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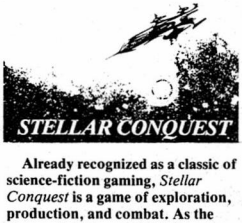

Already recognized as a classic of science-fiction gaming, *Stellar Conquest* is a game of exploration, production, and combat. As the players fight for control of a globular cluster, victory will go to the one who makes best use of the available resources to outbuild and outguess his (or her) rivals.

Components include 17" by 22" six-color plastic map; 400 ship counters; 20-page rule booklet; 4 spare data sheets; 78 "star cards," and a supply of record sheets.

For 2, 3, or 4 players; playing time 3 to 5 hours.

Designed by Howard Thompson; booklet cover by Kelly Freas.

***Stellar Conquest* sells for $9 — $8 for subscribers to Metagaming's magazine, *The Space Gamer*.**

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***Monsters! Monsters!* can be played by any number, and may last from a couple of hours to forever.**

Designed by Ken St. Andre; edited by Steve Jackson; illustrated by Liz Danforth.

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***Godsfire* can be played solitaire or by 2 to *15* players; counters are supplied for 6. Playing time varies from two hours to all day, depending on the scenario chosen.**

Designed by Lynn Willis; edited by Steve Jackson; illustrated by Elladan Elrohir.

***Godsfire* sells for $15. *TSG* subscriber price: $12.50.**

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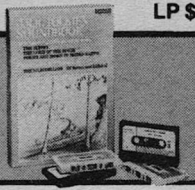

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remember Sputnik?

editorial

Twenty years ago—4 October 1957—the whole world was stunned by the fact that the first artificial satellite to be placed in orbit around the world was not America's well-touted Vanguard, but Soviet Russia's Sputnik I.

Talk about a "moral equivalent to war!"

The people of the United States were shocked, frightened, and stirred as they hadn't been for twenty-six years, when they had been suddenly thrust into World War II unprepared.

With one incredibly dramatic stroke, Nikita Khruschev served notice on the world that Soviet technology was the equal of the West's, that the uncommitted nations of the world could turn to Russia for technical and military assistance, that the Western democracies were shilly-shallying while the Soviet system made swift and sure political decisions, and—most importantly—that no place on Earth was safe from nuclear-tipped Russian missiles.

Of course, America caught up to the Russians. Thanks to President Kennedy's decision to "go for the Moon," we not only caught up, but sprinted so far ahead of the Russians in space hardware and research that the Soviets dropped out of the Space Race altogether and even tried to tell everyone that there had never been a race for the Moon. (The fact is, there was then *and there still is*. But that's another matter.)

So we got to the Moon, we got to Mars, we got to Mercury, and Venus, and even Jupiter. By 1979 we'll have robot eyes and sensors going through the rings of Saturn. And, closer to home, we have hundreds of satellites in orbit measuring, watching, guarding our own planet. We've put teams of astronauts into Skylab for months at a time. We're building the Space Shuttle and discussing space colonies, orbital factories, mining the Moon, and seeking natural resources in the asteroid belt. We have the hardware and the knowledge to send manned exploration teams to Mars.

The space program is far from dead. But . . .

Consider the Yom Kippur War in the Middle East, late in 1972. Think about heavily armed, armor-plated

modern tanks—costing several million dollars apiece—running pell-mell from individual infantrymen!

Those infantrymen were armed with wire-guided and/or heat-seeking missiles that could penetrate any tank's armor and destroy it. One soldier, one missile, one tank. It was a deadly equation, responsible for most of the battle casualties in that brief, bloody war.

The Yom Kippur War finally showed military experts all around the world that missile technology has reached the tactical battlefield at last. Tanks are prey to missiles. Years earlier, again in the Mideast, a Russian-made Styx missile had sunk an Israeli destroyer. One motorboat—armed with a modern missile system—can now threaten any warship afloat. Our huge, and hugely expensive, aircraft carriers are mammoth targets for supersonic missiles that can reach them from over the horizon within less than a minute.

It took roughly thirty years for military technology to go from the rather simple bazooka, an early antitank missile system, to the sophisticated tactical missiles of the Yom Kippur War.

In 1965, the first laboratory breakthrough into the realm of truly high-power lasers took place. If it takes thirty years for lasers to become practical weapons, they will be standard issue by the mid-Nineties.

And the first place that they will be used will be in space.

In this issue of Analog we have two science fact articles discussing two important aspects of laser weaponry. Jeff Hecht, the editor of Laser Focus magazine, gives details of how weapons-grade lasers work. Suffice here to say that a "puny" 10 kilowatt laser system purchased by Caterpillar Tractor Co. nearly ten years ago, was cutting through three-quarter-inch-thick spring steel at rates of fifty to one hundred inches per minute, when installed in Caterpillar's headquarters in Peoria.

Lasers are powerful enough for weaponry applications.

Professor Paul Nahin's article deals with the political implications of a laser Ballistic Missile Defense system, in which laser-armed satellites would be capable of destroying ICBM's during their rockets' boost phases. Such a capability could nullify the strategic value of ballistic missiles, and could either plunge the world into a new arms race—or it could end the nuclear "balance of terror" that we've all lived under since the late Forties.

It is not a very happy thought to consider that military operations will be taking place in space within the next ten to twenty years. There is enough idealist in each of us to make us wish that space could be a peaceful realm, where human beings will work together in harmony. But there is enough realist in most of us to force us to the conclusion that—unless some strong and workable steps are taken now—space will become another arena for human conflict and war.

Some steps have been taken al-

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ready. America and Russia have both agreed that no "weapons of mass destruction" will be placed into orbit around the Earth, and that the Moon will remain an international zone, where no nation can establish any claim of sovereignty or establish any military bases—just as Antarctica is treated today.

But—is a laser-armed satellite a "weapon of mass destruction?" Or is it a pinpoint, defensive weapon, whose only value is to shoot down individual rockets?

If a nation can effectively protect itself from nuclear holocaust by orbiting a network of laser-armed satellites, which interpretation of the law do you suppose that nation will make?

Look further ahead. Most major US corporations are already making plans for orbital operations. Space factories, orbital laboratories, lunar mines, asteroid exploration—all these are already being discussed in advanced planning groups all around the industrialized world. Private organizations such as the National Space Council and the L5 Society are forming pressure groups to urge more and better and faster development of space, including the establishment of full-scale space colonies, *a la* Gerard O'Neill's L5 concept.

Can we—dare we—put so much of our effort, our capital, our talented human resources into such space installations without even thinking about the necessity to defend them? There isn't a single American tourist traveling anywhere on this globe that does not have the shadow of American political and military power protecting him or her. There isn't a single American-owned factory or business establishment that is not, at least in principle, defended by our strength.

Will we put up orbiting laboratories, experimental factories, full-scale L5 type colonies, without a means to defend them?

A few members of the L5 Society have already considered that if large manufacturing facilities are established at the Lagrangian points along the Moon's orbit, their purpose might not be to build solar power satellites, but to build laser-armed military satellites! The other members of the Society hooted with scorn, arguing that the military "will not be allowed" to "pervert" the purposes of the space colony.

Really? Which government agency has the money to build a space colony? NASA? The National Science Foundation? ERDA? Or the Pentagon? Which private corporation, or consortium of companies, would risk their investors' capital if and when the Pentagon let it be known that the Defense Department will fund a space colony—for the purpose of building laser-armed satellites? Government money drives out private investment, and if the government wants space for military purposes, the private corporations will line up at the Pentagon's door, take the money, and build whatever the government wants.

All right, let's look at what's happening *now*. Today.

• The US Department of Defense is spending much more than $100 million per year on laser weaponry R&D.

• Major General George J. Keegan, the recently-retired head of US Air Force Intelligence, has publicly warned that the USSR is testing particle beam weapons—similar to lasers but using nuclear particles rather than photons—and may be years ahead of us in the race to achieve a practical missile-killing weapon system. His claims have been poo-poohed by the rest of the Defense Department, the CIA, and even the administration in the White House.

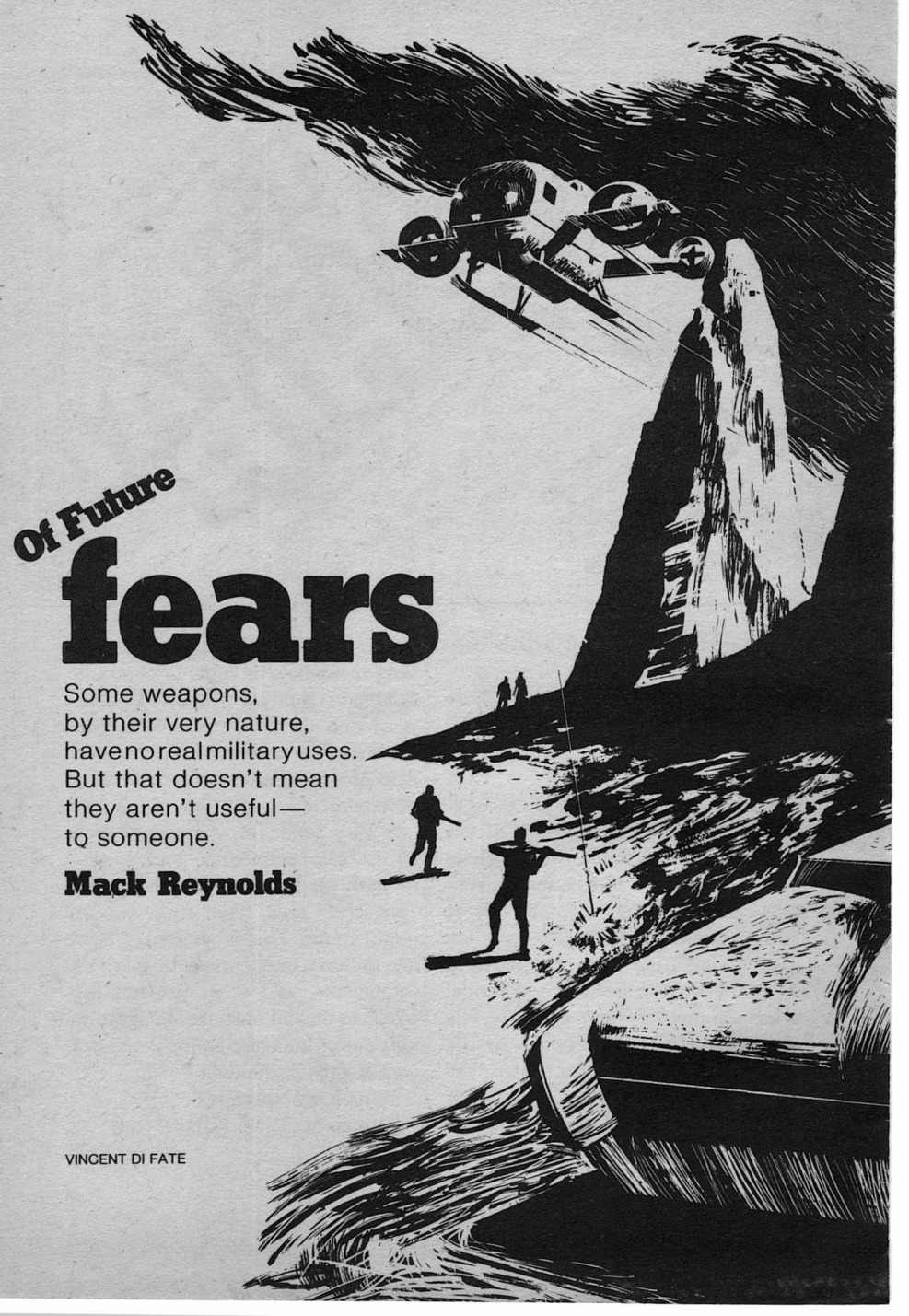
• Regardless of the Soviet particle-beam work, it is well-known that their laser technology is equal to ours. Certainly, as Sputnik I showed twenty years ago, we cannot assume that the Russians are laggards in any specific field of scientific research or weapons development.

• The tenor of American space efforts has been—since Vanguard!—to look on space development as a "peaceful" area, aloof from military implications. This is nonsense. There *are* military implications to space developments, and if we are not prepared to defend ourselves in space we may suffer immense political and economic setbacks here on Earth.

Remember Sputnik?

Remember Pearl Harbor!

THE EDITOR



Of Future fears

Some weapons, by their very nature, have no real military uses. But that doesn't mean they aren't useful— to someone.

Mack Reynolds

VINCENT DI FATE

Some high risk targets require a technical expertise and the kind of inside knowledge that few terrorists groups seem to possess, but this could be supplied by foreign backers . . . or, some of it could be supplied by a relative newcomer on the scene—the free-lance mercenary who offers his services to political terrorists although he himself is not politically motivated. This could add an even more dangerous dimension of expertise to some groups whose exploits have been somewhat amateur even when violent and successful.

Brian Crozier, Director
Institute for the Study of Conflict
Before Senate Judiciary Committee
of Internal Security, 1975

Ah, my Beloved, fill the Cup that clears
Today of past Regrets and future Fears:
Tomorrow!—Why, Tomorrow I may be
Myself with Yesterday's Sev'n thousand years.

The Rubáiyát

CHAPTER ONE

Nayef Habash, Anwar Assad, Ahmed Hussein and the Westerner were sprawled out atop a stony ridge which offered comparatively little cover, save for some cactus and sagebrush. To augment this, they had scooped out shallow foxholes. The three Africans bore Russian Kalashnikov AK 47 assault rifles and pouches with additional staggered row box magazines, each carrying thirty rounds of the 7.92 caliber short. The Westerner, who by appearance could have been either North American or European, was not visibly armed. They were all dressed in olive drab cotton coveralls and wore billed denim caps against the New Mexican sun.

They spoke variously in Arabic, French, or English and usually in one of the latter, since the Westerner's Arabic was halting.

Nayef Habash and the man of the West had binoculars to their eyes.

The North African said in English, "They've passed the bridge."

The other said nothing to that, continued to watch.

"Why don't they blow it!" Ahmed Hussein blurted. In his late twenties, he was youngest of the four, and the least collected. "What's the matter with Hafez?"

Nayef Habash, the leader, said in mild rebuke, "Hafez Arafat has blown more bridges than you have spent years in school. Perhaps he wants to suck one of their armored vehicles out into it, to take it out of the action."

And it was then the bridge went up in a glorious mushroom.

"Nothing else got across, except the lead hoverjeeps and armored car," the Westerner said evenly. "Good."

The three Africans took up their assault rifles and checked them still once again.

Further up the road, and out of their immediate sight, one of their hidden MG 42s cut in with its unbelievably high rate of fire, 1,300 rounds per minute. This gave it an immediately recognizable audible signature to each burst, in which the explosions so ran together that it almost sounded like tearing cloth.

Anwar Assad muttered, "That, at least, will knock out the first hoverjeep."

"And pin down the other two, we hope," the man of the West said, his voice still even. He gave the impression of unlimited competence.

The strangely designed, armored hovervehicle, which was the center of their attention, came swaying up the road from the direction of the destroyed bridge, traveling at a pace beyond that for which it had been built.

The road blew up fifty feet before it. It was a hovervehicle but the damage to the road was such that it could never have passed.

"Jasmin can always be depended upon," Nayef Habash muttered proudly and in satisfaction.

The vehicle had ground to a halt and from the far door two submachine gun-armed guards popped out. They were in United States of the Americas Army khakis. Both, in obvious surprise, even from this distance, came to a confused halt and their eyes darted up and down the road, out into the semidesert.

"Damn fools," the Westerner said, still utilizing the binoculars, though now the action was taking place within easy eye sight.

Ahmed Hussein brought his assault rifle up to his shoulder, excitedly.

"No," the one from the West said. "Don't reveal our position—not as yet."

The young North African lowered the gun, but unhappily. He looked over at Nayef Habash but his leader said nothing to override the outsider.

Jasmin's gun chattered from slightly up the road and the two American sergeants went down, both cut half in two. From the side of an armored transport vehicle two light machine guns cut out meaninglessly, since no target was in sight. It was unlikely that they had pinpointed Jasmin's dug-in squad.

Behind, at the bridge, was increasingly more gunfire. Anwar snarled in pleasure, "Mohammed's holding them."

The Westerner looked at one of the two watches he had on his wrists. He said to Nayef Habash, "Call in the laser."

The terrorist leader shot a quick look at him. "We're not ready for it as yet."

"We will be, by the time it arrives. We'll have to be. Here comes the jeeps and that damned armored car. Try to pin them down, there below. I don't think they'll try to move, until they know better how they stand, but give them something to think about."

The other three opened up with their assault rifles, Ahmed Hussein emptying his whole thirty-round clip

in one extended burst of fire.

The man of the West looked over at him mildly. "Shorter bursts, friend, or you'll overheat and jam or blow that gun." He turned back to observe the action.

The young North African snarled at him, hit the side of the gun, displacing the empty box magazine, and jammed a new one into place with the butt of his right hand.

Up the road, the three guard vehicles were having it out with Jasmin's squad of ten entrenched guerrillas. Both of the hoverjeeps had Browning-Brenn guns mounted and both had crews of four. The action had developed into a Götterdämmerung of automatic fire. One of the jeeps disengaged itself and sped along the road desperately toward the awkward looking larger vehicle which was obviously the center of attack. One of the jeep's crew had already been shot off the small army car and lay on the road behind; another, the one manning the Browning-Brenn gun, seemed wounded, but still on his feet. In the front, the driver was fighting his wheel, swerving from this side to that, either through jittery excitement or in an effort to take evasive action through the heavy fire. On its air cushions it floated around the area the mine had blown in the highway.

It sped up to the armored carrier and swerved to a halt.

Nayef Habash and his two men, acting in unison, as though rehearsed, jammed fresh magazines into their assault rifles and directed the guns at the newcomers. Muzzle velocity, 2,132 feet per second, cyclic rate 600 rounds per minute. The Russian automatic assault rifles tore the hoverjeep and its occupants into shattered and torn flesh and metal.

The laser weapons carrier with its technician and driver, came up behind the four.

The Westerner looked over at the two in the carrier. Both were North Africans, but the technician had taken his degree at MIT. The Westerner said, "You can knock out the door at this distance?"

The young engineer was scornful. "Yes, of course. We've been over this a score of times."

The European or American turned around and directed his binoculars below again. Those in the armored delivery van were obviously reacting hysterically, firing aimlessly. He absently wondered who the vehicle contained. Probably mostly scientific types, not action types, who had come along for the ride, never, never expecting to see an attack.

"Hit them," he said to the technician.

Nayef Habash said nervously, "Might we not destroy the . . ."

"No," the other said. "It's stored in the back."

The technician went about his business.

The European made a gesture toward the other two North African guerrillas with his head. "Send them down to mop up and get to it."

The terrorist leader took up his

assault rifle. "And me! We'll . . ."

The other shook his head. "No, you're not expendable. You won't be required at any rate."

"But, I'm the leader."

"No."

Ahmed Hussein and Anwar Assad scurried down the hillside, with guns at the ready, keeping about twenty yards between them so that one burst of fire couldn't take them both, and zigzagging as they ran. In a few minutes, they were at the now-smoking armored carrier. Those still on the hillside watched, Nayef Habash and the two who manned the laser carrier, standing, the one from the West down on one knee, binoculars to his eyes again.

He diverted his attention to the direction of the bridge momentarily. The firing had fallen off there. He looked up into the skies. Two Air Force helio-jets were coming up. He hadn't expected them this quickly and his lips thinned back over his teeth. However, there was nothing for it. He turned his attention back to the guerrillas who were now approaching their destination.

Anwar Assad thrust his assault rifle into the interior of the vehicle, the door of which had now been cut away by the laser beam, and there was a burst of fire. He darted inside, while young Ahmed stood guard outside. For the moment, there was nothing to guard against. All in the vicinity were down. Evidently, he saw a stirring in one of the men on the road—or was it simply his exuberance?—and cut loose with a short, sweeping burst.

Anwar Assad came staggering out of the smoldering ruin of the armored van, coughing as though the smoke was impossible on the inside, and dragging something behind him.

"Good God," the Westerner muttered. "Damn! Watch that!" Not that the Moslem could hear him.

The North African threw his gun to one side, brought the object he'd been dragging to his shoulder and headed back up the hill. Ahmed Hussein brought up the rear, his gun at the ready, his eyes darting in every direction—needlessly.

