nuttall has been circulating. He has. In a circle straight out of "Alice in Wonderland." Baby, that's not where it's at. It's in a mind clear of outside interference. If one wishes to transcend the material why not do it on his own? You can't fake it with chemicals.

It's really a pity.

J. TIMOTHY STOCKS
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And if LSD gives true revelations —morphine gives true Nirvana, which many millions of people believe to be the ultimate religious experience!

The Non-Gold Crisis

Continued from page 7

This had enormous advantages; sink a ship with a cargo of promissory notes, and they could be fully replaced by a few clerks; no great loss would be sustained. Pirates who stole promissory notes might just as well build a bonfire; they couldn't get rich with them. *Goods* could be exchanged, without having to ship gold back and forth and around about.

Credit—the belief in a man's ability and willingness to pay—became the primary medium of trade. Money's been defined as "What you use instead of going to the store for an egg's-worth of mustard."

True. But credit does just as well —*so long as it is believed in.*

One of the first effects of a credit-operated system was to make coins *look* wealthier—look bigger and more important. With credit, the image (to use a modern advertising term) is important. In a primitive gold-money system there was no image involved. "I don't care who you are, or what, or where you came from, or how you got here—show me your gold."

So long as most people lived by barter, and most commerce was purely barter, only long-distance travelers needed much money-gold. And there were mighty few of those!

As the world's economy picked up speed, credit came into the picture more and more because there simply wasn't enough gold to represent the actual wealth being dealt with. The late Renaissance period was in a bind for lack of gold, and was squeezed into perfecting the credit system, despite the sudden influx of very appreciable new gold from the New World.

The United States' current Gross National Product figures now stand at about 800 billion dollars a year. The total of known gold supplies is well under 100 billion dollars worth. If *only* gold dollars were used—no bank checks, no credit cards, no paper money, but *only* gold coins—how far do you think the world's trade would be able to get? Think of the immense gold trucking industry required to replace one day's turnover of checks in New York City alone. If the great Pteranodon World Airways ordered fifty new-type jumbo jet planes from Boeing, and put down fifty million dollars to bind the deal, tons of gold would be shipped into the conference room by one trucking line, and hauled off to the Boeing vaults in another set of armored trucks.

Gold in the old sense of Gold = Money *had* to be bypassed.

In recent years, gold has been used only to fill in the cracks left between immense international business deals. "We're sending you eight hundred ninety-five million dollars worth of coal and machine tools, in return for which you will send us

eight hundred eighty-one million dollars worth of grain and meat, nine million five hundred thousand dollars in vegetable gums and waxes, and the small change in gold."

Gold is not, and has not been for a century and more, *money*, in the old, original sense. It's a handy international small-change maker—when you realize the vast disparity between the magnitude of international trade bills and the total amount of gold in the world, it's obvious it *has* to be used only for making small change. When *one* United States corporation reports an income of several billions of dollars—if they tried to do something interestingly different and amusing, just as an attention getter, and pay off their stockholders' dividends in gold, purchasing the needed gold on the London exchange for that one transaction would make the March, 1968 gold-buying crisis look unimportant. You know—"I say, we're paying off our stockholders today; we need three hundred fifty million dollars in gold, please."

Gold is strictly and solely for small-change deals now.

Now let's do a little science-fictioneering. On July 4, 1970, Quidnunc Q. Quirn, weekend basement inventor and researcher finds a peculiarly nauseating purplish-chartreuse dyestuff which costs about fifteen cents a pound to produce from discarded banana peels, dejuiced orange skins, or discarded carrot tops. It dyes cotton fibers very firmly. It also turns out to be a remarkable substance in that it chelates gold atoms, and nothing but gold atoms, even in most extreme dilution. A strip of dyed cotton, drooled in the local sea water, gains about two ounces of weight in a day or so, and turns a very handsome Imperial Purple. Treatment in mild acid—Mr. Quirn first used some wine he'd been unsuccessful with, due to the presence of mother of vinegar—restores its original horrible color, and precipitates metallic gold on the floor of the treatment vat. On returning the dyed cotton to the sea, the chelating action recommences. Each strip of the dyed cotton can be used about one hundred times before it gets too shabby for use.

Mr. Quirn's process was first generally recognized when the Treasury became quite insistent on knowing where he had gotten the two thousand seven hundred ninety-three pounds of chemically pure gold he'd turned in during the preceding four months. Investigation showed that the Quirn process—which became known as "the Magic Quirn Process"—could grind out gold at a cost of roughly 0.5634 cents per ounce, when operated on an industrial scale, at a suitable location. Almost any place where a major ocean current kept sweeping sea water over the dyed cotton fabric worked fine. The dye turned out to be quite intensely toxic to ma-

rine growths, which kept them from fouling the strips and also made it fine for protecting ships' bottoms and pier structures where it wouldn't be seen by people with delicate stomachs.