The sounds of crashing combat from both the directions of the blown bridge, and up the road where the armored car was still shooting it out with Jasmin's squad, fell off some more. Time was running out. And the helio-jets were coming in. Not that it wouldn't take them time to orient themselves. From the air, all below must have seemed the utmost of confusion, and it seemed unlikely that any communication still existed.

When the two guerrillas arrived, with their burden, the man of the West looked over at Nayef Habash and gestured slightly with his head at the laser technician and the driver of the weapons carrier.

The terrorist chief wide-eyed him and blurted, "We need the technician."

"No. There is no provision."

The driver squealed something obscene and his hand went for a holstered pistol. The technician merely

closed his eyes, in anticipation of the blast of automatic fire, which came immediately.

The four remaining men turned and, headed by the Westerner, started slipping and sliding down the hillside in the opposite direction from the carnage-strewn road.

They plowed through the sand and gravel, directly into the mesquite and cactus-studded desert. The European or American shot a glance at a watch again. Behind them, the firing had fallen off even more.

"All right. Here," he snapped, stopping and looking up into the skies.

They stood there, exposed, panting from the exertions of their rapid half-trot over the impossible terrain. Anwar Assad lowered his burden to the sands. It was contained in what seemed a heavy canvas knapsack.

"Careful with that," the Westerner said anxiously.

The North African leered at him, breathing deeply.

Nayef Habash was scanning the skies in desperation. "Where is it?" he rasped.

The Westerner looked at his watch still once again. "We still have two minutes."

"Two minutes!" the youthful Ahmed Hussein said shrilly. "We'll all be dead. The firing has stopped. They've overrun . . ."

"It's all been timed," the professional said coldly, looking at his watch once more.

The speck came up upon them in unexpected speed. A helio-jet swooped in and landed but yards away.

The eyes of the four bugged. It was a two-seater and the pilot was the sole occupant.

The Westerner waved him out, and, scowling, the newcomer, who was obviously also of the West, and undoubtedly an American, half cut his engines and emerged.

When he was within voice range he yelled, "Let's get out of here for Christ's sake!"

The Westerner glared at him. "You damn fool. You were to bring at least a four-place craft!"

The pilot put his hands on hips, defiantly. "This was all we could rip off. Wheels came off the planes. You're lucky I got here at all. Now, let's get the hell out." He pointed up into the sky and at the helio-jets coming up.

The Westerner was breathing deeply, thinking quickly. He spun on Nayef Habash. "Finish him!"

The North African gaped at him. "We've got to have a pilot!"

"I can fly the damn thing."

The pilot was too infuriated to be afraid. He yelled at the other Westerner, "Why, you sonofabitch . . ."

Nayef Habash cut him down with a four-round burst, and spun to the other, his eyes wide, his breath coming quickly. "There's room for only two! Especially when we add the weight of . . ."

"That's right," the Westerner clipped. "Get it into the craft, behind the seats!"

Anwar Assad, already blank of face, in his knowledge of what was to come, lugged the canvas knapsack to the small helio-jet and heaved it into the back. Then he turned and looked at his chief.

He said, looking back over the route they had recently traversed, "We could fight a holding action. Keep them for a few more minutes." There were two hoverjeeps rushing over the sand and gravel toward them.

The Westerner said to the terrorist head, "No. We can't stand the risk of either of them being captured and questioned. Hurry!"

He turned and headed for the idling aircraft.

Nayef Habash looked at his two followers. "It is for The Cause," he said emptily.

"Yes, of course," the veteran Anwar Assad said. He let his assault rifle drop to his feet, turned to face east, dropped to his knees, and dropped his head to the sand, presenting his back to his leader.

The burst of fire threw him to his face.

Ahmed Hussein, his eyes bugging terror, screamed, "No!" and took the next burst in the chest and belly.

The terrorist chieftain turned and scurried for the opposite side of the helio-jet and to the seat there. On the desert, behind them, in the direction of the road, where the firefight had taken place, two tremendous explosions spit their agony into the skies.

The helio-jet bounded into the air.

Nayef Habash said, in total despair, "I do not know how I will ever be able to explain this to Ahmed's father."

The Westerner looked at him from the side of his eyes, even as he flicked his fingers over the controls, bringing us their speed. "I thought that Jasmin was your daughter."

"Yes, but Ahmed's father is my blood-brother."

The Westerner closed his eyes in rejection of mores that were not his own.

CHAPTER TWO

Rex Bader looked up from his library screen in irritation when his TV phone buzzed. He flicked off the computer teacher and activated the phone.

He was about five ten, about one sixty, a little over thirty and projected a laziness of movement. He had an easy-going face, usually quick to smile, though often sourly and in a self-deprecating sort of way. His eyes held a vulnerable something much doted upon by the various women who had loved him in his time. His hair was faded brown and usually mussed, which wasn't aided by his habit of running his fingers through it; his eyes were tired blue. You stretched a point to call Rex Bader handsome; he was, at best, pleasant looking.

The face in the phone screen was that of John Mickoff, one of the top assistants, some said the Man Friday, of John Coolidge, Director of the Inter-American Bureau of Investigation. Rex had never known what John Mickoff's actual official title was.

The IABI man winked now and said, "Hi, younger brother. What spins?"

Rex looked at him glumly. "I thought nothing but every time I see your less than handsome phiz, something starts. Wizard, it's your rubberband, start snapping it."

Mickoff cheerfully ignored that. "How's it going with the last of the private eyes?"

"The last of the private eyes," Rex sighed, "is studying ten hours a day in hopes of getting a job on the Lagrange Five project."

The other chuckled. "You dreamer, you. Are your eggs completely scrambled? You've got about as much chance of getting a job in space as you have of blasting off for Luna without benefit of a rocket. You should've started about twenty years ago, younger brother. You're an old man now, compared to the kids coming up. The National Data Bank computers wouldn't pick you for a job helping to build the space colony, even if . . ."

"Wizard," Rex Bader interrupted. "What in the hell did you want, Mickoff?"

"Don't look so suspicious, younger brother. I wanted to invite you to a party."

"A party! Where?"

"Here at my place."

"Your place. For Christ's sakes, you live in Lincolnville, Greater Washington. I'm here in New Princeton."

"That's right," the other said, as though the fact made him happy. "Nothing should stand in the way of a bang-up party."

"You must be around the bend, Mickoff. It'd take me a coon's age to get there. You'd probably be passed out by time I arrived. By the looks of you, you've already been at the guzzle."

"Nope. We'll all still be sober. I've got a bang-up curve to introduce you to." Mickoff looked at him skeptically. "You still like curves, don't you?"

"Yes," Rex growled. He couldn't figure this at all. It didn't make sense. "When I switch to boys, I'll let you know."

"Wizard, chum-pal. Jump on your horse and make tracks. You might try yelling, 'The British are coming! The British are coming!' as you proceed. This mouthwatering broad I'm telling you about is from England."

His face faded, leaving Rex Bader staring at the screen.

Was Mickoff joking? A party?

But no. In spite of his bantering way of talk, John Mickoff wasn't prone to joking. Okay, sage. So Rex Bader would take in the party and meet the British girl.

He got up from the tiny desk and stood for a moment looking about his mini-apartment. For the one thousand and first time, he decided it was too small to be anything more than a good sized dog's kennel. It amounted to a small bath, a small kitchenette and one combination living room, bedroom, dining room and study. If he stretched his right hand up and stood

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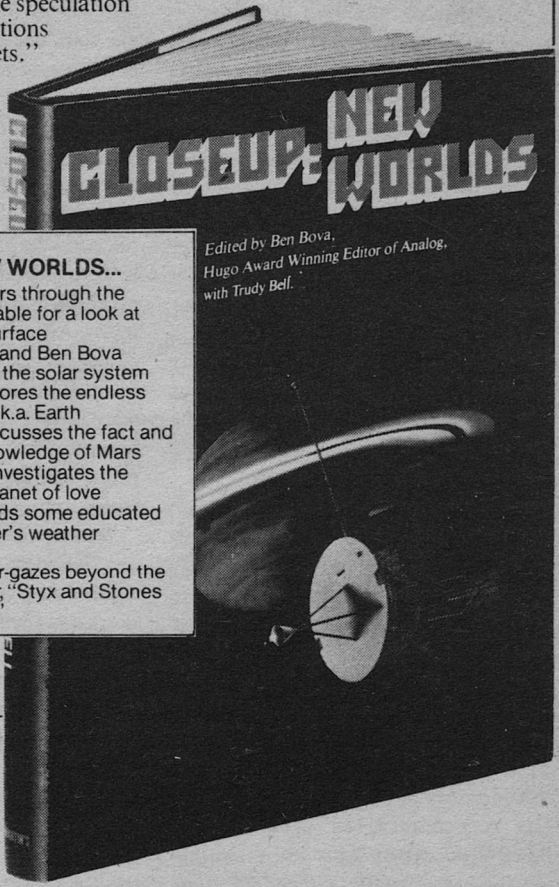

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on tiptoe he could touch the ceiling. It wasn't quite possible to stand in the middle of the living room cum everything else and touch the walls to each side, but damn near it. It had precious little more space than a motorized camper.

So this was Meritocracy, People's Capitalism, the Ultrawelfare State. Ha!

He went over to a built-in cabinet—everything possible was built-in, in a mini-apartment—and opened a drawer and stared down into it thoughtfully. In it were his 9mm Gyrojet pistol and its harness, plus several boxes of the rocket cartridges it utilized. He hesitated, but then shrugged it off and banged the drawer closed. He was invited to a party, not a shoot-'em-up. What kind of a dizzard was he developing into?

He got his jacket and left his tiny quarters. Greater Washington was some five hundred kilometers to the south and the trip would take him the better part of an hour.

The Bader mini-apartment was on the eighth basement level of the 110-story, aluminum-sheathed, twin-towered, high-rise apartment building in which he lived in the University City of New Princeton. There were some 2000 apartments in all and the fact that he had one of the smallest, and one without windows, and which was eight floors below ground level, helped considerably in the rent. And low rent was a necessity. In spite of Rex Bader's license as a private investigator, he was usually dependent upon Negative Income Tax, sometimes called GAS for Guaranteed Annual Stipend, to get by. As a bachelor, existence was on the difficult side. He wasn't able to split expenses with a wife, also on NIT, and had no children dependents. And if he did make anything from his occasional detective work, they taxed him brutally.

The transport station of his building was two floors beneath his own. He took the elevator down and made his way along the corridor to the metro station. There he took the first mini-bus to New Princeton's central terminal and switched there to a twenty seater express to the central terminal in Greater Washington. The automated bus took them through the underground ultra-highway at a clip of at least six hundred kilometers per hour. All over again, Rex Bader decided the damn things were getting too fast these days. At this rate, they were going to have to improve the acceleration chairs. Either that, or make changes in the attaining of full speed and of deceleration.

At the Greater Washington terminal, he took another mini-bus to his destination, the Midas Building, in the Lincolnville section of town.

The building had its similarities to Rex's own but Apartment 1009, on the tenth floor, John Mickoff's home, was far and beyond his guest's, as Rex bitterly knew, though he had been there only once before. Right off the bat, it was at least six times as spacious, though it still came under the heading of a bachelor's mini-

apartment. He couldn't guess why.

Rex Bader stood before the identity screen in the door and fanned his hand before the activating lens. John Mickoff opened up almost immediately. He held a glass in hand but there didn't seem to be any sounds of a party beyond him.

"Younger brother!" he exclaimed. "You made it. I wasn't sure you possessed the know-how to get from New Princeton to here."

"Ha, ha. Stop it, you're killing me," Rex muttered, following the other in. "How in the hell did the computers decide you were eligible for a job, but not me?"

"I sleep with the wife of the Director of the National Data Banks," Mickoff told him, over his shoulder. "And in appreciation—he can't stand her—he rigged the computer reports for me."

The living room of John Mickoff's apartment was downright pleasant. He had obviously taken pride and trouble in furnishing it to taste. It was *lived in.* Which was more than Rex could say about his own sterile digs. There were paintings, real books, photographs, even a gun rack, though a man must go a great distance in order to hunt these days. The furniture was comfortable and meant to be sprawled in. The autobar was a handsome cabinet, not built-in like the one in Rex's place and it was larger. There wasn't a status symbol in sight, which was a departure in this day.

There were two other occupants of the living room when they entered. One came to his feet, smiling pleasantly.

He was similar in age and build, and in his natty dress, to John Mickoff. Say about thirity-five, say about five feet six inches, a little thin. Facially, though, the two were miles apart. Mickoff's Slavic features were squarish and almost ugly. The stranger's were fine, with an aristocratic effect. His hands, now holding a large snifter glass between them, were as delicate as those of a pianist—or a woman. Rex's immediate reaction was, this isn't an American, though he didn't quite know why.

The girl, or perhaps woman was the better term, since she must be about thirty, was definitely not an American and she was obviously the Britisher that Mickoff had mentioned on the phone. Only an Englishwoman could look so well in tweeds.

Rex could hardly keep from staring at her. The British, he was of the opinion, produce the damnedest women in the world. On an average their pulchritude was far and below that of, say, Italy or France, not to speak of Texas or California. They average out as dowdy and drab and soon deteriorate into fat and lumps. But that's on an average. The girls who are in the chorus lines in the Folies-Bergere or the Lido, the models who parade in the top dressing houses of Paris, are seldom French; they are almost invariably English. Above that, the British produce the almost unbelievably beautiful actresses such as Elizabeth Taylor, Jean Simmons, Vivian Leigh,

Deborah Kerr. Rex was an authority on such, being addicted to the historic movies which he dialed from the National Data Banks on his library booster.

Those four came immediately to mind since the tweedy one seated before him, and looking at him questioningly, seemed an amalgamation of the actresses. Offhand, Rex Bader would have pronounced her the handsomest female—curve as Mickoff had called her, in the current idiom—he had ever had the pleasure of seeing. He had no reason in the world for it, but somehow her very perfection irritated him.

Mickoff was saying grandly, "Rex Bader, may I present you to Cecila Duff-Smythe, you lucky dizzard, and to Jean-Paul Lafitte?"

Rex shook hands with the man and muttered some standard amenity to the girl.

"Ah, the famous Mr. Bader," the man murmured pleasantly.

"Lafitte," Rex said. "As in the New Orleans pirate?"

The other smiled and bowed his head and made a small mouth as though in self-deprecation. "A distant ancestor, I believe." The accent was slight but it was French.

John Mickoff said, "What'll you have, Rex? The usual, pseudowhiskey?"

"Wizard," Rex said.

Cecila Duff-Smythe said, and her husky voice matched the perfection of the rest of her, "I say, pseudowhiskey, with excellent Scotch available?"

Rex Bader looked at her and said, "It's my belief that the boys in the American laboratories have come up with drinkables better than the Scotch of Scotland, the cognac of France, the rum of Jamaica, or the vodka of Russia, for that matter. Anybody who drinks the original stuff is just paying for status symbols."

"That's quite a belief," Jean-Paul Lafitte laughed, reseating himself and looking down into the snifter glass he held. It obviously contained cognac.

The host came over with Rex Bader's drink, which he had dialed on the autobar, and handed it over.

Rex said, seating himself in one of the room's comfort chairs, "Where's the party?"

Mickoff grinned and gestured at the four of them. "This is it," he said. "I forgot to mention that it was a small, informal affair. However, a couple of more are due to drop in." More seriously, he added, "I didn't want to mention, over the phone, the real reason for the gathering."

Rex didn't get it but inwardly shrugged. He imagined that whatever the IABI operative had in mind would eventually come out. He sipped at his drink and looked over at the Frenchman. "How do you mean, the famous Mr. Bader?" he said.

The Frenchman smiled and said, "We have records, of course, of some of your exploits, Mr. Bader."

"Who's we?" Rex said.

"Interpol."

Rex eyed the smaller man. He had never met a member of the interna-

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tional police organization before. He looked over at John Mickoff, who was grinning wryly for some unknown reason, and then back to Jean-Paul Lafitte. He said, "I've heard only vaguely of Interpol. Do we Americans belong to it?"

Lafitte nodded. "Yes, of course. We now have 114 member countries, which makes it all but unanimous, save for the Soviet Complex. The United States was authorized to join by Congress back in 1958. At that time, since your Treasury Department was responsible for the suppression of counterfeiting, smuggling, and the narcotics traffic, all of which have international ramifications, it was that department which was designated as American representative to the International Criminal Police Organization, Interpol for short. However . . ." he nodded to John Mickoff " . . . since all of your police and espionage-counter-espionage have been merged into the Inter-American Bureau of Investigation, we now deal with the IABI."

Suspicions were beginning to form in the back of Rex Bader's mind. He said carefully, "Actually, as I say, I know practically nothing about Interpol."

The Frenchman shrugged in full Gallic fashion. "There's little to know. We were originally based in Vienna and our files on international criminals were quite extensive, having been built up for years. However, during the Second World War they were seized by the Hitler people and, ah, disappeared. After the war, the General Secretariat was reconstituted in the Parisian suburb of Saint-Cloud. It functions as a central depository for fingerprints, photographs, and other records of international criminals. We even operate an international radio network to over forty of our member countries."

Cecila Duff-Smythe cleared her throat softly and said, "While the Sûreté represents the organization in France, the Questore in Italy, and so forth, the National Central Bureau of Scotland Yard is the liaison between Interpol and the British Police." She seemed to switch subjects. "Mr. Mickoff, on the phone, called you the last of the private eyes, Mr. Bader."

"That's right," Rex said sourly, taking another sip of his highball. "Also, the last of the shamuses, gumshoes, sleuths, dicks, hawkshaws, and all the other snide terms that have been used to describe the private detective."

"I see. And what have you detected tonight, thus far?"

"That you represent Scotland Yard and that you and Mr. Lafitte here are cooperating in something in America in which Interpol is involved."

"Stute! Go to the head of the class," Mickoff chuckled. "Fresh drinks, anybody?" He looked down at his wristwatch.

But it was then that the door's identity screen buzzed. John Mickoff put his glass down and went over to open it.

Had it been the second coming of

the Christ, Rex Bader could hardly have been more surprised when Colonel Ilya Simonov entered.

Ilya Simonov, of the hard eyes, agate hard, of the wolfish expression. Of the erect, alert military posture. Head of the *Chrezvychainaya Komissiya* in Greater Washington, and hence ranking officer in charge of Soviet espionage-counter-espionage in the United States of the Americas. Ilya Simonov, who wore in his jacket lapel a tiny red ribbon. Tiny, but it represented the Soviet Hero's Combat Award, which, as Rex knew, was about as easy to come by as the British Victoria Cross or the old Imperial German Blue Max, the Pour le Mérite. Much more difficult to take than the American Congressional Medal of Honor, for that can be awarded to generals and admirals, among others, far behind the lines. The Hero's Award, the Victoria Cross and the Pour le Mérite, were taken only in actual combat and usually posthumously.

Ilya Simonov. His reputation among international espionage-counter-espionage circles, was that he had killed more men—and women—than the black plague.

CHAPTER THREE

The Russian looked about at the gathering and bowed slightly from the hips as John Mickoff closed the door behind him.

He said, "Ah, Jean-Paul, I expected them to send you." He looked at the girl. "But hardly you, my dear. What is it your colleagues call you . . . Sissy?"

"I'm not your dear, you know. And the name is Cecila Duff-Smythe. And, I say, why in the name of hades shouldn't they send me?" Her voice was sharp. Obviously, the colonel was not her favorite person.

His eyebrows went up in slightly wolfish amusement. "Because, I was of the opinion, this assignment might become rather sticky, to use your British term."

"I've been on sticky assignments before, as you damned well know."

The newcomer looked at Rex Bader. "Ah, Comrade Bader. I might have expected that you, too, would be here."

"Comrade, yet," Rex muttered. "Hello, Simonov. What in the hell are you doing here at this jolly party?"

But before the Russian could answer, if he had answer in mind, Mickoff came up from behind him and said, "Drink, Ilya?"

"Of course. Very cold vodka, if I may."

John Mickoff went over to the autobar and dialed.

The colonel, without invitation, took a place on the same couch that Jean-Paul Lafitte occupied, at the other end, and said, "And how is your charming sister, Jean-Paul?"

"Tres bien, merci," the Frenchman said. He sipped at his brandy and looked at the other reflectively.

Mickoff came over with a three ounce glass and handed it to the Russian.

Ilya Simonov held it up slightly in mock toast and said, "To the success of our mutual project."

Nobody said anything to that and he dashed the spirits back over his palate in the stiff-wristed motion of the practiced drinker. He looked over at his host wryly. "My dear John," he said. "You should stock Zubrovka. Your American vodka is hardly fit to be served to a patriotic Russian."

John Mickoff laughed. "And Rex was just telling us that we Americans turn out the best guzzle in the world, all of it synthetic."

Rex blurted, "Why in the hell don't you arrest him? He's the biggest spy in the country!"

"Second the motion," Sissy murmured under her breath.

John Mickoff sighed, picked up his glass and resumed his chair. He said, "You have a lot to learn about international intelligence, younger brother. If we arrest Ilya and some of his people here in Greater Washington, within twenty-four hours they would arrest his equal number of the IABI in Moscow, and some of our people there. Then, after a year, or even less, we'd arrange an exchange and the colonel would be free for duty again. But meanwhile, his place would have been taken by someone else that we don't know and we'd have our work cut out getting a slant on him. As it is, we know the colonel, and can pick him up, if necessary, any time we wish. A known danger is better than an unknown."

"Détente," the Russian smiled. "Our own professional détente. Another point is, if we picked up the IABI agents in Moscow, it'd take them time and expense putting a new man in." He looked at Mickoff. "Your superior isn't to be present?"

Mickoff began to say, "He should arrive any . . ." but then the identity screen buzzed again and he hurried to answer it, a bit less briskness in his attitude.

Rex Bader heard him say, "Hello, Chief. Everybody's here," and then John Coolidge came into the room. In actuality, Rex had begun to expect him.

The Director of the Inter-American Bureau of Investigation looked about, taking them all in. He nodded, without addressing anyone, walked over to the desk and sat at it, with a weary sigh.

Rex had come in contact with the director before and then, as now, had been surprised at the other's age, though as far back as Rex Bader could remember he'd seen the ultimate police official on Tri-Di, and earlier on TV, or had heard him on the radio. John Coolidge made a practice of his own version of fireside chats, in the F. D. Roosevelt tradition. Usually, they dealt with the threat of subversion emanating from the Soviet Complex or China. For the better part of a century, that drum had been beaten by the American bureaucracy, and it was Rex's personal belief that the Soviet Complex was just about as interested in subverting the West as the West was in subverting the Soviet

Complex, and except for a few crackpots, that was about nil these days.

But though the Director shed some twenty years before the Tri-Di lenses, in person he showed his give or take seventy-five. He was heavy and square of face, with a wide, stiff mouth, reminiscent, in a way, of George Washington. And he most obviously expected to dominate any gathering at which he was present.

Mickoff said, "A drink, sir?"

"No, of course not. Just a glass of water, John," his superior told him. When it came, he took a small pillbox from an inner pocket and selected a capsule from it and washed it down.

He looked around at the now silent gathering again, cleared his throat and said, "To be sure that we are all equally informed, I'll start with basics. Undoubtedly, you've all heard of the mini-nuke. God knows, there's been enough about it in the news media of the world recently. The whole thing started back in the 1970s, I suppose, when Maxwell Taylor, of the Joint Chiefs of Staff, joined the Pentagon leadership in calling for the development of a new generation of low-yield battlefield nuclear weapons."

The bureaucrat looked around at them heavily, as though challenging rebuttal, which didn't come.

"Production," he went on, "became possible in the mid-1970s as a result of the intensive effort to produce these light, compact atomic explosives. The army sought to procure ammunition of this sort for its field artillery and for short and medium-range tactical missiles. Miniaturization allowed them to become so small that the mini-nukes soon could be carried by one man in a knapsack."

He looked about again but all remained silent. Cecila Duff-Smythe raised her eyebrows to John Mickoff and he took her glass to refresh it. The Director was obviously irritated by that interruption but kept his peace and went on.

"In 1973, General James Polk argued that if we overcame our so-called mental block against nuclear weapons we would find a strategy based on their early use would be, ah, a more viable and less dangerous scenario than existing NATO plans. And in 1975 Air Force General Edward Giller told Congress that the Pentagon planned to acquire several thousand mini-nukes over the next few years at a cost of a couple of billion dollars."

The old man took a deep breath. "Possibly, at that time, they didn't foresee the ultimate development of the mini-nuke, the pilot example of which this country recently assembled. In short, it is now so small that it can easily be carried by one person and so simple that anyone, anyone at all, can detonate it, after ten minutes of instruction, or half an hour of reading them. In short, there is now on hand a nuclear fusion bomb that the man in the street can use."

Rex Bader said, "How were they able to get them down that small? I thought a fusion bomb had to be set off by a fission bomb."

The Director shook his head. "You're far out of date, Bader. The mini-nuke can now be detonated by a small laser, contained in its shell." He looked around. "You all realize what this means. The weapon was designed for retaliation, for revenge, *after your side had irretrievably lost the war.* Even a civilian could easily smuggle it into a city, activate it, and leave. The timing device can be set at anything up to twenty-four hours."

"Needless to say," Jean-Paul said softly, "when news of this development got out, the world was horrified." He added, "Including the people of the United States of the Americas. How did the bitter graffiti go—I am a collector of American graffiti—*Ban the bomb, make the world safe for conventional warfare."*

"Yes," Cecila murmured, "The ultimate horror weapon. Meant to destroy what little remained after the holocaust. How insane can our species become?"

"Possibly," the Russian put in, "it was the best development that could have come along. In rejection of this Frankenstein monster, the whole world reacted. The United States pledged to destroy the one example that had been assembled. Politicians in the Reunited Nations, of both the West and the Soviet Complex, threw their arms about each other, sometimes with tears running down their cheeks, and swore to create a true détente." He twisted his mouth, in a small cynicism.

"Which brings us to date," the Director said as though brushing aside their comments. "As you undoubtedly know, the mini-nuke, on its way to Los Alamos to be disassembled before a world delegation of nuclear scientists, was hijacked by a group of terrorists. Since then, the radical wing of the Third World Liberation group has claimed credit."

Colonel Simonov said evenly, "They didn't have to. We already knew. Anwar Assad, Nayef Habash's right hand man, was found among the dead. So was Jasmin Habash, the daughter of the terrorist chief."

"How'd you know that, chum-pal?" John Mickoff bit out.

The Russian looked over at him in amusement. "We've known for weeks that Nayef Habash was in this country, and a double score of his people along with him. All underground. We didn't know what they had in mind but we knew that they were here. The most dedicated, most ruthless terrorists since that Mideast nonsense a generation ago."

"Very well," Coolidge said in an irritation that seemed almost senile to Rex Bader. "We get to the here and now. How many of the terrorists survive, we don't know. But, somewhere in this country is the mini-nuke in the hands of Nayef Habash. What he plans to do with it, we don't know. Almost no matter what he does with it, the United States of the Americas and, to a lesser degree, all other nations who have entered the nuclear race, are blackened. Our job is to find

that damned portable nuclear fusion bomb."

By this time, Rex Bader had had enough. He said belligerently, "Wizard, but what in hell has this got to do with me? You people are all international pros. It's your job. I wish you luck. But what in the hell's it got to do with me? I'm a civilian working man—when I can find work, which isn't very often."

Coolidge looked at him impatiently. "See here, Bader, don't you see how impossible it would be for the information to leak that our government was condoning the utilization of Colonel Simonov in this investigation? Or even Interpol? An Interpol operative, such as Monsieur Lafitte, has no legal position in this country, even though we belong to the international organization. He has no legal position in any member country. He can't make an arrest, most certainly he cannot even carry a firearm, not to speak of utilizing it. Interpol operatives are on an advisory basis—at most. Local police take a dim view of their interfering with law enforcement. Even worse, how would it look if a representative of Scotland Yard was known to have been, ah, called in to help solve our problems for us? The IABI would appear to be ninnies. Supposedly, we are the most efficient police and intelligence body in the world."

The Russian colonel smiled.

"I still say, what in the hell's this got to do with me?" Rex said.

"We need a liaison man," Coolidge told him, with impatience. "We need somebody, not in government employ, to coordinate the efforts of Colonel Simonov, Monsieur Lafitte, and our young lady, here. It would not do for there to be any record, whatsoever, of my bureau working with them. You will act as this liaison man, reporting to John, who will, in turn, report to me, directly. No one else will even be aware that such a cooperation is taking place. Each of these operatives have special aptitudes applicable to the case, but you must run interference for them."

"In short, you ride shotgun for our overseas colleagues, younger brother," Mickoff grinned at him.

"That will be all, John," Coolidge said grumpily. He came to his feet.

Rex said, "No, wait a minute. What's in this for me? I'm all for the project, but I'm also for me."

"Nothing," Coolidge said flatly. "Aside from the satisfaction of performing a patriotic duty. By the way, you've been given a Priority One rating in the National Data Banks to facilitate your work and that of your team."

"With satisfaction in performing a patriotic duty and one half a pseudo-dollar, I can buy a glass of beer," Rex said. "Everybody else, here, is undoubtedly receiving a nice salary. What do I look like, a dizzard?"

Cecila Duff-Smythe laughed softly. "I say, self-interest raises its ugly head."

Coolidge said impatiently, "We want no record of this whole matter to

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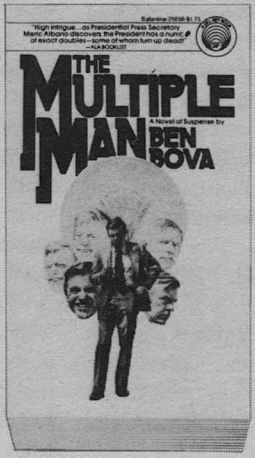

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appear anywhere. Certainly no record of you being paid through the IABI. If it was in the records—anywhere—sooner or later some muck-raker, or some member of the opposition in Congress would ferret it out and expose the fact that we were cooperating with Soviet espionage-counter-espionage, not to speak of finding it necessary to ask assistance from Interpol and Scotland Yard."

Rex looked at him emptily.

Coolidge said, "John has mentioned that you are dissatisfied with continually having to resort to Negative Income Tax to supplement the little you earn as a private investigator. If this assignment is successful, Bader, you will be given a position with the IABI, bypassing the computer recommendations."

"Wizard!" Rex said. "Why didn't you say so?"

The Director of the Inter-American Bureau of Investigation, without another word, nodded to all, turned, and let John Mickoff usher him to the door.

CHAPTER FOUR

When the IABI man returned to the others he looked about the four of them. "Anybody use another drink?" he said. "The party is going dead."

All four of them could use one more of the same.

When they had been served, the Russian said, "And now, to use the Americanism, we get to the nitty-gritty." He knocked his vodka back over his palate and shuddered, not from its strength but its quality.

"The nitty-gritty?" Cecila murmured. "Such as what, would you say?"

Simonov said, "Such as some interesting aspects of this whole, ah, romp, caper, job—what are the other Americanisms?"

"Screw the Americanisms," Mickoff said. "What are you talking about?"

Colonel Simonov looked over at the host. "Let us review what we know," he said. "It will reveal something that has possibly evaded you."

"It's your ball, let's see how you bounce it," Rex said.

"What has evaded us?" the Scotland Yard operative said, doing little to avoid indicating that the Russian was not exactly her cup of tea when it came to colleagues.

"The story is this," he said easily. "Some thirty terrorists, led by the notorious Nayef Habash, ambushed the convoy taking the mini-nuke to Los Alamos where it was to be somewhat dramatically dismantled by a gathering of international scientists. They set up a roadblock in a remote area. How they knew where, and when the convoy was to be at that spot, is interesting. After the lead guard hoverjeeps and the armored vehicle carrying the mini-nuke had passed over a bridge, the bridge was blown, and some ten of the terrorists, dug in, resisted that element of the convoy following the carrier. Up ahead between the carrier and the lead jeeps, the road, which had also

been mined, was blown, preventing the highly armored vehicle carrying the mini-nuke from continuing. It ground to a halt. Farther along the road, another group of the terrorists were dug in and immediately opened fire with World War Two heavy machine guns and other weapons. Meanwhile, a highly sophisticated laser weapons carrier rolled up and cut through the sides of the armored delivery van. The occupants were slaughtered and the mini-nuke taken. Meanwhile, as the fighting progressed between the two dug-in terrorist groups and the ground guards of the United States Army, two American Air Force helio-jets came up, and moved in to help. At this point, another Air Force helio-jet swooped in and the mini-nuke was put aboard it—unbeknownst to the guards, both ground and airborne—and lifted away. It never occurred to the other helio-jets that it was in the hands of the terrorists and had been stolen only hours earlier. We know now that it was a small, two-place craft. So only two of the terrorists escaped, with the stolen mini-nuke. Immediately after it had taken off, two explosions erupted, completely finishing off those terrorists fighting a rearguard action. No survivors remained to be questioned. All were obviously deemed expendable and sacrificed."

"Very well, Colonel," Jean-Paul Lafitte said, sipping casually at his brandy. "Ah, so what has evaded us? This is the known story."

"I submit that Nayef Habash's people couldn't have done it."

The other four stared at him.

"I say, what in the name of hades are you talking about?" Cecila blurted.

He turned his eyes to her. "Someone had to find out where that convoy was coming in, and when. Someone had to arrange for stealing their laser weapons carrier and to station it available to the enormous power source needed to activate it. Someone had to plan the stealing of the two-place Air Force helio-jet. Nayef Habash and his people were obviously dedicated and in good funds, but they weren't up to all that. Most of them, we know, were not even able to speak English and practically none of them had ever been to North America before. They couldn't have done it. And, supposedly, the only American involved was the pilot of the helio-jet, who was found dead, shot by the terrorists themselves, and he was a known criminal. Who flew the helio-jet in its escape? Certainly no member of that terrorist group of North and Central Africans—none of them would have had the know-how, as the Americans say."

"What are you leading up to?" Mickoff growled, for once his voice not bantering.

"That someone outside the Third World Liberation group provided the expertise. Somebody outside the group masterminded it."

"Why?" Jean-Paul said skeptically. "Why couldn't it have been a member of the group? Some fuzzy-minded

type with a fairly good technical education."

The Russian shook his head definitely. "No reasonable person, who doesn't actually live in any of the Third World countries, is going to stick his neck out joining that fanatical group of terrorists. What would motivate him? And how many people in those countries have the background to mastermind the coup, to have been acquainted with lasers and how to utilize them, could have penetrated American security to the point of intercepting the convoy right at a point where power lines could be tapped so the laser could be activated? He also had to know how to fly a helio-jet, and how to arrange to steal one."

Simonov shook his head again. "No, Nayef Habash's people hired an expert, a professional mercenary with considerable technicial and combat training. He's a near genius to have accomplished all that."

"All right, wizard," Mickoff said. "So we've got an expert doing our pal Nayef's thinking for him. From what you seem to think, probably a white man, probably either a European or an American. And, if he doesn't belong to the Third World himself, he's most likely a mercenary, working for money and a hell of a lot of it."

Simonov said, "Correct."

And John Mickoff said in disgust, "What difference does it make? Our job is to locate the damn thing, before they smuggle it out of the country and get it down to Jo-Burg, or wherever, and blow one hell of a lot of city real estate all over the place."

Cecila looked at him questioningly. "Why do you think they want to set it off in Johannesburg?"

John said impatiently, "South Africa's the big enemy for the African members of the Third World and Nayef Habash is an African."

Jean-Paul shook his head. "This is a very big operation, involving the expenditure of probably millions of psuedo-dollars and the lives of, already, over thirty terrorists, and another score of soldiers and American technicians. So it's not just Nayef Habash and his dreams of a united Africa. It's the whole Third World Liberation group and some of them are Asiatic, some Latin American, some from other parts of the world."

He thought about it for a moment, his fine-featured face in frown. "Terrorism has been transnational for some time. I would think the classic example was the Lod Airport massacre in Israel, way back in 1972. The members of the so-called Japanese United Red Army, the Rengo Segikun, who carried it out, were trained in North Korea, picked up their funds in Germany, their arms in Italy, and then had further training in Syria and Lebanon. They sprayed the airport on behalf of the Popular Front for the Liberation of Palestine."

"What are you getting at, dear boy?" Cecila said.

"I don't think that they're going to try and smuggle that mini-nuke out of the country. Aside from the fact that

that would present difficulties, I think this is the best place for them to utilize it."

All eyes were on the Frenchman now.

He rubbed one of his small hands ruefully over his mouth and looked at Mickoff. "Just how powerful is the thing? What would the bomb do to Manhattan?"

It was Simonov who answered. "Destroy it. Not level the island, of course, but, if set off in the center, do enough in the way of destruction that Manhattan could never be reinhabited."

Rex Bader put in, "And, among other things, the Reunited Nations building is there. When it fell over, the debris would clog the road halfway to Albany."

"Very funny," Cecila murmured.

"I think Jean-Paul's right," Mickoff put in. "They can use it most effectively as a terrorist threat, right here in America."

"What do you mean *threat?*" Rex said.

The IABI man looked at him. "Younger brother, they're not going to set that thing off. They're just going to threaten to. The moment they did set it off, they'd no longer have it and they could no longer have it hanging over the head of the world. No, it's one of a kind and no more will ever be assembled. They can't afford to use up their whole arsenal."

"They're crackpots," Rex growled. "If they're turned down in their demands, whatever they might be, they could get mad enough to set it off just to get even."

"Why in the name of hades haven't they made their demands?" Cecila said, "They've had it several days now and all we've heard is from their central headquarters in North Africa when they released the news item claiming responsibility."

Colonel Simonov said slowly, "I've considered that. I think that they've temporarily gone to ground. They're regrouping, planning the next steps. I suspect that they lost more of their force than that mercenary expert of theirs had figured upon. Perhaps the captured helio-jet was originally meant to carry more people. It seems unlikely that Nayef Habash would have needlessly sacrificed Anwar Assad, his right-hand man, and even his daughter. They must also have lost most of their weapons in flight."

John Mickoff said, "Well, let's make some plans on how we'll operate. Frankly, I'm of the opinion that this little group isn't going to accomplish much. My chief has all the resources of the IABI at his command and he'll throw them all, tens of thousands of operatives, into it. There's only four of you, counting younger brother. And you're not even operating on your home territory."

Colonel Simonov smiled wolfishly at him. "However, we shall do our best, Comrade Mickoff. Perhaps we can come up with something that doesn't occur to your Director Coolidge." He stood and added, "I do not expect to work with the rest of you,

beyond calling upon Mr. Bader, possibly, from time to time, if I run into some situation in which I need him to, ah, run interference, as someone called it, or to report through him to Director Coolidge."

Rex said, scowling, "You mean that you don't figure on cooperating with the rest of us?"

"That is correct," the Russian nodded. "You must realize, I have my own organization."

Jean-Paul said, distant amusement there, "So the Soviet Complex espionage apparatus in the United States is going to be thrown into the effort to save America from both destruction and world disapproval."

"That is correct. Sissy, Jean-Paul, Rex, John, until we meet again. And good luck." He turned and headed for the door.

Cecila said to his back, "Don't call me Sissy."

When the Russian was gone, Rex looked at her and said, "Why the chip on shoulder? That is, beyond the point where we all have it in regards to our commie friend?"

"He probably shot my brother," Cecila said flatly.

Mickoff said, "Wizard. Simonov says he'll work on his own. That leaves you three to do what you can and leaves me available, through Bader, here, as a liaison man to the Director. Let's keep continually in touch."

"Tres bien," the Frenchman said, standing.

"Righto," the girl said, putting down her glass and coming to her feet as well. She was anxious to work.

Rex sighed and said, "Let's go to my place and try to figure out some plan of action. Frankly, I don't know where in the hell to start."

"Oh, we've started already, old chap," Sissy said.

CHAPTER FIVE

Alioune Senghor was under the influence of student stimulant drugs when the identity screen on the door of his quarters buzzed.

He was a lean boy of about nineteen, with the physical perfection and the jet black complexion that the Senegalese seem to achieve beyond any other people in West Africa. Only the Masai, in East Africa, can match them in body, in cleaness of features, perhaps in intellectual achievement. It was no mistake that, when Senegal was part of the French colonial empire, the Senegalese had been used over and over again as shock troops in French wars, not only in Africa but through the world. They had, for instance, been the terror of German troops in Flanders in the First World War, and it had been Senegalese, under French officers, who had wiped up the Sahara when the Europeans had "liberated" that great area from the Tuareg and other aborigines. The obvious intelligence in his face matched his physical impressiveness.