Since the available tonnage of gold in the sea is quite astronomical, the world's gold markets immediately collapsed completely and closed all operations permanently.

And that was the end of gold.

But it was not, of course, the end of money. Thenceforth gold was traded on the commodities exchange, along with copper, tin, lead, and other metals. Since the source was effectively inexhaustible, the price varied only as new demands opened up and as new extraction plants were built to relieve the resultant shortage.

And the world set up a new balance-of-payments small-change system, and went on, little changed and little better off for the rash of solid-gold bedsteads and gold-tiled palace floors in some southern-hemisphere nations, but markedly improved by the development of heavy goldplated steel sheet for automobile bodies that didn't rust, weren't corroded by the salts used in melting snow and ice, and the widespread introduction of steel-backed gold pipes and vats in chemical heavy industry.

O.K.—in a world where gold sells for one cent an ounce, plus shipping charges for the heavy stuff, could there be a gold crisis such as we had in March, 1968, and at various times earlier in modern financial history?

Certainly—because *it is not a gold crisis.*

This one's been brought on to a considerable extent by Charles de Gaulle, who bitterly hates the United States and Great Britain.*

De Gaulle has been successful in blocking Britain's entry into the Common Market, which would have helped Britain's economy. He has loudly demanded that the world return to the gold standard (knowing perfectly well that that's impossible). France was taken out of the gold-support pool, and during the recent crisis has been busily pumping the fluctuations as hard as possible, buying gold heavily, and keep-

*During WWII, de Gaulle wanted Churchill and Roosevelt to recognize him as the political leader of France—as *the* French man speaking for the French people. In effect, as the President and Commander in Chief of all French forces. His sole claim to that status was that he wanted it; at that time he had almost no forces behind him. Moreover, none of the French African areas had any use whatever for de Gaulle; they considered him an outlaw, since he had not laid down arms as his government and commanding officers had ordered. At the best of times an extremely willful individual, de Gaulle was further infuriated by the fact that he *had* to accept the place America and Britain allowed him, and thank them politely for it, because there wasn't the slightest chance of getting anywhere without their handouts. There wasn't any other possible source of arms, supplies and food.

At the Battle of the Bulge, de Gaulle rejected flatly Eisenhower's request that French forces in the neighborhood be sent into the battle to stop the advancing Nazis. The French forces were, of course, equipped with American armor, trucks, weapons, and fuel. Eisenhower suggested that if de Gaulle did not send that American-made armor and weapons into the battle, further supplies of materiel needed to keep the equipment functioning were going to be most extremely scarce from then on. When a stubborn and arrogant man is forced to yield to an inescapable necessity, he tends to remember it.

ing the Paris gold market open when all other major European markets were closed for stabilization.

However—*this is not a gold crisis.* De Gaulle's efforts wouldn't have had much effect if he hadn't had a real situation to exaggerate.

It's a *credit* crisis.

Credit is based on two things: "He has always paid his bills on time and in full in the past. There is every reason to believe he can and will pay his bills promptly and fully in the foreseeable future."

In a world where credit *has* to be the major economic factor, credit is all important.

The first major crisis came when Britain got into more and more trouble, there was a heavy run on British gold, and Britain had to devalue the pound.

In any neighborhood where a man is known to be spending thirty thousand dollars a year, and has an income of twenty thousand dollars a year, his creditors start getting worried. They're perfectly willing to sell him anything he wants for cash, of course—but they'd prefer not to be one of his creditors. Sure, he's always paid his bills in full and on time in the past, and it's true he has thirty thousand dollars in his bank account, but . . . well, in the foreseeable future, that guy's going to be in financial trouble if he doesn't cut down his expenditures, or jack up his income.

Britain, due to increasing domestic labor costs, and high welfare, and social assistance programs, was raising the prices of exported goods, while increasing importation of foreign-made products. There had been a marked rise in the domestic standard of living—but not in the domestic standard of production. Greater expenditures—lesser earnings. Conclusion: there's going to be economic troubles. Unless the British learn to spend less, and earn more, they will presently be unable to meet their international debts.

In the simple, now-familiar phrase—"They have a negative balance of payments." Which simply means there was more money going out than there was coming in. Since gold is used to "make change" in international deals, gold was going out of Britain, and not coming back in.

By devaluing the pound, Britain automatically made an across-the-board cut in the price of all goods she exported, and boosted the domestic price of everything Britons wanted to buy abroad. And efforts —serious efforts this time!—were made to increase the ratio of production to consumption of the British people.

That change of production/consumption ratio was something Britons *had* to do; the rest of the world was right in predicting financial collapse if they didn't do something about it.

But it was an immense satisfac-

tion for "Le Grand Charles" to have been a major agent in bludgeoning Britain into accepting that bitter pill at his insistence.