The student had been cramming when the screen summoned him. Cramming English, since, though his French was all but perfect, as an exchange student in the United States

of the Americas, he found that he had difficulties in his studies in a tongue in which he was only modestly proficient.

Alioune had been sitting before his TV library booster screen, his pupil headphones over his ears, his vocotyper available. The first pills had hastened his speed of assimilation; the second of the two he had taken was related, so he understood, to mescaline, and was supposed to broaden his perception and insight. They seemed to work. In his home village in the southern part of Senegal, where his father was an hereditary paramount chief, they would have been considered witchcraft—black magic.

He sighed impatiently, took off the headset, and went to the door. The impatience disappeared when he saw the face of his visitor, and he hurried to open up.

"Mamadou Diop," he said, flustered. "I am greatly honored!"

The other, a heavyset, jowly man, but obviously of the same tribal heritage, entered quickly and closed the door behind him.

"There is no one else here, Alioune Senghor?"

The boy looked around his cramped student quarters and shook his head in depreciation. "As you see, Your Excellency, I am ashamed to welcome you to my . . ."

"Not at all, not at all," the other said. "Your illustrious father insisted that I drop in to welcome you to this part of the world, when last I saw him. Unfortunately, I have so little time, I could only now make it."

The exchange student looked at the high official from his country's embassy to the United States of the Americas and to the Reunited Nations. He'd had no idea his father was acquainted with the renowned Mamadou Diop. It would have seemed unlikely.

He scurried about, attempting to neaten his cramped mini-apartment.

The older man sank into the room's sole comfort chair and said, "Don't bother, don't bother, my son." They both spoke in Wolof, the lingua franca of Senegal. "I too have been a student, in my time."

The younger man, relieved to find that the speed-up study pills he had taken earlier seemed to be wearing off, seated himself on the edge of the couch opposite his visitor.

"I am greatly honored . . ." he began again.

"Don't speak of it, my son," the older man said. "You are, after all, the only young man of our country who is at present a student in this university city." His face emptied of expression somewhat and he added, "In the old days, the nations of the West were more anxious to educate our young people, less contemptuous of our needs."

Alioune Senghor frowned. "I don't understand. I am the only student from Senegal here, but I understand there are more in the universities further west and in Canada. Not to speak of Paris and . . ."

The diplomatic official scowled in

turn and shook his head sadly. "Even these. The fact of the matter is that our country does not have the finances to continue the dedicated studies you, our sons, are performing. The expenses involved . . ."

"But we're exchange students."

The other nodded. "Yes, but, you see, this does not exclude expenses. Not everything is covered. Besides, the very term indicates that when we send a student to the West, they send one to our nation—usually insufferable bigots who pretend to study such subjects as anthropology and what they call primitive art, in other words, the sacred art of Senegal which they are incompetent to understand."

Alioune Senghor was aghast. "You mean our education can no longer be maintained in the advanced countries?"

Diop sighed and smiled ruefully. "You are a fool, my son. Why are they *advanced* and we *developing countries* as they condescending call us? Are you aware of the British, or is it American, term, 'they have us by the balls'? They do not want such young men as yourself to learn technology. It would overturn their applecart. Africa gave birth to the human race. We also gave birth to civilization, in Africa, in Egypt. But the whites, with their pastoral traditions, their raiding traditions, their war traditions, swept down and took everything before them. Now they control all."

The younger man, suddenly aware of his position as host, hurried to his feet and said, "Your Excellency, a beverage, or some other refreshment?"

His guest took the invitation most charmingly. "How hospitable of you. Of course, as Moslems, alcoholic beverages are forbidden us, but I would love to have a cooling fruit drink, and . . ." he glanced at his watch ". . . a bite of something."

Alioune Senghor was taken aback and anxious. "Your Excellency, as students we . . ."

The other laughed condescendingly. "My son, my son. As I told you earlier, I too was a student in my time. In Paris, later in Moscow. I am used to student fare."

The Senegalese boy scurried to the tiny kitchenette and dialed the student meal of the day, for two. He was still astonished. At the fact that his father knew this notable. At the fact that a top government official such as Mamadou Diop, who was well known to have held important position in the cabinet, right next to the president himself, would bother to visit him. And, above all, that he would remain for a student's lunch!

They sat across from each other at the small auto-delivery table, and Alioune Senghor continued to apologize. He knew full well that his guest was one of the wealthiest men in Dakar.

But the other would have none of it and turned on his charm, even as they ate.

The boy said, "How long do you think we will be able to bear the financing of our students abroad?"

"Not long, I am afraid. We of the Third World are becoming increasingly, ah, shaky, in our finances."

"But how can that be? Our raw materials, our oil, copper, bauxite, nickle, iron ore, phosphates—all the rest of it—not to mention agricultural products, coffee, cotton, chocolate."

The other made a sour mouth. "Unfortunately, they control the prices of these raw materials."

The older man took a forkful of his food, disguising his distaste—he was a gourmet. He said, "It is the old story, my boy. We of the Third World have been for more than a century at the mercy of the industrially advanced powers. For all of this time they have purchased our raw materials at minimum prices, used them to manufacture their products and then resold these to us for astronomical amounts. As a result, our third world countries remain impoverished and they are all affluent beyond our dreams."

Alioune frowned unhappily. "But, Your Excellency, why do we not simply charge them higher amounts for our raw materials which they need so badly?"

Diop nodded and shook his fork at the student for emphasis. "That would seemingly make sense, and attempts have been made. Half a century ago, the most successful was when the Near East countries and a few others gathered forces and drastically raised the price of crude oil which had formerly sold for a few dollars a barrel and most of that went to Western multinational corporations which had bribed and stolen their way into control of the oil fields. The developed countries were incensed and did everything possible to browbeat, divide and even militarily confront the oil nations who thwarted them. Plans were actually made to drop a few divisions of American paratroopers into Arabia to take over the fields and force the oil countries to lower their prices. Happily, in that case the hotheads didn't prevail. However, immediate plans were made to provide nuclear and other power to supplant petroleum."

The boy was still frowning his confusion. "But why couldn't we do the same?"

The older man nodded sorrowfully. "Perhaps, thus far, because we haven't been able to exert the pressures the oil countries did. The need for our minerals is less pressing and they turn us one against the other. For instance, our country, Senegal, is rich in bauxite and recently we have located rich deposits of copper. Very well, we formed a loose organization with Jamaica, Yugoslavia, and other nations rich in bauxite, from which aluminum is extracted, and such countries as Zaire and Chile, rich in copper, and demanded higher prices. And then the agents of the West and Japan went to work. They bribed officials and sometimes actually assassinated those they couldn't bribe. Sometimes, they overthrew governments that opposed them, with clandestine tactics—Chile was an example, some decades ago. Or, sometimes,

when there was a temporary glut of copper or bauxite on the world commodity market, they would approach one of our nations, or the other, and offer to buy their full product, at a rate undercutting that agreed upon between us. Such poverty-stricken nations as Jamaica couldn't resist since its people were on the verge of starvation. They capitulated and our cartel was broken. The same happened again and again, with other commodities."

The boy was aghast. It was not a field in which he was knowledgeable. He was a student. He said, "But what can we do?"

The high official sighed. "Perhaps, our only hope is that such dedicated men as Nayef Habash and his Third World Liberation group will show us the way."

Nayef Habash! But he is the notorious terrorist!"

Diop chuckled ruefully. "That is the manner in which the Western news media present him, understandably, from their viewpoint. In Senegal and throughout the Third World, he is considered a patriot, a holy man. Perhaps he is our only hope."

"But this . . . this on the news in the past few days. Almost fifty persons were killed in his seizing of the mini-nuke. And the potential threat is that he was to use it to blow up some major population center in the West."

The high official finished his last bite, inwardly grateful, and put down his fork. "My son, hardly a century ago the ships of these Western nations were pulling into what is now Dakar and raiding into the interior for slaves. Thousands of our people were killed or captured for a fate worse than death, on but a single one of these expeditions. Are we to mourn, now, the necessary deaths of a few of these same whites?"

"But our own people died too, under Nayef Habash's command!"

"Patriots. And not simply patriots of our own small land, but of the whole Third World which has joined at long last to fight for its rights."

The student sank back in his chair, staring. "But what does he hope to accomplish?"

The older man nodded his acceptance of the validity of the question. "The Third World Liberation group demands that prices be set for all exported raw materials, based on the cost of imported manufactured goods. If inflation drives manufactured products upward, then the prices of raw materials would also ascend. It seems to us, of course, as most elementary justice, but the West, to date, has always thwarted us in this respect and we starve, while they live in affluence."

Mamadou Diop did not look as though he had done much in the way of starving in his time, but the younger man didn't think about that. Nor did he consider the fact that the diplomat was known to control half the bauxite mines of Senegal.

Alioune Senghor said slowly, albeit passionately, "I . . . I wish I could

help in some way—any way."

The official put a hand across the table and on the student's arm. "Your father would be proud of you, my son." He shrugged. "And, who knows, perhaps one day you can." He looked at his wristwatch. "Ah, I am afraid that I must be going. It has been a pleasure, Alioune, to meet you, despite the depressing subject we have dwelt upon—the humbling of our beloved country and our people."

It was that very next night that a complete stranger's face appeared on the identity screen of Alioune Senghor's tiny student apartment. A stranger of dark complexion, though not a Negro, and rather obviously not an American.

With frowning puzzlement, the Senegalese boy opened up.

The other entered. He was carrying a military knapsack over his right shoulder and he looked about the small quarters warily.

Alioune said, "Are you sure that you have the right place?"

The other was a man of possibly forty, quick of dark eyes, and his lower face looked as though it was more at home in a beard, though now it was close shaven. He also looked as though he was not used to the Western clothes he wore.

He said, almost sharply, "You're Alioune Senghor, are you not? Son of the patriot and contributor to The Cause?"

Alioune had never heard his father described as a patriot, but then, of course, the paramount chief seldom confided his business even to his eldest son. Nor did Alioune have the vaguest idea of what the stranger mean by "The Cause."

The newcomer's English was inadequate, so the Senegalese student switched to French, saying hesitantly, *"Oui."*

"Je suis, Nayef Habash," the stranger said simply, in that language. "I have been told by . . . by a mutual friend and follower of The Cause, that you are anxious to serve."

He had closed the door behind him and now his dark eyes were level on the boy's.

Alioune's own eyes, obviously widened, and for a moment no words came to him. But then he got out, "Why . . . why, yes."

"Very well." The terrorist leader unslung the knapsack, which seemed only moderately heavy, and lowered it with care to the floor. "You will hide this, as carefully as possible, here in your apartment and relinquish it to no one, save myself, or to another who bears a written message from me."

The boy was gaping at him.

The North African turned to go, saying, "Either I, or the other, should come within a few days. Remain within your quarters until then."

"I . . . I . . ."

But Nayef Habash turned quickly and left.

Alioune Senghor stared down at the canvas bag. It was strongly sealed with thick wire and lead seals. He tried to pretend to himself that he

didn't know what it contained. But he did. He did.

CHAPTER SIX

Cecila Duff-Smythe and Jean-Paul Lafitte had accompanied Rex Bader back to his mini-apartment in New Princeton University City, largely to orient themselves with their new liaison man.

On the way, in the mini-buses and the twenty seater express, they had spoken little. Originally, when Rex had ushered them toward the mini-bus in John Mickoff's building terminal, Sissy had frowned.

"I say," she said. "Why don't we dial a limousine and avoid all of the bother?"

Rex looked at her in exasperation, though it occurred to him that any man who could look at a curve like Cecila Duff-Smythe without panting, probably had one testicle missing.

He said, "For two reasons. One, you heard that old bastard Coolidge. I'm not even on an expense account, not to speak of salary. Two, this relationship between the IABI and your people is ultra-hush-hush. If we go on record as renting a hoverlimousine, it's automatically in the National Data Bank files. That's the trouble with the computer National Data Banks. They have *everything* on file. Talk about God noting the fall of every sparrow. He's a piker. They have on file every time a kid buys an all-day sucker, and it will remain on file for eternity. When you can stick a whole *encyclopedia* on a disk no bigger than an old-time dime coin, then there's no reason not to keep everything, but everything, on file. And it is. So we want no record of our renting a hoverlimousine from Mickoff's building to mine. Especially on one of your international credit cards. And I refuse to use mine, since I can't afford it."

"As Mickoff said," the Frenchman told him smoothly, "you have much to learn in international intrigue. One of us could use our card to a point a half kilometer or so from your high-rise apartment building and we'd walk the rest of the way."

Nevertheless, they took the more proletarian transportation.

Practically all that was said, en route, was when Sissy asked Rex, "What's all this last of the private eyes thing?"

Rex, still not knowing why the beauteous Britisher rubbed him the wrong way, said, "The socioeconomic systems in England and the United States of the Americas are fairly similar but not completely so. In the States we usually call it Meritocracy, which is a lot of curd, because we of the common herd seldom have much capital under this system called People's Capitalism. However, the way it works is this. The National Data Banks know practically everything there is to know about every citizen in the country. Jobs are at a premium. When one becomes available, a citizen is selected by the computers to fill it. He who is on the unemployed rolls, who is most capable of filling it. Few

indeed refuse. It means escape from NIT or GAS as it's sometimes called. That is, Negative Income Tax or Guaranteed Annual Stipend. In short, if you have a job, any job, you live on a scale above the poverty level."

"All that is well known," Sissy said. "But where does this last of the private eyes come in?"

"I'm one of those who rebels against being on the dole. I rather desperately want to work, in a society where it's practically impossible to get a job, because of the inroads of the computers and automation. They're now beginning to call it ultramation. Wizard. When I was a young fellow, I assiduously studied flying. By the time I left school, piloting, and related jobs had become all but completely automated. So I went back to school and submerged myself in the field of petroleum, and graduated with honors."

Jean-Paul chuckled sympathetically. "Just when nuclear power really began to take over, along with solar power and so forth."

"Yes," Rex said. "However, since youth I've been an inveterate reader of old-time thriller writers like John D. MacDonald and Ian Fleming. So it occurred to me that I had the qualifications, with a bit of cramming of subjects, to become a private investigator, to get a license as a private detective."

"And you did," Sissy said. "But why the *last* of the private eyes?"

"I don't know if I'm truly the last. That's John Mickoff's joke. But there's precious little in this era for the private investigator. A large amount of their work was formerly divorce. But how can you get divorce cases when so few bother to get married any more? And, even when two marrieds want a divorce, they're usually both on NIT and there's precious little property involved, so there's little acrimony between them. Then the private eye used to get criminal cases sometimes, but today crime in the old sense has practically disappeared. With the coming of the cashless-checkless society it isn't practical to steal things. It's almost impossible to steal pseudo-dollars from another man, because only he can use his Universal Credit Card and spend his pseudo-dollar credits in the National Data Banks Banking Section. Petty theft is still possible. You can steal a fur coat, or whatever, and then take the risk of flogging it somewhere. But there's no money in it that amounts to anything. So the day of the private investigator is through."

The Frenchman said, amusement in his voice, "So, what are you studying now, Rex?"

Rex Bader shrugged. "We're coming up on our destination," he said. And then, looking at the Interpol man, "This space colonization project. I'd like to bone up to the point of being able to get a job on the construction of Lagrange Five, or the lunar construction base, or even the Island One space colony."

Sissy snorted rejection of that. "Just beginning? At your age? You'd

be better off taking Director Coolidge's offer and getting into his IABI as an operative, I shouldn't wonder."

"Sage," he said wearily. "But that's contingent on our being successful in nabbing Nayef Habash and recovering the mini-nuke. Here we are."

They had pulled into the terminal. They left the minibus and made their way from the metro to his apartment.

Inside it, the three of them crowding the small living room, Sissy looked around in surprise. "I say, do you mean that you *live* here?"

"Yes," he told her.

"Very snug," Jean-Paul said, taking the mini-apartment in.

"That's one way of putting it," Rex told him, moving some things off the couch which became his bed at night, so that they could be seated.

The British operative said, "No wonder you wish to get into something to augment your income."

"Yes," Rex said again.

The other two took the couch and Rex Bader sank into his comfort chair, exhausting the seating capacity of the living room, except for the seat at the desk.

"Is that why you live in a University City?" Jean-Paul said. "So that you can continue your studies on space, in hopes employment in the space colony project will materialize?"

"That's right," Rex said. "In one of our American university cities it's rather moot where the student facilities end and an ordinary pseudo-city begins. I can carry on my business, such as it is, with this as my headquarters, but at the same time cram up on space travel and construction in space when I'm not working."

"I say, what an eager beaver," Sissy said.

Rex looked over at her. "Should we get about the business on hand, putting the arm on our terrorist friends, and avoid the snide remarks? Would anybody like a drink?"

Sissy said, "I'll try one of those pseudo-whiskeys you think better than Scotch."

The Frenchman shuddered and said, "I'll stick to cognac."

Rex got up again and went over to his autobar. No matter how careful he was about this deal, it was going to cut into his limited resources. That bastard Coolidge wasn't even letting him have expenses. It probably never occurred to these highly paid foreign operatives that even a couple of rounds of drinks were a drain on him.

He returned with the glasses, served them and resumed his seat. "Now then," he said. "Let's get on to friend Nayef."

Sissy sipped at her drink and looked at him in disgust. "You mean that you prefer this to Glenlivet? Let's check the news first, to see if there are any new developments."

Rex shrugged and went over to the Tri-Di screen, set into the mini-apartment wall. He tuned it to Library and Replay and located the last news broadcasts. When it came on, he

flicked it through the first few items and then kept it for a moment on a dispatch about the construction of the space colony.

Sissy said, "Isn't there anything new about the mini-nuke?"

"Wait a minute," Rex told her. "I like to keep up on these developments."

She resigned herself to the news commentator's message about the three new space shuttles being put into service at the Beni Abbes spaceport in Northern Algeria. There were also developments on the some two hundred men on the Moon who were digging up aluminum and titanium ores and catapulting the loads toward Lagrange Five. The ores were dumped into a circulating series of buckets and accelerated by electromagnets along a track. When escape velocity was reached—low on the Moon's surface—the buckets slowed down to launch their contents toward the prefabricated space station, which was the base for construction of the space colony itself.

"Do you twig all that?" Sissy demanded.

"Yes," Rex told her. When the item was finished, he flicked on further to developments in the mini-nuke highjacking.

The whole world was in a continuing state of alarm. It had been since the existence of the mini-nuke was first revealed, but that was nothing compared to this development. The ultimate horror weapon was in the hands of ruthless terrorists. Every governmental body, every politician, every publication, every broadcasting medium was seemingly up in arms.

There was only one new major development. The stolen two-place Air Forces helio-jet, which had already been found abandoned some one hundred kilometers from the scene of the shoot-out, had been found to have rendezvoused with at least one hover vehicle. The two helio-jet occupants, one of them assumed to be Nayef Habash, has been spirited off, complete with the nuclear weapon. But the new development was that the escape land vehicle, or possibly vehicles, had been flushed by highway police within twenty kilometers. There had been another shoot-out and the two police officers involved had been killed. But so had three terrorists. All five of the bodies and two riddled hovercars had been left behind. Seemingly, Nayef Habash, his companion, and possibly some other members of the terrorist gang, had pressed on to whatever their destination.

When the news item was over, Rex deactivated the set and returned to his seat and drink.

Sissy was biting her lower lip. She said, "I say, that bastard Simonov was probably right. They've lost more of their people than they had figured upon. For all we know, only Nayef and the colonel's so-called expert might be the only ones left. They've probably gone into hiding to regroup, I shouldn't wonder."

Jean-Paul rose from his seat and

said, "Meanwhile, I have some angles I'd like to look into on my own. I can always reach you on my pocket transceiver, Rex. Or, I suppose, usually find you here."

Rex nodded to him. "I'll stick pretty well to base. I assume that both of you, and Ilya Simonov, will be continually checking in."

"Right," the Interpol man said, nodded a farewell to Sissy Duff-Smythe and let himself out.

Rex turned back to the girl. "Another drink?"

"Not of that stuff."

He said, "Back in John's apartment when I said I didn't know where to begin, you said that we had already begun. What in holy hell did you mean by that curd?"

She looked at him, amused. "That's no way to talk to a lady," she told him.

He was irritated at himself, in being continually irritated at her. She brought out all of his own prejudices at the smug type of Britisher. But he said, "That's one of my pet peeves, the genteelism."

Her eyebrows went up. "I say, what in hades is a genteelism?"

"Using words like hades, when you mean hell. Using words like odor, when you mean smell, bosom when you mean breast, lingerie when you mean underclothes, dentifrices when you mean toothpaste, perspire when you mean sweat, soiled linen when you mean dirty clothes, expectorate when you mean spit, enquire when you mean ask, retire when you mean go to bed. Do you need any more?"

She was laughing.

"But my pet peeve," he went on, "is the use of the word lady, when you mean woman. A lady is a British peeress below the rank of duchess, or a baronet's or knight's wife, and so on. It is also passably acceptable to designate a gentlewoman in this manner, in respect of her attaining graciousness, good breeding, honorable instincts, kindliness, and so forth. However, the term becomes a genteelism when you begin using terms such as charlady, lady doctor, lady lawyer, or lady cop. Because a doctor might also be a woman, doesn't mean that she is necessarily a lady. I think the ultimate was reached when Steinbeck referred to a prostitute in *East of Eden* as 'the whore lady.' "

Sissy was still laughing softly. She opened her purse, dug around in it for a moment, found a calling card and handed it over to him.

It read: *Lady Cecila Duff-Smythe.*

She said, "My late father was a marquess. My brother inherited the title which was originally granted in the field by William the Conqueror. He worked in British Intelligence, before me and I strongly suspect was, ah, liquidated, as the Soviets call it, by Ilya Simonov, though I have no proof. It is one of the reasons I am now with the National Central Bureau of Scotland Yard."

"Oh, Christ," he said, handing the card back. "Sorry."

"Not at all," she said, British nostrils high, aristocratically. "Now, as

to what I meant by saying we had already begun. We have the names of quite a few of the terrorists, besides Nayef Habash and his daughter, Jasmin, who was evidently sacrificed in the hijacking. Most, if not all, of these are also now dead. More of the bodies are being identified, almost hourly, but of the some thirty terrorists who originally infiltrated this country, we know: Anwar Assad, Yasser Sadat, Hafez Arafar, Ahmed Hussein, Mohammed Hawatmeh, Rashid Junblatt, Kamal Karami, and Abdul Frankieh."

"Most of them dead," he repeated. "Where does it get us?"

She looked at him. "These terrorists, as Simonov pointed out, are not necessarily particularly bright, no matter how dedicated and willing to die for what they call The Cause. Most were strangers to America, I wouldn't wonder. They evidently infiltrated the country as tourists, or whatever, one by one, possibly two by two, and immediately went into hiding, probably most of them together. This would indicate that they had assistance here in America from other Third World persons who have been in the country longer; friends, relatives, or other terrorists who had entered at an earlier date. I say, you follow me, thus far?"

"Of course. Sure you won't have another drink?"

"Thanks, most awfully. Do you have Scotch on that fantastic American mechanized bar?"

"No."

"Very well. To get on. Interpol has its resources. We are checking out, in their countries of origin, all of the terrorists known to have participated in the hijacking. Monsieur Lafitte and I, and John Mickoff as well, are all connected with Interpol. The organization is attempting to pinpoint all Third World persons now in America, who are friends, relatives, or other contacts of any of the terrorists."

Rex scowled at her.

She said, "You might expect one terrorist, or two, particularly the more intelligent ones, to maintain tight security. However, when you have at least thirty, we hope that some of them might make or have made contact with others from their home countries; relatives, sweethearts, or whatever. If so, such persons might give us leads that would help in tracking down Nayef Habash and the mini-nuke."

"Makes sense," Rex admitted grudgingly.

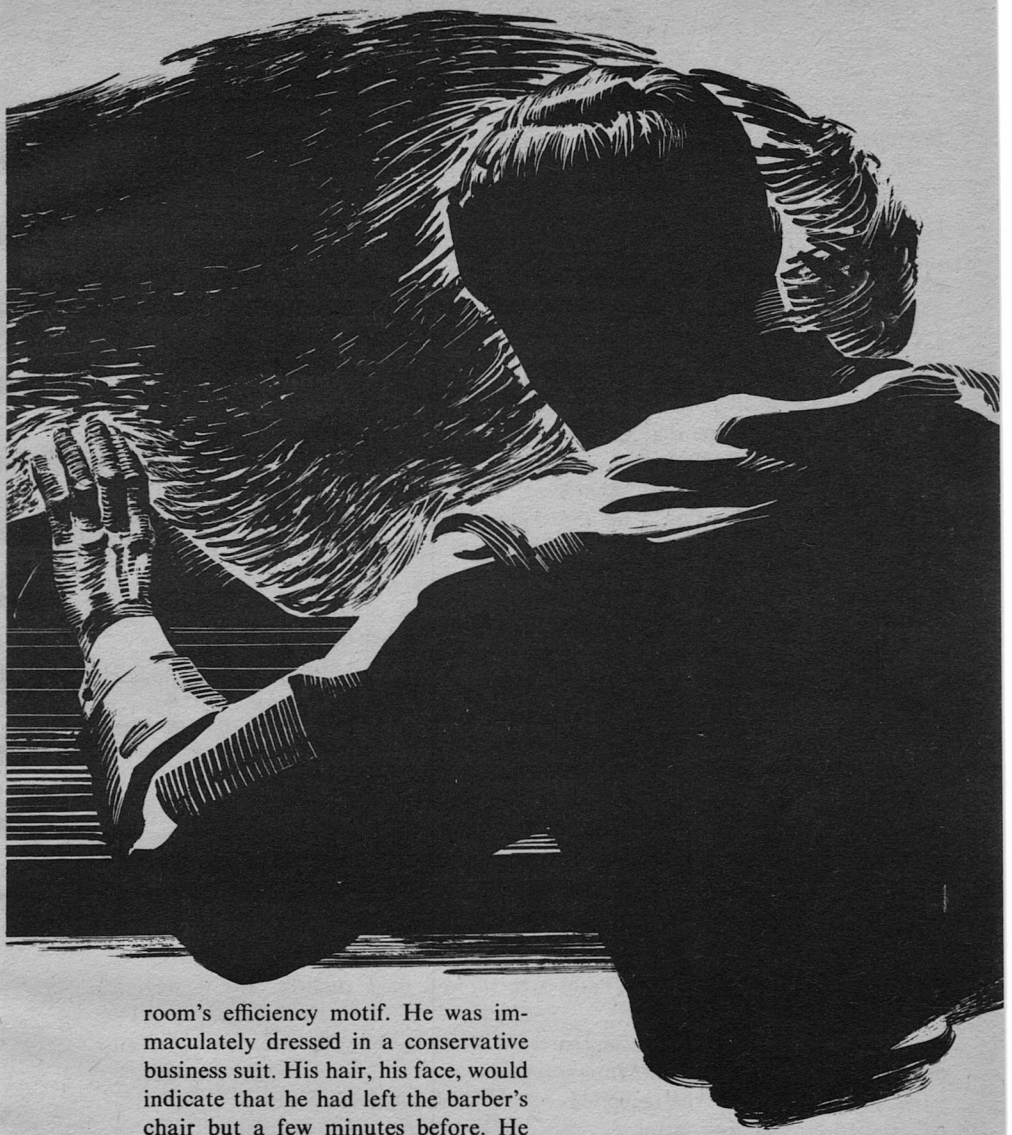
"We are checking out even far removed possibilities. For instance, most of our terrorists gang were from North Africa, but not all. Two were from Lebanon, one from Kenya, two from Senegal. We think that practically all, save the Levantines, were from Africa but we're not sure. We're checking out even far removed contacts. For instance, there are only a handful of Senegalese here in North America. We're checking to find if they have even the most remote connection with any of the terrorists—the most tentative relationships."

CHAPTER SEVEN

When The Expert entered the inner office of Anthony Damon he was followed by the young, rugged, though dapperly dressed, smoothly courteous male receptionist from the outer office. Young, dapper, courteous he might have been but there was also a distant aura of toughness and his eyes were bleakly empty.

The office was well done but certainly lacked ostentation. It was the office of a ranking executive. Cold, efficient. The rugs, the furniture, the paintings, the desk, looked as though they might have been installed but yesterday. A cleaning woman would have had her work cut out to find the merest mote of dust.

Anthony Damon carried out the



room's efficiency motif. He was immaculately dressed in a conservative business suit. His hair, his face, would indicate that he had left the barber's chair but a few minutes before. He was a very well preserved fifty, undoubtedly a horseman, undoubtedly a tennis buff, probably he sailed, probably he hunted. His tan was impressive.

And now he said, "How did you get my unlisted phone number?"

The Expert looked at him directly. "It was the only way I could think of to get in to see you."

"That's not what I asked you. My phone has a Priority Two listing. That's almost as tough a priority to get by as the private line of the President of the United States of the Americas. In short, it's practically impossible for anyone to get that number unless I give it to them."

"I know," The Expert said. "That's why I utilized it. As I said on the phone, I was anxious to see you. It was the quickest way I could think of to do it."

The man behind the desk said, "Freddy, frisk him."

The Expert heard the slightest sounds from behind. He spun in all but a blur of speed. He reached for the young man's jacket lapel, grasped it, jerked quickly to the right. His other hand blurred in. Freddy, his eyes wide at the unexpected response, rallied to resist. Leverage turned his efforts against him. The newcomer was suddenly, miraculously, behind, and, off balance, he almost fell. He felt a hand dart inside his jacket.

And suddenly the newcomer was to one side and to the rear a bit. In one hand, rock-steady, was the receptionist's short-barreled laser pistol.

Freddy, infinitely trained in the toughest of schools, began to move in, in spite of the impossible odds.

Anthony Damon, who was sitting there, his face without expression, his two hands flat on the desk surface, said, "No. That's all. Get out."

His underling's eyes were no longer empty. They smoldered hate. But he was robot-trained. He turned and left.

Damon took in The Expert, standing there, gun negligently in hand. "All right," he said evenly. "You've proven you're tough and you've proven you're smart enough to have cracked a phone number with a Priority Two. Now what?"

The Expert advanced to the desk, put the pistol down on it, turned and brought up a straight chair and sat. He crossed his legs. "Antonio," he said. "We're going to have to get to know each other much better."

"The name is Anthony."

"The name is Antonio. If you wish, I'll tell you your paternal grandmother's maiden name and your grandfather's real name. The one he was born with and carried until he was sixteen years of age and had to flee to this country after he finished his *patrono* with a shotgun."

For the first time, the other's face indicated expression. It was surprise. It showed only slightly, but it was there.

"Who in the hell are you?" he said.

"You can call me Smith."

The older man grunted. "John Smith?"

"Is there any other?"

"What do you want? You've gone to a lot of trouble already and even took some risk. Freddy's a good man.

You're lucky he didn't take you."

His visitor shook his head but made no comment on that last. He said, "I came to discuss a good thing with you."

The other looked at him for a very long moment before sighing. He said, "I'm always open to a good thing but I doubt that you've got one that would interest me, Mr. Smith." He looked at his manicured nails on his left hand. "The fact that you know my grandfather's name before he fled to this country, as you put it, indicates that you've gone to all of this trouble under a misapprehension, Mr. Smith. You see, there is no crime in this country anymore. None that makes any difference. It doesn't pay off anymore."

John Smith continued to look at him but said nothing.

Damon sighed and said, "In the old days there were a lot of things illegal that were profitable. Selling booze during Prohibition. Prostitution. Labor unions. Gambling. Even more serious things such as bank robbery, kidnapping, and other extortion." He shook his head, though not in nostalgic regret. "No more, Mr. Smith."

John Smith said, "Are you sure that they are all things of the past?"

Now Anthony Damon was impatient. "Don't be a dizzard, Mr. Smith. Prohibition is a century in the past. Prostitution? When all the curves give it away these days, before a guy can ask? Labor unions, when, for all practical purposes, there is no labor anymore, what with ultramation, and what jobs there are filled by the government computers? Gambling, when we no longer have money in the old terms? In the Bahamas, yes, through international exchange relations, but in America, no. Bank robbery, when we no longer have banks in the old sense and our pseudo-dollars are all in credit accounts in the National Data Banks Banking Section? He shook his head again.

"You forgot extortion."

The other relaxed to the point of staring at this strange visitor. "Are you completely around the bend? Look, Smith, or whatever your name is. We're not stupid. And we're not small time. These days, and long gone, we're legitimate and we're big, well-established. We have our money in resorts, in hotel chains, restaurant chains. Only in countries where gambling is practical and legal, such as in the Bahamas, once again, do we deal even in that. We're certainly not interested in snatching, as the old term had it, some multimillionaire's kid and holding him for a few million in pseudo-dollars. For one thing, a few million is peanuts for us these days. For another thing, they'd land on us like a ton of manure, even if there was some manner of figuring out how to receive payment from the father. It's stupid."

The Expert nodded. "I wasn't talking about kidnapping, and I wasn't talking about a few million dollars."

By this time the other really was staring.

He said, "Then what in the hell *are* you talking about? If it wasn't for the

offbeat way in which you got into this office, I'd kick you out right now. But I'm still curious about just who in the hell you are and what you're up to."

"I'm talking about *real* extortion, the biggest example in history. When the Spanish Conquistadores kidnapped Atahualpa, the last of the Incas, and made his people ransom him with tons of gold, silver and jewels, that was peanuts, to use your term. And I've figured out a way you could collect this ultimate ransom we're talking about and be safe to spend it."

"Now I know you're drivel-happy. The only reason I'm interested in the rest of your story is because it's so crazy. How many pseudo-dollars are you talking about, anyway? If my college history serves me, that Inca ransom was worth hundreds of millions, translated into today's medium of exchange."

"That's right. Peanuts. I'm thinking of at least a billion. Actually, the sky's the limit."

Some of the other's educated suaveness faded a bit. "What in the hell sort of extortion romp are you talking about? And who's going to pay off this billion?"

"The whole world."

Anthony Damon was goggling him.

The Expert said smoothly, "If you had possession of the mini-nuke, what could you extort the world into giving you, in return for not setting it off in one of its population centers? Or, for that matter, in the Kremlin or in Greater Washington or . . . ?"

By now, the once self-possessed business executive was speechless. And for the time, the Expert held his own peace.

Damon said finally, "But I don't have possession of the mini-nuke. Some crackpot ragheads have it."

"I know where it is. With a few good, ah, boys such as Freddy, out there, we could get it."

The other was quicker in recovery this time. "How in the name of Holy Jumping Zen could you ever collect?"

"You'd collect through the Reunited Nations. Have whatever you asked for deposited to numbered accounts in Switzerland. Nobody but a few would know who you were. You could draw on the accounts, and spend your credits, anywhere in the world. And they wouldn't dare touch you because your organization would still have possession of that mini-nuke."

"Holy Mother," the other blurted. "You mean it. You mean the whole thing."

The Expert nodded.

Anthony Damon came to his feet, staggered to his feet, would be the better term. He went over to an attractive personal bar, set inconspicuously between some bookshelves on one wall. He shakily took up a bottle and a tall glass.

"Drink?" he said.

"Whatever you're having."

Damon took up another glass and returned to the desk. He slopped two generous portions into the glasses and

handed one of them to his visitor. He knocked his own drink back without waiting for such amenities as a toast. He slumped back into his desk chair and reached for the bottle again.

The other sipped at his glass and raised eyebrows at his host.

Damon said finally, "Where do you come in? What do you get out of it? Why come to our organization? Why not handle it yourself?"

"It's too big for me. I've figured it out to the last detail, but I couldn't handle some aspects by myself."

The other's eyes narrowed. "How do you know we wouldn't cross you, once we got our hands on it?"

"Because I know its operation. You don't. It'd take you some time to find out—without me. By that time, I'll be long gone."

"Go into that a little more."

"All right. I want you to deposit a million pseudo-dollar credits to my Geneva account. I want it to be there when I've delivered to your satisfaction. Then I'm going to disappear. You'll never see, or hear from me, again. I'm not too hungry. A million is plenty."

Anthony Damon slumped back into his chair, his eyes wide. He finished his drink.

"I'll have to think about it some more and talk it over with some of the others in the organization." He paused, before adding, "They'll most likely turn it down. As I told you, we're legitimate now. We've got our money in resorts . . ."

But The Expert was shaking his head. "You keep underestimating me, Damon. Your organization, as you now call it, is on the skids. And it's just a matter of time before you go under."

"You don't know what you're talking about!"

"Yes, I do. The origin of your families was far back, under feudalism. You thrived. Then classical capitalism evolved, and under it you thrived again, particularly here in America through the first of the 20th century. With the coming of what is sometimes called State Capitalism, after the Second World War, you still did fine. But this is Meritocracy, still an advanced form of capitalism, perhaps, but with differences."

"I'm beginning to think you're around the corner again."

The Expert shook his head again. "Obviously, you're no longer an organization of illiterate hoods, such as Al Capone, or even Lucky Luciano. The children, grandchildren and great-grandchildren of such as these went to college. They became educated, uh, ladies and gentlemen—such as yourself. But the thing is, nepotism still remains the basic thing. You're on the top of the heap personally because you were born into one of the families, with all its accumulated resources. But that doesn't work under Meritocracy, Damon, and I imagine you're beginning to realize it. When old Henry Ford died, his children took over management, and the grandchildren and so on, after them. But no more of that today, if you want

to stay in business. University education, even Ivy League, isn't enough. You've got to really have it on the ball. And those of the great fortunes who attempt to handle their corporations in the old way, go under. Meritocracy doesn't give a damn who your father was, or how much money your uncle has, that sort of thing. It selects the best person in the country for a job, management or otherwise. Sure it selects some of these from the old rich families, it selects some of them from people born in the slums. It selects some from the children of Meritcrats, but only when they're best suited for the job."

Damon said sourly, "It works differently with us. We don't depend on the computers. We still run our own projects."

"And that's why you're on the skids. The reason you don't turn your interests over to the Meritocracy setup is because you don't dare. All the other sizable corporations have. But you can't. Due to the centuries-old nature of your whole outfit, you can't expose it to public gaze. You've got to keep everything within the families. I'll bet that even Freddy, our strong arm boy in the outer office there, is a nephew, or something, of yours. The computers wouldn't even select him as an office boy, in an ordinary corporation."

Anthony Damon didn't like it a bit, but for the moment he said nothing.

The Expert wound it up. "And that's why you people are on the way out, Damon. One of these days you'll go broke. This opportunity I'm giving you is a godsend. With this much of a nestegg, the whole bunch of you can retire."

Damon was breathing deeply, probably unbeknownst to himself. He said, "I've still got to talk it over. But, if you're on the up and up, Smith, I think perhaps we've got a deal."

CHAPTER EIGHT

When Colonel Ilya Simonov entered the small cafe, it would have been difficult for him to have been picked out as other than any of the habitués, though he had done little in the way of disguise beyond taking a hypodermic shot which had darkened his complexion several shades within a couple of hours. The usually faultlessly dressed agent wore an aged, unpressed second grade suit and wore it in that manner those of North Africa almost universally wear Western garb, as though they would have been more comfortable in a djellabah. He even walked as though more used to Babouche slippers than shoes. He stood in the doorway for a moment and looked about.

The cafe was an anachronism; in an age of autocafeterias, autobars, and autorestaurants, it was a breath of yesteryear. Located in lower Manhattan, in an area largely inhabited by Levantines, Arabs, Armenians and Berbers, it would once have been called a coffeehouse. Today, some of the traditional dishes were still served, particularly overly sweet, dripping with honey or syrup, pastry desserts,

but the Baalbek Cafe was also licensed for such potables as anis and arak, despite the prohibitions of Islam. A single waiter, in soiled apron and wearing a bedraggled short beard and a dirty yellow turban, served.

Simonov made his way to an empty and more or less isolated booth, located where the doors both to the street and to the kitchen could be observed, and when the waiter came, ordered Turkish coffee and a glass of arak. At some of the other tables, waterpipes were in use, but he couldn't quite stomach such, even for the sake of protective covering.

When the coffee arrived, he took it down, Near East fashion, in two tiny sips, leaving the black dregs in the bottom of the cup, and then sipped at the atrocious arak. It was an Iraq brand, made of dates, and tasting, the Russian was of the opinion, like turpentine.

When the man Ilya Simonov was waiting for sidled into the booth across from him, the Russian agent eyed him for a long time.

Finally, he said, "Comrade Sese Kaunda? I am known as Comrade Ivan." He spoke in faultless Arabic, but right now with a slight accent which would have placed him from somewhere in the vicinity of Bamako or Mopti, in Mali. He could have used other accents.