Now he's doing his best to do much the same to the United States —with an added point of anger to motivate him. The great General Charles de Gaulle got his tail burned very thoroughly, and driven out of Vietnam some years back; he has had the displeasure of managing the dissolution and collapse of the French Empire. I do not believe a man of his character enjoyed the experience.

The idea that the United States might now demonstrate that the Communist generals who defeated France can be defeated by Americans would be a most exceedingly unpleasant idea to him.

He has many very deep, very abiding reasons to do all he can to cause the United States loss of face —to destroy our credit before the world. So if he has a chance—he will do what he can.

And, like it or not, we are giving him his chance. We are, right now. doing exactly what Britain was doing, and getting into the same trouble: We're spending more than we are earning.

Now note carefully: the war in Vietnam is not a very major factor in our international balance of payments. We do not buy war supplies from other nations in any appreciable amount; we make our own. Therefore, we are not massively affecting our *international* balance of payments.

The man who's spending thirty-thousand dollars and is earning twenty thousand dollars may be eating five thousand dollars worth of fancy fruits and vegetables every year—but if he's growing them all in his own back yard, they do not affect his situation with respect to his creditors. It's the fancy suits his tailor makes, and the visit to Europe on vacation, and his annual new car that cause creditor problems.

I'm not saying the Vietnam business isn't important—it is. I'm simply saying that so far as the balance-of-payments problem goes, that is not an *international* expense.

If the Congo should go to war with Tanzania, that war would immediately and drastically attack their international balance of payments; they'd have to buy all their weapons from other nations. They have no domestic heavy industry.

What *does* affect our balance of payments quite immediately is the steel strike, the copper strike, the automobile strike and the settlements that come out of them. Reason: when the costs of labor go up, the price of the finished product goes up—unless there is a compensating increase in productivity. I.e., if a man were getting twenty dollars per eight-hour day, and producing one hundred units, the labor-price would be twenty cents per unit. If he can be helped so he

turns out two hundred units a day, then a raise of forty dollars a week does not increase the labor-cost of the units.

But the labor costs per unit in the United States have been rising much faster than they have in the world market. Increased productivity via automation—bitterly fought by labor—has partly compensated that, but not completely. Result: U.S. prices have gone up in the world markets, slowing down our international sales.

Meanwhile, well-paid labor is happily buying more goods. Since the productivity increase in this country has not matched the wages made available, the new consumption has to be imported from elsewhere. Those beautifully made Japanese cameras and electronic gadgets—Volkswagens—French wines—Italian suits, shoes and dresses—from all over the world they come.

Why don't we have any good, precision cameras at popular prices made in this country?

Sorry—we make the world's finest cameras, but you can't have 'em. Strictly for government work. Labor costs in the U.S. make it impossible to manufacture quality cameras for general sale here.

We invented the transistor of course—which has been an inestimable boon to Japan. We can't match the labor costs/productivity ratio they have.

Just to get things perfectly clear: England is *not* fighting in Vietnam or elsewhere; their financial collapse resulted because the labor costs/productivity of British Labor brought about recurring and increasing unfavorable balance of trade. Which gave de Gaulle precisely the opportunity he needed to achieve a long-cherished revenge for the insults he suffered during WWII.

But it was not de Gaulle's fault that Britain was living beyond its income. He simply delightedly pointed it out to the world.

If the United States persists in the happy operation of a standard of living we are not earning, de Gaulle will have the opportunity to avenge all the hurts he suffered during WWII.

Also, let it be perfectly clear that I'm not saying that I like the facts, or think that a U.S. austerity program would be a good thing for people.

It is my position, however, that any economic unit—individual, corporation or nation—that consumes more than it produces for any extended period will most evidently lose credit-standing in the world.

And it's been a long time since there was enough gold to make world trade possible on a cash basis.

There is only one possible solution—increase the productivity-to-costs ratio.

The people of the United States are not going to like the next decade or so. THE EDITOR.

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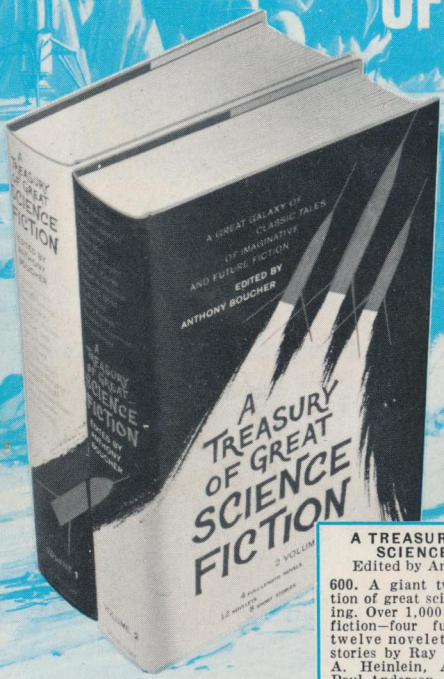

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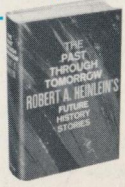

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