The other was somewhat more prosperous in appearance than the average of the some thirty occupants of the Baalbek Cafe. His suit was not wrinkled and begrimmed and he was lardy and sweaty. He could have gotten an actor's job any time at all on Tri-Di as a stereotype Levantine businessman, probably in some semi-illicit, or, at least, shady enterprise.

He said unhappily, "I did not expect this . . . meeting. We have been very careful of my cover, with the long view in mind. It has been over three years since I have been directly contacted by the KGB." He also spoke Arabic, his voice so low as not to be heard further than across the table.

The waiter came shambling up and took the newcomer's order for French cognac which brought a slight rise to the employee's eyebrows. Simonov ordered another arak.

When the waiter was gone, the Russian said, "This is obviously a matter of importance, Comrade Kaunda, or I would not have run the risk. You are our sole operative in New York who is both a Party man and a . . ." His mouth twisted in a slightly sardonic moue " . . . loyal member of the Third World Liberation."

There was unhappiness in the other's small dark eyes, which Ilya Simonov didn't fail to catch.

"What is it that the Party wishes of me?" he said.

Simonov said smoothly, "As you undoubtedly know, the Soviet Complex has been supporting the more radically inclined, not to say rabid, elements of the Third World Liberation."

The other looked slightly surprised at that, but then the waiter came with

their drinks and he held silence.

When they had been served and the waiter had gone, the Russian went on. "With the motivation, of course, of discomfiting the West. Supposedly, an era of détente prevails, but still an underground battle of the campaign for men's minds continues."

Evidently, that seemed to make more sense to the other, who now looked somewhat less apprehensive. "Yes, of course," he said, taking down half of his brandy as though he felt he needed it.

"Clandestinely," Simonov went on, "we have been aiding Nayef Habash . . ."

"May his life be as long and flowing as the tail of the horse of the Prophet," Kaunda entoned, in formula.

The other's tone shouldn't have been quite that strong, the Russian realized, and inwardly felt a twinge of satisfaction. His hunch was working out.

He went on. " . . . both financially and in securing weapons and other needs, passports, that sort of thing."

"Yes, of course. Then the news accounts that the Soviet Complex has joined the Western powers in rejecting Nayef Habash and The Cause are simply . . ."

"Propaganda," Simonov said flatly.

"I see," his companion nodded. "And what is it that the Party asks of me?"

"Every indication is that this people's champion is now in difficulties. We must make contact, so that we can come to his assistance. Certainly, above all he must need funds." The Russian pretended to think about it. "And possibly means by which he can bring additional followers into the country, so as to complete his current great project. Undoubtedly, you have heard of the unfortunate fact that the brave Anwar Assad, Nayef Habash's closest companion, was lost in the attack upon the convoy of the imperialists, as well as many others."

"Yes," the other said lowly and quickly finished his cognac.

Ilya Simonov nodded. "We believe that the remnants of Nayef Habash's guerrillas have gone into temporary hiding, until assistance can be brought to them. However, how is it possible to assist unless we can make contact?"

The sweat was more obvious on the other's face, but he got out, "Yes, of course."

The top Russian operative continued. "Now, obviously, for our courageous Third World champion to hide out in America presents its problems which would not exist in Africa, where a thousand, a million, eager followers would spring to his aid. It is not simply a matter of occupying some remote cabin in the mountains, or perhaps in the desert of western America. In such places he would be conspicuous."

The other nodded, accepting that immediately.

"His best alternative is to, ah, go to ground, inconspicuously in a large city and preferably one where there are as many others as possible who resemble

him, racially and otherwise. And what city in all of North America is the home of the largest number of our peoples?"

"You mean New York?" Kaunda said, and once again there was unhappiness there.

"Of course. We have come to the conclusion that Nayef Habash and his surviving companions are somewhere in this city. We have made somewhat complicated arrangements to transfer American pseudo-dollar credits to his account—through any front which he might now be using. And I have been given the task of getting this financial aid to him and also to find what other requirements he has."

The other was frowning hesitantly. He said, as though in apology, "But why should the Soviet Complex support Third World Liberation?"

And Simonov was condescending. He said, "My dear Comrade Kaunda, the Soviet world is self-sufficient. We do not need the oil of Algeria, the phosphates of Morocco, the copper of Zaire, the bauxite of Senegal. We have our own. But if Third World Liberation is successful, and prices of raw materials are raised sky high on the commodity markets, then the economies of the West will be wracked. Under such conditions the Party might well come to power in at least some of their countries."

That seemingly made sense. The fat undercover operative had never known the Soviet Complex to be motivated by altruistic reasons. What his superior was actually saying was that the Party didn't give a damn, really, about the Third World, but was anxious to embarrass the United States of the Americas and the rest of the West.

"Yes, of course," he said. "But still, what is it that you require of me?"

Simonov looked at him. "I want to be put in touch with Nayef Habash."

The other must have been able to see it coming, but he still winced. He said, "I . . . I don't know where he is."

Ilya Simonov looked at him again, "Then who does?"

"I could investigate. I . . . I could possibly find out."

"Very well. We shall go to your office and you will investigate. Time is most important, Comrade Kaunda. It is well known that the American IABI is devoting all of its energies toward finding him and the mini-nuke. We also know that Interpol and the British National Central Bureau are active in finding him and have diverted their top field agents to seeking this champion of the Third World."

The fat man didn't like that, obviously, but just as obviously there was nothing for it, though he had hoped to be allowed to go off and make his own efforts to locate the elusive terrorist. He began to come to his feet.

But the Russian said, "You'd better pay for these drinks. I am traveling incognito and I would rather not pinpoint myself by using my International Credit Card."

Sese Kaunda took out his own Uni-

versal Credit Card and put it in the payment slot. The two arose and, arousing no attention whatsoever, left the Baalbek Cafe and its sad gathering of North Africans and Near Easterners far from their own more compatible homes.

On the street, the shorter, fatter man brought forth his pocket transceiver to summon an automated hovercab but the Russian operative shook his head. "No. We'll walk."

"But it's several blocks."

"In my time, I have walked several blocks before," the Russian said wryly. "The hiring of any cab goes into the data banks, both the point of picking it up and the destination. We also have heard that the Americans are beginning to put spy lenses into their vehicles so that the faces of the occupants are also recorded."

The other said in surprise and obviously thinking back, wondering if in any way that affected him, "I didn't know that."

Simonov said dryly, even as they took to their feet, "The famed freedom of the West seems to be slowly eroding."

As Kaunda had said, his office was a few blocks away. They spoke little until they arrived.

"The stairs, rather than the elevator," the Russian said. "Elevator compartments are also susceptible to being bugged and to having spy lenses."

"But my cover is perfect," the lardy man protested.

"Indeed?" Simonov said, leading the way to the stairs. "If so, it is the first time in my experience."

His companion didn't exactly know why, but he felt a qualm of unease as he mounted the stairs. There was no record—anywhere—of his rendezvous with this ultimately dangerous Soviet Complex agent.

His office was well done, even a bit on the luxurious side, in the fashion of the East, and the eyebrows of Ilya Simonov went up slightly. He had noted, as they progressed down the corridor to it, that none of the other occupants of the floor were present at this time of the evening. The offices were unlighted.

Kaunda had caught the expression and said, overly hurriedly, "My business, which is also my cover, has prospered in the past few years since I was located in New York."

"It seems to have," Simonov said. He found himself the most comfortable chair in the room and settled into it and crossed his legs. "And now, the efforts to locate our Third World hero?"

The other hurried on short, chubby, quick moving legs to an autobar. "A drink?"

"Vodka, please. Very cold. Russian or Polish, preferably."

"I am afraid that my bar is set only for the domestic ersatz brand."

"I was afraid of that too," the Russian sighed.

Drinks in hand, the lardy one raised his glass and said, "To the world revolution."

The Russian raised his vodka and

changed the set formula. "And to those who faithfully strive for it." He had slightly stressed the *faithfully*.

They knocked the drinks back. Simonov said gently, "And . . . now?"

Sese Kaunda had taken the chair behind the desk. He said, his voice less than happy, "Rumor has it that Nayef Habash has taken refuge in northern New Jersey."

Simonov was mildly surprised. "Indeed?" he said. "Then, Comrade, let us go about tracing down this rumor."

But it was then that the phone screen buzzed.

Frowning, the heavyset undercover agent activated it. From where the Russian sat, the screen couldn't be seen and the speaker's voice seemed to be held low.

Finally, Kaunda's face came up and it was wan. He said shakily, "It was a warning from . . . from someone close to Nayef Habash. He said that Colonel Ilya Simonov of the *Chrezvychainaya Komissiya* has been ordered to ally himself with the Americans in seeking Nayef Habash, may Allah award him in Paradise."

"Ah," Simonov said interestedly. "And who was this someone close to our Nayef?"

"He . . . he didn't say. He was a Westerner, American or European, I'd guess. He said merely that he was an expert in the services of the Third World Liberation group."

The Russian's face froze. "An *expert?*

"Yes, Comrade."

Ilya Simonov, taken aback, said finally, "I see. And what else did he say?"

"He described you, Comrade Simonov. His call was to warn me that if you appeared on the scene, not to reveal the hiding place of Nayef Habash."

"Indeed?" the Russian said coldly. "You have let something slip *Comrade* Sese Kaunda. You obviously know our hero's hiding place. There is no need for you to trace down vague rumors."

"No, no!" He had gotten the implication. In terror, the fat man darted a hand for a desk drawer.

Ilya Simonov's right hand seemed hardly to move but there was suddenly a vicious-looking stubby handgun in it. He said, "You'd better leave that where it is, *Comrade.*"

Kaunda froze. Slowly, he brought his chubby hands up and put them on the surface of the desk.

"That's better," the Russian said pleasantly. "And now, Comrade, it becomes obvious that you are no longer of use to the Party as an agent of the KGB. Original plans were to plant you here for an indefinite period, without knowledge of how you might be ultimately utilized. Something would evolve, sooner or later. But it would seem that your allegiance to the Third World Liberation group and The Cause is stronger than that to the Soviet Complex."

"No," the other gasped, breathing deeply, desperately. "I am loyal to the

Party and to the Soviet . . ."

"You can prove that by now telling me just where Nayef Habash has gone into hiding. On the face of it, this expert who phoned you lies, for whatever purpose we know not. But my assignment still stands. I am to contact the Third World leader and get funds to him and request of him his other requirements. You will tell me his location, *Comrade* Kaunda, then I will leave. You will no longer be in the KGB's employ but will go your own way in whatever manner you see fit."

The fat man didn't believe him. He blurted, "You'll . . . you'll shoot me."

Simonov snorted. "You have been watching too many of the Yankee Tri-Di shows, Kaunda. Such things are matters of the past. We no longer shoot people, certainly not for such little reason. How could it possibly benefit the Party to shoot such a nonentity as yourself? You're not important."

The sneering deprecation gave heart, however little, to the fat man. He clutched at straws, in desperation. He said, "He is staying in the New Princeton University City."

Ilya Simonov was again surprised. "He is? Where in the University City?"

"I don't know. That's all I know."

"You're lying, Kaunda."

The other shook his head violently and yelped, "No. No, that's all I know."

Simonov considered the quaking jelly of a man. It would seem the other wasn't lying. It was all that he did know.

The Russian agent shrugged and came to his feet. Easily, gracefully, even nonchalantly, he raised the laser pistol he held. It hissed and Sese Kaunda was cut all but in two. The scream that rose to his lips was never uttered.

Simonov reholstered the weapon, looked about the room briefly, then turned and left.

CHAPTER NINE

When Colonel Ilya Simonov appeared at the mini-apartment of Rex Bader, it was to find Rex and Sissy deep in paperwork, both the TV phone screen and the National Data Banks library booster in use.

The British agent looked up, and with ill-disguised dislike said, "Oh, it's you."

Simonov took over the comfort chair and said, "What are you two about?"

Rex, who had answered the door to let the other in, resumed his seat at the small desk, facing the TV phone screen and the library booster to one side.

He said, "Sissy has put both the British National Central Bureau and Interpol to work on identifying the terrorists who were killed in hijacking the convoy and then checking out whether any of them had friends or relatives in this country. It's the only idea we've come up with to try to get a line on Nayef Habash and his gang. So far, we've had precious little luck,

in spite of the fact that I've been given a Priority One in the data banks. How about you?"

The Colonel said, "I contacted one of our agents, who's job was to keep in touch with developments of North Africa and Near Eastern elements in this country. He'd heard rumors that Nayef's terrorists had gone to ground in New Jersey here."

"Huh," Sissy said, not looking up from a list she was checking over. "I don't twig that at all. He'd more likely pick some big city. New York or Chicago, I shouldn't wonder."

"Ummm," the Russian said. "My own first guess. However, we come to another interesting aspect. He also informed me that a Westerner, a European or American, who called himself an expert in the employ of the Third World Liberation group, has been spreading a warning against revealing Nayef's hiding place to Russian agents, since we had united ourselves with the West to recapture the mini-nuke."

Both Sissy and Rex looked at him blankly.

"An *expert*?" Sissy blurted. "I say, that's the exact term you used when you came up with the theory that the terrorists weren't smart enough to have pulled this, ah, romp by themselves. That they'd have to hire a Western-trained mercenary—an expert."

"Yes," the Russian agreed. "Quite a coincidence."

Rex scowled down at a paper in his hand. He said, "Rashic Franjieh. He lives in Chicago. He's a cousin of Mohammed Hawatmeh. Both born in Oran, Algeria. Hawatmeh was one of the terrorists killed in the shoot-out."

"All Moslems have a couple of hundred cousins," Sissy muttered. "However, . . ." she dragged the phone screen around to face her. "We'll have Mickoff send an agent to twist this chap's arm a bit."

While she was at the TV phone, the identity screen on the door buzzed and Rex went to answer it.

It was Jean-Paul Lafitte, wearing his customary wry expression. Old movie buff Rex Bader thought that he looked like that star of the past, Franchot Tone.

"Where in the hell have you been?" Rex said, leading him back to the others.

"Compiling more of your American graffiti," the Frenchman told him cheerfully. "I found this gem in a *pissoir,* written on the wall. *Do not throw cigarettes in the urinals as they become soggy and hard to light."*

Rex Bader sighed and said, "That's one of the standard old wheezes. This is a better one. *The Lord said to the Good Shepherd, Fuck Off, this is cattle country."*

"All right, all right, you chaps," Sissy said. She looked at Jean-Paul. "What have you really been doing?"

He sank down onto one end of the couch. "Well, it occurred to me that the terrorists had at their command an inordinate amount of fire power. Most of them were armed with later model Russian Kalashnikov AK 47

assault rifles, one of the best submachine guns ever produced. But there were also two German MG 42s, which in turn is one of the better heavy machine guns. Most were also equipped with more modern Gyrojet sidearms. Besides that, there were the explosives that mined the bridge and later blew the road. I'm not counting the laser weapons carrier, since we know that was stolen from an Army arsenal."

"And?" Simonov prompted.

"It seems unlikely that they would have smuggled in that amount of equipment when they themselves entered the country one by one. Had they tried, most certainly some of them, at least, would have been apprehended. That means that they must have secured their armaments here in the United States of the Americas."

"But where?" Sissy said.

Jean-Paul looked over at her. "Here in America there are still elements of free enterprise, though they call their socioeconomic system People's Capitalism, or sometimes Meritocracy or the Ultra-Welfare State. These include several private enterprises that buy up used surplus war equipment and resell it. Through them you can purchase anything from pistols to artillery and even aircraft and tanks."

Sissy looked at Rex Bader, her nostrils high, "I thought the United States of the Americas currently had rather strict regulations involving buying and selling weapons."

"So did I," Rex told her. "It's only because I'm a licensed private investigator that I'm able to own a firearm."

The Frenchman shook his head. "They don't sell to Americans, but only to foreign customers, governments, or other overseas groups. In some portions of the Third World there are elements attempting to overthrow their leaders. There is no law against providing them with arms, just so the arms are shipped abroad."

"And what did you find?" Simonov asked. "Forgive me for saying that I am no great admirer for free enterprise."

The Frenchman snorted at that, considering the source, but said, shaking his head, again, "A company located in Delaware had, indeed, made a sale which was undoubtedly to our terrorists friends. The weapons were paid for in Swiss gold and supposedly loaded upon an aircraft and flown to one of the Caribbean islands. The papers of the arms company *and* those of the purchasers were quite legal. However, obviously the guns and other equipment never really left this country. I have two of my people trying to check out the aircraft utilized and also to get a lead on the single person who made the purchase. The salesman claims that the man's identification seemed to be in order and that he was very dark of complexion, which wasn't surprising for one who claimed to be a Caribbean islander, and that his English had a British accent but was excellent."

"How does it look?" Rex said.

The Interpol operative shook his head. "I could be wrong, but I doubt if we'll get a lead through this. Undoubtedly, whoever is masterminding the whole thing, took considerable care to keep his tracks covered."

"The Expert again," Sissy said. She added grudgingly, "I'm beginning to accept the colonel's hypothesis."

"I'll report this arms thing to John Mickoff and through him to the Director," Rex told them. "They'll possibly throw more manpower into it. I suspect that the IABI is ass deep in manpower with no ideas of where to use it."

Jean-Paul shrugged. "My people could probably handle the matter but possibly you're correct. A larger number of agents might be able to discover where the aircraft unloaded, though I suspect that it was in some out of the way place, rather than any airport."

"So, chaps, where are we?" Sissy said.

"Nowhere," Rex told her glumly. "All we can do is continue to try and find some friend or relative in the remote possibility that he could lead us to our remnants of the terrorists."

Simonov said, "I'll continue to check our KGB agents. Some of them have contacts with minority dissident groups. And I have a few other ideas I'll mull around."

Rex looked at the Frenchman. "Jean-Paul?"

"I'll continue to collect my graffiti."

"Ha," Sissy said. "Very evasive. What have you got up your sleeve, old boy? Something I should know?"

"My arm, old girl. Has there been anything in the news of late?"

"Nothing really," Rex told him. "World indignation is boiling over. It would seem that half the students of school age are on the streets demonstrating rather than sitting in classrooms or before their auto-teachers. Politicians are having a field day with their speeches. Everybody and his maiden aunt are sounding off against Uncle Sam for ever building the mininuke at all. The other nuclear powers piously proclaim that they wouldn't have done it. But nobody believes them. Colonel, was the Soviet Complex working on a similar device?"

"Yes," the colonel said. "You people merely beat us to it. However, in the past few days scores of nuclear physicists have signed petitions against such weapons being developed in the Soviet Complex and there has even been a strike by workers and technicians in one of the nuclear weapons industries against our government building such doomsday devices." He added, wryly, "A strike in our country is somewhat unique."

The phone screen buzzed and Rex Bader answered the call, the others watching him. He looked up. "A would-be client. He wants an appointment. I'll brush him off."

But Jean-Paul said hurriedly, "No, don't do that. There'd be a record of the conversation and there's no reason, supposedly, for you to discourage a potential client, since you aren't presently on a case. This connection

between we three and yourself is supposedly ultra-hush-hush. Nothing can remotely relate us to you."

"Well, what in the hell can I do with him?"

Sissy said, "Why not just let the chap come? Listen to whatever case he wants you to take, and then come up with some reasonable reason for rejecting the assignment. We'll leave and check with you later. I've got something to look into that'll take an hour or so."

Jean-Paul yawned as he came to his feet. "And I, too. I haven't got around to checking two of the men's rooms down on the lobby floor for graffiti."

There seemed nothing else for it. The representatives of the Soviet Complex, England, and Interpol filed from the tiny room.

Rex turned back to the phone screen and made arrangements for an appointment.

Afterward, while awaiting the appearance of his potential employer, he dialed himself a pseduo-whiskey and soda and took over the comfort chair. He mulled it around.

It didn't mull very well. If this team of four was successful in locating the mini-nuke and the terrorists, then he had it made. He'd realize his dream, the securing of a lucrative job and an escape from being on Negative Income Tax. It didn't make any difference who cracked the thing, himself, Sissy, Jean-Paul, or Ilya. If any of them cracked it, or all in unison, he'd get the position with IABI that the director had promised.

But the thing was, they weren't going to crack it. If anybody did solve the mystery of where Nayef Habash and the mini-nuke were, it would be the IABI, with all its resources and manpower. But he had a suspicion that they weren't going to do it either. This character they were beginning to call The Expert was too far ahead of them. So far, not a wheel had come off his extensive plan. Not a hole had manifested itself in the scheme.

In a way, you had to admire the sonofabitch.

Still waiting for his visitor, he switched on a replay of the last news, to find out what he could of the Lagrange Five and the building of the space colony Island One. Everything, it would seem, was going swimmingly. The project was far ahead of schedule. There was a debate taking place in the Reunited Nations, which was financing the whole colonization project, to construct another ten space shuttles to speed matters up even more. Good, Rex Bader decided. The bigger it got, the greater his chance of ultimately landing a job with them, if he didn't swing this appointment to the IABI.

Of course, there was opposition too. Opposition to the whole space program but especially the building of a space colony, the Island One. It was basically the same opposition that had existed since President Kennedy had announced that the United States would put a man on Luna before 1970. Billions of dollars had been expended on what the opposition had called a gigantic boondoggle. With

millions of human beings literally starving on the face of the Earth, why plow billions into reaching the Moon? Today, the argument was simply an extrapolation. Why spend more billions on constructing a space colony which, even if completely successful, would house but ten thousand persons? The same amount of resources spent on Earth could bring modern agricultural methods to the Third World, could bring perfection to the farming of the sea, could open huge areas of the world, now practically untouched, to human exploitation. The Amazon valley, for instance.

The debate burned hot and thus far the advocates of the development of space were a hairsbreadth ahead. The program went on. But each time a new appropriation was called for, it became more difficult to push through. Even the adherents must wince when costs soared. Programs that had originally been budgeted at a billion or two, would finally be completed for four or five. And over and over again. The opposition contended that Mother Earth was being bled white to finance this meaningless expansion into the solar system.

He was deep in all this when his door buzzer sounded. He flicked the library booster off and rose to answer it. The face on the screen was that of a young black. In fact, the blackest Negro Rex Bader could ever remember having seen. However, the features were not Bantu, but reminded him of statues of the early Egyptian pharaohs, say that of Rameses the Second in his early years.

Rex opened up and gestured for the young man to enter.

The other came in hesitantly and looked around. "You are Detective Rex Bader?" he said, frowning slightly.

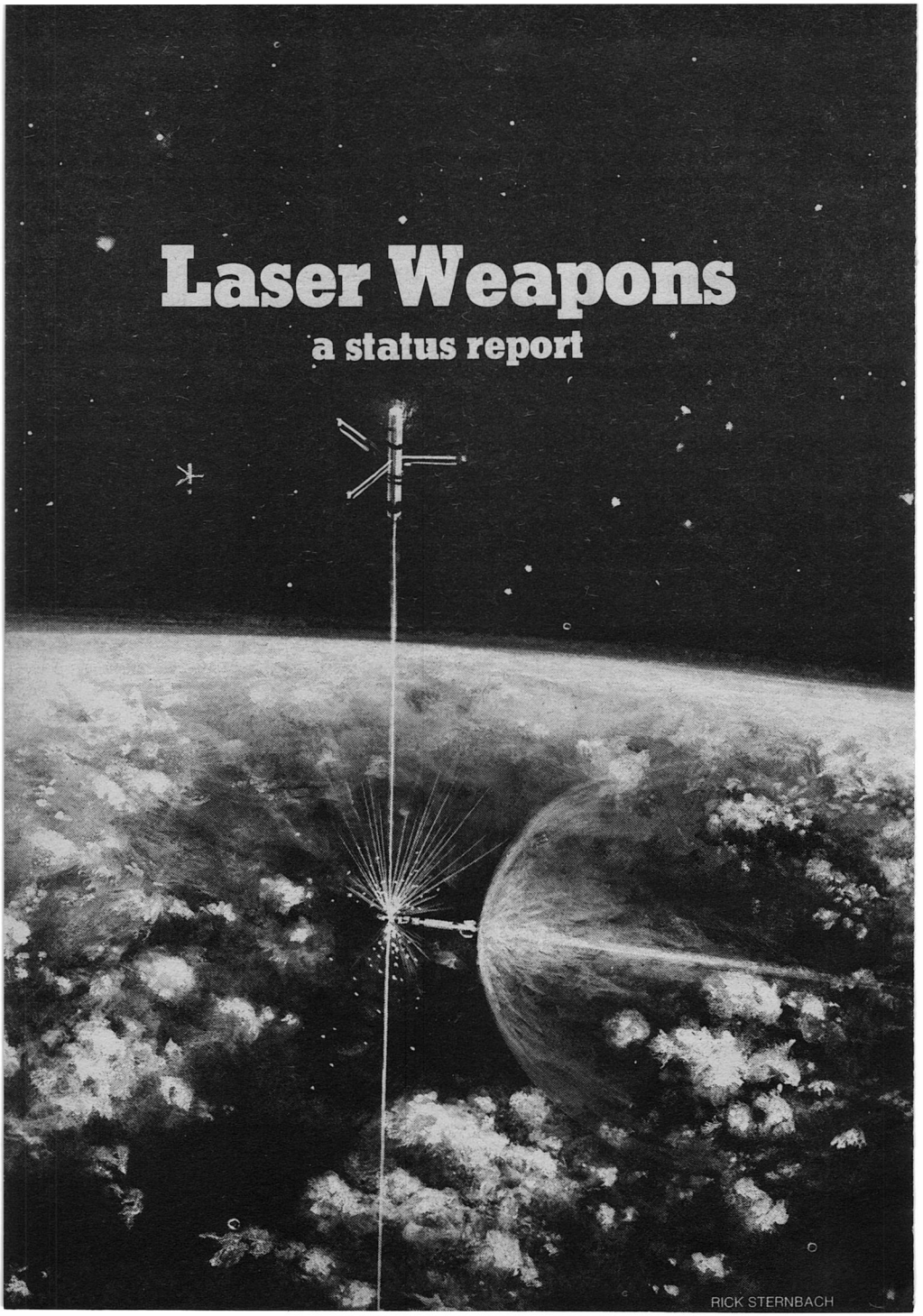
"That's right."

"My name is Alioune Senghor."

END OF PART ONE

Laser Weapons

a status report



RICK STERNBACH


The
Laser
BMD

Laser Weapons

a status report

We're not yet at the stage where the hand-held "blaster" is in sight. But we're getting closer!

by Jeff Hecht

When the first laser was demonstrated in 1960, it was quickly identified with a standard prop of science-fiction writers as least as far back as H. G. Wells—the "death ray." Since then lasers have found a multitude of peaceful applications, from sewer alignment to reading bar codes, that were never envisioned by science-fiction writers. The military has used lasers to guide bombs and missiles to their targets. But despite research costing hundreds of millions of dollars, practical laser weapons remain in the realm of science fiction.

The basic problem—from the military point of view—is that lasers aren't really very deadly. It's easy to build a low-power laser with a beam capable of inflicting damage only to

The Laser BMD

New weapons cause new problems—for everybody

by P. J. Nahin

We live in an age of weapons. Never before in the history of mankind have the weapons of war been so dominant a concern as they have been since 1945. Armaments now have enough destructive power to destroy most life on earth. Their acquisition or presence determines, in large part, the makeup of governments, the course of foreign policy, the thrust of economic effort, the social climate in which man lives. No significant act of contemporary history is free of their influence. Few other concerns in the world demand so much effort, time and money. —George Thayer

The War Business: The International Trade in Armaments
(Simon and Schuster, 1969)

the eye of someone silly enough to stare into it.* To build a high-power laser for use as a weapon, however, three formidable requirements must be met. First, the laser must be big, able to emit about a billion times more power than the small helium-neon lasers used for most demonstrations. Second, the laser must be rugged enough to survive a hostile environment, and reliable enough to fire at a moment's notice at every one of a series of targets. Finally, the laser must be able to get enough energy through the atmosphere to a target to destroy the target.

** Someone foolish enough to stick fingers into the high-voltage power supply of an operating laser could easily get electrocuted, but the same could also happen with many other types of electronic equipment.*

Despite these obstacles, laser weapons offer enough advantages—at least in theory—that military agencies are continuing to pour large quantities of money into laser weapons research. This year the US Department of Defense will spend almost $200 million just on programs to develop high-energy lasers. By the mid 1980s, government planners hope to have some usable hardware to show for their research dollars. Most of the details are highly classified, but enough can be pieced together to give an overview of the state of the art.

The basic reason for the interest in lasers is that they could provide an almost perfect weapon against satel-

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There is no way I can avoid admitting it—this is an opinionated paper. To emphasize this, I have written it in the first person. Advocates of dispassionate, hard-nosed analysis based on the rock of the "laws of nature, mathematics, and the limitations of technology as we know them today" will grind their teeth at much of what appears here—some of them might even want to put my neck between their teeth while they grind! But the disruption of lives of this sort is my goal here, in the hope that where they find fault they will respond with the aforementioned hard-nosed analyses.

It has become fashionable to produce disdainful smiles at the credibility of laser weapons technology. The old saw, "A laser big enough to do militarily significant damage would be so big it wouldn't have to work—just drop it on the enemy," has been trotted out so many times that hardly anyone seems to stop to see if it *really* has cutting teeth. Certainly there are enormous technical difficulties involved, but it astounds me that writings on such topics as interstellar communication [1] and orbiting solar power stations costing tens of billions of dollars [2] can be received in a serious way, while at the same time technical objections are raised to laser weapons because, for example, it will be just damn hard to make an output mirror with an absorption coefficient of less than 10^{-4}! Pardon me, but there seems to be some confusion on

(continued on p. 84)

lites and such fast-moving targets as aircraft and missiles. Like other forms of electromagnetic radiation, a laser beam travels at the speed of light: 186,000 miles or 300,000 kilometers per second. In the time it takes the laser light to travel 150 kilometers, a plane or missile traveling at several times the speed of sound moves only one meter. As the target moves, the laser beam can be made to keep pace with it simply by adjusting a mirror near the laser.

The speed of the laser beam and the ability to move it quickly make a laser weapon far superior to a missile, which cannot move much faster than its target. To hit a target with a missile, you have to aim where the target will be when the missile crosses its path. This gets complicated, especially since potential targets can be kept on paths deliberately made difficult to predict. It's no wonder military planners would prefer a laser beam which would—at least to a first approximation—travel in a straight line to its target.

A laser weapon would operate by depositing enough energy onto the target to destroy or disable it. That doesn't mean that the target would have to be vaporized, however. Electronic sensors for reconnaissance and guidance could be "blinded" by pointing an intense laser beam at them. The beam wouldn't have to do any permanent physical damage; all it would have to do is "overload" the sensor, preventing it from "seeing" the weaker signals from other sources that it was intended to monitor. Such blinding of reconnaissance satellites or aircraft could shield military operations from observation. There is some evidence that the Soviet Union has already tested the idea—in late 1975 some US satellites over the Soviet Union observed phenomena that could be interpreted as indicating illumination by a high-power infrared laser, but the evidence is far from conclusive.

With more power, a laser beam could deposit enough energy to destroy electronic components. The easiest targets would be the sensors, which have to be on the outside of a missile or satellite, and which can be damaged by temperatures that metal skins can easily withstand. Electronic equipment inside a large object would be more difficult to damage because it would be isolated from heat applied to the outside.

Because a laser beam could be pointed at a satellite longer than at a fast-moving object in the atmosphere, there would be special considerations in using laser weapons against satellites. Destruction of a small satellite would be simple; with no place else to go, the heat deposited by the laser would raise the satellite's temperature enough to "kill" the electronics. In fact only the surface electronics that handle communications would have to be destroyed, since an unarmed satellite would be useless if it couldn't communicate with its ground base or other control center.

A larger, manned satellite could be

disabled by melting a hole through its surface to let the air out. The same technique could cripple high-altitude aircraft. By melting a hole through a fuel tank, it might be possible to disable a target carrying fuel. Depending on the type of fuel and the amount of oxygen available, the heat from the laser might trigger an explosion that could destroy the target. At the very least, putting a large hole in the skin of a fast-moving target would make it very difficult to navigate in the atmosphere.

Considerations get more complex for targets armed with nuclear weapons or some other method of fighting back, with detailed strategy depending on the nature and capabilities of the target. In some such cases, it might be necessary for a laser weapon to completely vaporize a target almost instantaneously to destroy it. That type of laser may be a lot farther off than the first laser weapon.

The laser weapons described above would destroy targets by heating them, and thus are called "thermal weapons." Another suggested type of laser weapon, which has received disproportionate attention from the press, is a laser emitting X rays or gamma rays. Because both X rays and gamma rays have very high energy and can cause severe damage to large molecules and crystals, sufficient intensities can kill people as well as electronics.

Such a laser might *sound* like a "death ray," but—if it's possible to build one—it would be unlikely to be used as such a weapon. There already are plenty of ways to kill people that are simpler, cheaper, and more versatile than an X-ray laser is ever likely to be. In blunt military terminology, an X-ray laser would not make a cost-effective antipersonnel weapon.

Besides, in the world of the long-term military planner, weapons intended to kill people are often less important than those that can kill hardware. Even now there is more concern about defending the United States against Soviet missiles than against Soviet troops. Future plans call for unmanned high-technology hardware to play an ever-increasing role on the battlefield. The rationale is not particularly humanitarian: electronically controlled hardware can do things that soldiers can't do, and follows orders far better than human soldiers.

In any case, the physics involved make X-ray lasers unlikely candidates for battlefield weapons. The difficulty of building a laser increases as the wavelength decreases, and it is not clear that it is physically possible to build an X-ray laser. Even if it is possible, it is unlikely such a laser could be used as a weapon. One problem is atmospheric transmission. The shortest wavelength emitted by a laser at this writing is about 40 nanometers (4×10^{-8} meter)*, by a device at the

** This wavelength is at the short-wavelength end of the ultraviolet region. The distinction between ultraviolet radiation and X rays is poorly defined, and is based primarily on how the radiation is produced. No laser has yet emitted real X rays.*

Naval Research Laboratory in Washington. This radiation is absorbed very strongly by the atmosphere. To be transmitted through air, X rays must have wavelengths shorter than 0.1 nanometer.

Another difficulty is obtaining high enough output power. Still another is building a device simple, compact, and reliable enough for use, not as a pistol (which appears impossible even in theory) but as a piece of artillery. Since gamma rays are shorter than X rays, a gamma-ray laser would be even harder to build.

Well aware of these problems, the military expresses little interest in X-ray lasers as weapons. For example, Dr. George Heilmeier, director of the Department of Defense's Advanced Research Projects Agency, told Congress that X-ray lasers could have a major impact "on the broad area of materials processing," and cited specific applications including making integrated electronic circuits even smaller than possible today. This doesn't seem to be just a way to avoid saying "weapons"—military experts have mentioned the idea of laser weapons in public, although most of the details remain classified. Since Dr. Heilmeier's testimony, in fact, ARPA has cut back its already small support for X-ray laser research, indicating pessimism that any useful hardware will result.

Prospects are much better for development of lasers with output at longer wavelengths for thermal weapons. Continuouswave* output powers have reached at least 500,000 watts for carbon-dioxide lasers emitting at 10.6 micrometers (10.6×10^{-6} meter); for comparison, the small helium-neon lasers used in most laser demonstrations emit about 0.001 watt at 0.633 micrometer. It's not clear that 500,000 watts is enough for a thermal weapon, but that's the largest figure that's been mentioned in public. Thermal weapons might have to be 10 or 100 times more powerful, but such an increase does not seem overwhelming considering how far laser development has already come.

It's far from an easy task to get any kind of laser to work. The operation of a laser is based on events that occur when an atom or molecule shifts between states in which it has different amounts of energy. Under normal circumstances fewer atoms or molecules are in states with higher energy than in low-energy states. For a laser to work, energy has to be added to invert the population, so the population of at least one high-energy state is larger than that of some states with lower energy. When atoms or molecules go from the high-energy state to a lower-energy one, they release energy, a fraction of which can be extracted as a laser beam.

** Laser weapons would have to be able to emit a beam continuously for at least a second; because the processes within lasers occur much faster, this is called continuouswave emission. Pulsed lasers, which emit a beam only for a small fraction of a second, can emit much higher powers, but only for brief intervals. Lasers used in fusion experiments, for example, can emit peak powers of 10^{12} watts, but this power is reached only for about 10^{-10} to 10^{-11} second*

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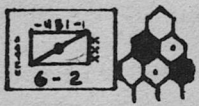

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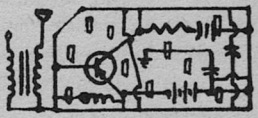

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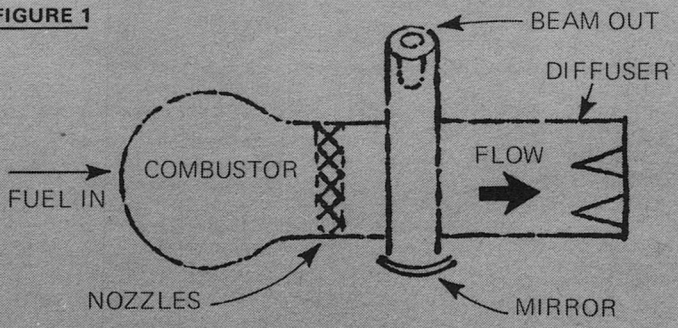
Putting energy into a laser in the proper way is a problem that increases in magnitude with the size of the laser. For the laser to work, the energy must excite atoms or molecules only to certain high-energy states. To produce a useful beam, the energy must be uniformly distributed through the laser medium. For the laser to be practical, the energy must be extracted efficiently in the laser beam, and leftover energy, in the form of heat, must be removed. Three types of lasers have been developed to solve these problems. In all three, a flowing gas emits a high-power beam of infrared radiation.

In a "gas-dynamic" laser, the gas is heated, typically by combustion, then expanded through a nozzle at supersonic speeds to produce the desired population of energy states. The beam is emitted as the gas flows through an optical cavity. Such lasers bear a strong resemblance to wind tunnels, and their construction involves some of the same aerodynamic considerations.

Another approach is to excite the gas by passing it through an electrical discharge. Energy of the electrons in the discharge is chosen to excite a particular energy state in the laser gas. The beam is produced at or near the discharge. Electric-discharge lasers can produce higher power than gas-dynamic lasers, but they require cumbersome power supplies.

In a chemical laser, a chemical reaction in a mixture of flowing gases

FIGURE 1

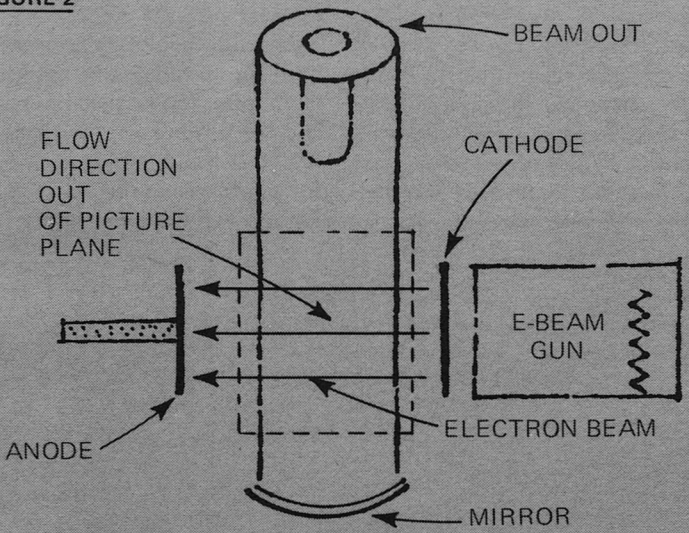


A GAS-DYNAMIC LASER. Energy is produced when fuel is burned in a combustor; the gas is then expanded through nozzles, producing the population inversion of energy states necessary for the laser to work. After some energy is extracted as a laser beam, the gas flows out of the system. As in all high-power lasers, much energy remains in the gas as heat; this heat must be removed to keep the laser from destroying itself. This drawing, and the two that follow, were taken from High Energy Laser Technology Assessment, prepared by Edward A. Brown and Martin V. Jones at the Army's Harry Diamond Laboratories in Adelphi, Md.

produces molecules in high-energy states, and the beam is produced near where the reaction takes place. The highest powers have been obtained when hydrogen and fluorine combine to form hydrogen fluoride. (The heavy isotope of hydrogen, known as deuterium, is often used because deuterium fluoride emits at a wavelength where there is less atmospheric absorption.) Chemical lasers have the highest potential output, and are less cumbersome than discharge lasers. They have important drawbacks, however, including the high toxicity of hydrogen fluoride (which typically is exhausted to the atmosphere after it's produced) and the difficulty in handling some of the chemicals used. Many compounds containing hydrogen and fluorine have been tested to get around the handling problems, which can be severe. Stainless-steel tanks containing fluorine gas, for example, have a nasty habit of blowing up without warning or apparent reason.

The selection of the type of laser to be used as a weapon will depend on the environment where it is to be used as well as on the output power. A bat-

FIGURE 2



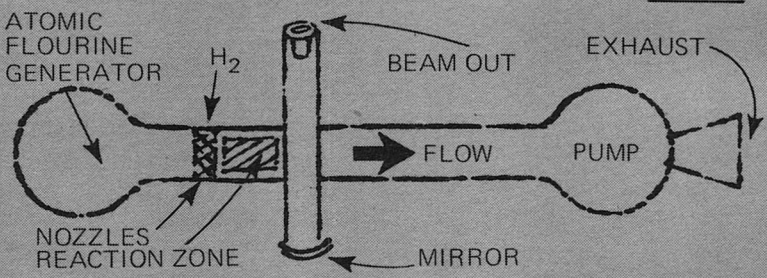
IN AN ELECTRICAL LASER energy comes from electrons injected into the laser cavity (in this case by an electron-beam generator). The gas flows perpendicular both to the direction of the laser cavity (and hence the laser beam) and to the direction of the electrons. In this illustration, the gas is flowing out of the page, electrons are flowing from right to left, and the beam is emitted toward the top of the page.

tlefield laser would have to be rugged, portable, and simple enough to operate that ordinary military technicians could handle it. A laser for defense against ballistic missiles, in contrast, could be stationary and could require better-trained operators, but it would have to be ready to fire reliably on very short notice. A laser carried in an unmanned satellite would have to meet a third set of requirements: able to withstand the shock of launching, compact, remotely operable, and with a power supply that would last a long time without replenishment.

Present lasers would have problems meeting both durability and size specifications for thermal weapons. Ruggedness presumably can be improved when designers have time to worry about it after obtaining sufficient output power. Size and weight are more fundamental limitations, which are most severe for electric-discharge lasers and much less important (although still present) with chemical lasers. The emission of hydrogen fluoride into the atmosphere is not a serious problem for a chemical laser mounted in an airplane or satellite, but it could be disastrous if it's mounted in a tank and there are friendly troops nearby.

Because of these types of limitations, military researchers are still searching for new types of lasers. One long-term goal is combining a laser and a nuclear reactor. Conventional reactors use solid fuels, but this type would use a gas, probably uranium hexafluoride. The gas core of the reactor would be set up to act as a laser, with much of the energy produced by nuclear fission emerging as a laser beam. The National Aeronautics and Space Administration has studied the prospects for using such reactors for power generation in space, with

FIGURE 3



A GENERALIZED CHEMICAL LASER. After atomic fluorine (F) is generated, it flows rapidly through nozzles, where it is mixed and reacts with molecular hydrogen (H_2) to produce excited molecules of hydrogen fluoride (HF). The beam is produced when the gas passes through the laser cavity in center. The fluorine can come from molecular fluorine gas, but typically it is produced in reactions of easier-to-handle fluorine compounds.

the laser beam transmitting power either to other satellites or to the ground. The same type of reactor-laser hybrid could also be used as a satellite-mounted laser weapon. There's a long way to go before it becomes practical, however; so far only a few low-power lasers have been demonstrated using this principle, and none of them have included a reactor.

The problems in getting a laser weapon to work have only just begun when you generate a high-power beam. For the weapon to be of any use, enough power has to reach—and be absorbed by—the target to cause damage.

The most obvious problem, and the easiest to address, is atmospheric absorption. At many wavelengths in the infrared the atmosphere is almost opaque because of strong absorption by molecules, primarily water vapor and carbon dioxide. The simplest solution—and probably the only one worth considering—is to pick a laser that emits at a wavelength where there's little such absorption. It shouldn't be surprising, then, to find that the types of lasers under active consideration for thermal weapons all can be made to emit at wavelengths where the atmosphere has low absorption.

It's not enough for the atmosphere to let the light through, however. If high powers are to be concentrated on a target, the beam must pass through the air without being bent, broken up or distorted. And if the target is moving, the beam must follow it. This is nowhere nearly as simple as it sounds: at very high powers even the tiny residual absorption present at all wavelengths is enough to cause all sorts of nasty effects. One is thermal blooming—in which the atmosphere causes a narrow beam to spread out across a wider area, preventing it from being focused on the target. Another is beam wander, in which similar effects cause the beam to move off target. Both become more complex when the beam is moving.

The physics of these problems is complex, and simulations of the processes involved take hours on very big and very fast government computers. Many of the factors that influence such distortion are atmospheric factors which the weapons designer cannot control; others are restrictions imposed by the nature of the laser, the battlefield, or the target. One factor that can be controlled is the beam's wavefront—the pattern of light emitted by the laser and the manner in which it is focused on the target. Adjustments to control the wavefront must be very precise—accurate to within a fraction of the laser's wavelength—and this requires a special optical system.

Most ordinary optical systems are built to focus light in only one way, with at most the limited range of adjustment possible in binoculars or a telescope. Even systems that allow considerable adjustment of the focal point, like "zoom" lenses, are built

from components that have fixed focal characteristics. The adjustments are made by changing the spacing between the components.

Such systems wouldn't work with thermal weapons. They provide neither the speed nor the extreme sensitivity needed to control a laser wavefront. A more fundamental limitation is the use of refractive optics, in which light is focused by passing through a transparent material. Since no material is perfectly transparent, some light is always absorbed. When hundreds of kilowatts of light are involved, even a tiny fraction of a percent absorption can cause serious distortion and perhaps destroy the optics. Although a sheet of some transparent material must be used to separate the laser gas from the outside environment, the beams from high-power lasers are focused with mirrors.

One advantage of mirrors is the ease of removing excess energy absorbed from the beam. Even the best mirrors absorb some light, but the absorption is near the front (reflective) surface, not inside. Since the nature of the inside of the mirror has no effect on the quality of the beam, heat can be removed by flowing a coolant through it.

Mirrors have another advantage: the way they focus light depends only on their surface contour. This makes it possible to change the focus of a beam merely by deforming the surface of a mirror. For thermal weapons, the bending would be done quickly and with great precision by electronically controlled elements beneath the surface. The same approach could be used to move the beam to follow a moving target, but mechanically turning or tilting the mirror would generally be more practical.

In practice, "adaptive optics" would consist of several distinct subsystems. A sensing instrument would measure beam distortion produced by the atmosphere. A tracking and aiming system would keep track of target position. Data from these two systems would be fed to a computerized control system which would calculate the adjustments to be made in the mirror's surface and direction. An electromechanical system would translate the computer's directions into changes in the surface configuration and position of the mirror.

Building suitable adaptive optics will not be easy. The surface adjustments must be made with extreme precision across the entire area of a large mirror (large area decreases the beam intensity at any point on the mirror, permitting the use of higher total power). The system must be able to track a fast-moving target accurately enough to keep the beam on the same part of the target. Simultaneously, the beam has to be focused through the atmosphere onto the target. Prototypes have been made, but those discussed in public are crude in comparison to what would be needed to focus a thermal weapon.

Delivering the energy to the target would not solve all potential prob-

lems—the light would still have to be absorbed. This can be a problem because most metals strongly reflect infrared radiation—about 90% to 95% of light at the 0.01-millimeter wavelength of carbon-dioxide lasers is reflected. This means that only 5% to 10% is absorbed, which doesn't make for a very efficient weapon.

There may be ways to minimize surface reflectivity, especially for the many metals that absorb more energy as they get hotter. Controlling the variation of laser power with time might help, or the target could be illuminated with a second, lower-power laser at a wavelength that is more strongly absorbed. Even if these approaches fail, there remains the time-honored but inelegant resort to brute force—higher-power lasers.

Getting the beam to the target would be much simpler if the laser was mounted in a satellite and the beam didn't have to travel through a lot of dense atmosphere. Adaptive optics would still be necessary to track the target and focus the beam, but the corrections for atmospheric effects could be simplified or eliminated. That's an important advantage because of the complexity of the calculations that must be performed to correct for atmospheric effects on the beam. Even with a computer, such calculations require time, and there may not be enough time during a battle.

Another potential advantage of putting laser weapons in satellites is the ability to use lasers whose output cannot be transmitted through the atmosphere. Some types of lasers can emit high powers at such wavelengths, but there has been little incentive to develop them for applications on the ground. In space, they may be able to deliver high powers at wavelengths where metals absorb strongly, making them more efficient weapons than groundbased infrared lasers.

An orbiting thermal weapon would have tactical advantages, too. Sitting high above the atmosphere, it could zap intercontinental ballistic missiles at the peak of their flight as well as picking off other satellites. With sufficient power and the ability to correct for atmospheric effects, it could even destroy small targets on the ground. (Power limitations would keep thermal weapons from being used effectively against large targets on the ground.)

Offsetting some of the advantages are difficulties in building an orbital thermal weapon that go far beyond making the laser light, compact, and durable enough for a satellite. Most high-power lasers exhaust some or all of the gas flowing through them because output is very sensitive to impurities; even traces of lubricants used in fan motors can cause problems. Closed-cycle lasers have been built, but so far their output power has been limited.

Compounding the problem is the need for a reliable source of lots of energy. Chemical lasers are attractive

because liquid fuels can be used, providing high energy per unit weight of fuel. Recycling the chemicals, however, doesn't look practical in the near future; you'd need tremendous amounts of energy and an orbiting chemical processing plant. The lasers, furthermore, are too expensive to discard when the fuel is gone, so they would have to be refueled in orbit. Hybrid reactor-lasers of the type described earlier might eventually make better orbiting laser weapons—if they work.

An important part of the development of any weapons is the study of ways to defend against it. Studies of defense against laser weapons are centering on the interactions between laser beams and the surfaces of various materials.

The simplest defense against laser weapons would be to make the surface highly reflective, but that approach is far from perfect. There is no such thing as a perfectly reflective surface, so high enough powers would eventually break down the surface. Besides, such a surface would be very vulnerable to many kinds of physical damage, which would lower the threshold to damage from laser weapons at points where there was physical damage.

More sophisticated defenses would rely on the intricacies of the interaction between a laser beam and the ionized gas produced when the beam hits a target. Under certain conditions, what is called a "laser supported absorption wave" can be produced. When this happens the ionized gas between the laser and the target absorbs most of the energy in the laser beam, preventing the energy from reaching the target. This gas forms a wave that travels toward the laser.

Such a defense would be almost ideal—it would be turned "on" automatically whenever a target was under attack by a laser weapon. There are, however, some important questions remaining. Can such waves be sustained around a missile traveling at several times the speed of sound? Is there anything similar that would work outside the atmosphere? Is it viable for aircraft that may be subjected to repeated laser attacks? These questions are getting their share of attention from government researchers.

Defenses against lasers, or "laser countermeasures," are studied not just for defense, but also to help design weapons that can overcome such defenses. That stage is called "laser counter-counter measures," and it too is under study. It might be possible, for example, to modulate the beam intensity so the absorption wave generated by the beam would dissipate between "shots." Or the beam could move across the surface, slowly cutting out a hole at intensities too low to generate an absorption wave. Although there may be some answers hiding under cloaks of government secrecy, at the moment there seem to be far more questions than answers.

There are similar problems in the

whole area of thermal weapons. In theory, they have a multitude of advantages that could revolutionize the high-technology battlefield. In practice, there are a large number of problems that have to be solved first. Both the United States and the Soviet Union are working intensely on these problems, with neither side having an obvious lead.

It is, moreover, not at all clear that all the problems *can* be solved. Building a big enough laser is a straightforward problem compared to dealing with the perturbations produced when the laser beam interacts with the atmosphere. The same goes for the interaction between beam and target. The processes involved in such interactions are complex and often unpredictable, and the only way to make certain what will happen is to try it experimentally. Until that has been done, it remains possible that laser weapons won't be viable at all, or will find only a limited range of applications.

There is also the question of cost. If laser weapons can be built, they will be expensive; the 500,000-watt laser mentioned earlier cost about $40 million. For that sort of money, a thermal weapon would have to do a job that nothing cheaper could do as well. Defending against ballistic missiles is one case where laser weapons look very good—they could provide a much more effective defense than an antiballistic missile at a cost that might even be lower than an ABM system. Lasers are not, however, going to become antipersonnel weapons—rifles are much simpler and cheaper and vastly more cost effective.

If thermal weapons begin to appear in military arsenals, changes in strategy will follow. The nature of the changes will depend on the nature of the lasers and who has them. Bulky stationary lasers, for example, might prove highly effective against ballistic missiles passing overhead, but would be useless against targets out of their line of sight (barring the use of such auxiliary equipment as large orbiting mirrors to reflect and focus beams to other locations.)

If thermal weapons can be made to work, one possible spinoff is laser propulsion of rockets, which would require solution of more severe atmospheric-transmission problems because powers would be much higher. But even if propagation problems prove insurmountable, research in high-energy lasers has already led to a number of peaceful laser applications in materials working. Searches for new types of lasers with potential for high-energy output have revealed much about chemical processes, and this knowledge could lead to more efficient and effective techniques of chemical synthesis and high-power lasers figure prominently in a variety of plans to generate power by nuclear fusion.

Jeff Hecht *(B.S., Electrical Engineering, Caltech) is managing editor of* Laser Focus *and contributing editor to* Energy Research Reports. ■

(continued from p. 71)

what is tough and what is tough to the *N*th power (pick any *N* greater than seven or eight).

Why do I use the *AES Transactions* as a forum for a topic so clearly of a nature different from that of "the tracking characteristics of phased-locked loops" or "the statistics of a sine wave in log-normal sea clutter"? It seems to me that with so much taxpayer money being spent on laser weapons technology it is long overdue for the issues to be discussed in a forum more suitable for a reasoned development than "popular" articles [3]. The lack of awareness of just what the whole antiballistic missile thing was about in the 1960's is still fresh in my mind, and as I emphasize in this paper, I think we may be heading for the same uninformed state about laser weapons. Too many dismiss thinking about this developing technology with the rationale that the people in Washington have it all classified and there is so much they know and we don't and what's the use. Nonsense. The laws of physics, mathematics, and logic aren't classified, and all those without a background in classified laser development are free to analyze and to write *openly* about their discoveries.

I hope this paper will stimulate such activity.

Jargon Key

Some brief comments on the format of this paper are in order. First, for convenience, I have rather casually used the terms *Soviet Union, Russia, Soviets, USSR,* etc., interchangeably, even though they denote really different things in detail. In the same manner, by *China* and *Chinese* I mean the People's Republic of China on the mainland, and not the Nationalist Chinese on Taiwan. Second, the text is peppered, like buckshot, with jargon. Rather than break up the text with definitions, many, if not all, of which will be familiar to readers, I have assembled them here for easy reference.

AAM	Air-to-air missile.
ABM	Antiballistic missile.
ACDA	Arms Control and Disarmament Agency, Washington, DC.
ALCOR	Arpa-lincoln *C*-band observables radar.
ALL	Airborne laser laboratory.
(D)ARPA	(Defense) Advanced Research Projects Agency, Arlington, VA.
ASM	Air-to-surface missile.
AWACS	Airborne warning and control system.
BMD	Ballistic missile defense.
C^3	Command, control, and communication.
CEP	Circular error of probability.
CNO	Chief of Naval Operations.
COAT	Coherent optical adaptive technique.
CW	Continuous wave.
DDR&E	Directorate, Defense Research and Engineering.
DoD	Department of Defense.
EDL	Electric discharge laser.
ELF	Extremely low frequency.
ERDA	Energy Research and Development Agency, Washington, DC.

FBM	Fleet ballistic missile.
FLIR	Forward-looking infrared radar.
GDL	Gas dynamic laser.
GPO	Government Printing Office.
HELRG	High-energy laser review group (in the Directorate, Defense Research and Engineering).
HEMLAW	Helicopter-mounted laser weapons.
IBM	International Business Machines, Yorktown Heights, NY.
ICBM	Intercontinental ballistic missile.
IDA	Institute of Defense Analyses, Arlington, VA.
IFFN	Identification, friend-foe-neutral.
INLAW	Infantry laser weapons.
JPL	Jet Propulsion Laboratory, Pasadena, CA.
J-TIDS	Joint tactical information distribution system.
LBMD	Laser ballistic missile defense
LSCW	Laser-supported combustion wave.
MAD	Mutual assured destruction.
MHD	Magnetohydrodynamic.
MiCom	Army Missile Command.
MIDAS	Missile detection and surveillance.
MTU	Mobile test unit, Army.
NASA	National Aeronautics and Space Administration, Washington, DC.
NATO	North Atlantic Treaty Organization.
RV	Reentry vehicle.
SALT	Strategic arms limitations talks.
SAM	Surface-to-air missile.
SCAD	Subsonic cruise armed decoy.
SLBM	Submarine-launched ballistic missile.
SNAP	Space nuclear auxiliary power.
SORTI	Satellite orbital track and intercept.
SRAM	Short-range attack missile.
SRI	Stanford Research Institute, Menlo Park, CA.
TDM	Time-division multiplex.
TDMA	Time-division multiple access.

Introduction and Background

As the preeminent military powers in the world, the United States and the Soviet Union are today mutually endowed with overwhelming capability to destroy the civilization of the other (and in the process, much of the rest of the world, too). However, both lack first strike capability and therein lies the basis for the so-called mutual assured destruction theory. Since both can destroy, but neither can survive, the MAD theory concludes that only insane decision makers would initiate central war. Thus any innovations in defensive, damage-limiting systems by one side that convincingly negate the strategic offensive strength of the other are destabilizing influences. For this reason, the US and the USSR essentially agreed to abandon the deployment of population defense

shields throughout their homelands and elsewhere.

The agreement by the Soviet Union to include defensive ABM systems in the SALT negotiations represented a complete turnabout in the arguments initially advanced by them for not so including the ABM. At first their position was, in the words of Gerard C. Smith, Director of the ACDA [4]: "Well, defensive missile systems don't threaten anybody. If you want to spend a lot of money on them, that is your business." The Soviets, up until SALT, rejected the idea that constructing extensive damage-limiting systems should cause concerned observers in the United States to infer possible Soviet preparation for a preemptive first strike capability. Of course, it was just this concern that caused so much uncertainty in the United States in the late 1960's about Soviet intentions, as they apparently were building a population ABM defense around Moscow. To be even-handed about the level of sophistication displayed by both sides along this line of reasoning, we should recall that the Soviets were equally alarmed about US intentions in the late 1950's when the civil defense fallout shelter fad literally swept the country [5].

As signed in Moscow by then President Nixon and Secretary Brezhnev, the 1972 ABM Treaty specifically defines an ABM system as consisting of *interception missiles, missile launchers,* and *ABM radars* [6]. However, in one of the "agreed interpretations," i.e., initialed statements, ABM systems ". . . based on other physical principles and including components capable of substituting for ABM interceptor missiles, ABM launchers, or ABM radars . . ." are also contained within the scope of the treaty [7]. This would, for example, preclude the substitution of a high-energy laser for the interceptor missile role (which would also result in the elimination of the need for missile launchers).

I believe that the actual deployment of extensive BMD systems in the Soviet Union and the United States would be a deplorable development [8], but for a variety of reasons, I also believe that the ABM debates and the ABM Treaty have not put an end to the issue. There are indications that both the US and the USSR are currently experiencing pressures to reconsider the limitations on the development, and even deployment, of ABM's and other esoteric forms of BMD, such as the LBMD. I will devote the rest of this section to elaborating on these pressures.

What are these pressures that could cause even the limited arms control gains of SALT Phase I to be lost? I see them as follows:

1) *Soviet perception of a threat to their national security by the growing Chinese ICBM capability.* As reported in [9], the Chinese have deployed CSS-X-3 ICBM's in western China. This missile has a warhead of about 3 megatons and with a range of 4000 miles it could reach Moscow. This same report also indicates that US delegates to the Standing Consultative Commission in Geneva have been indirectly approached by the Russians to determine the American reaction to the deployment of an ABM system to counter these missiles—but not for use against the

US! This proposal has a familiar ring to it [10].

2) *Soviet and American reaction to advancing technology that may cause significant reassessments of previous ABM issues.* This is an area which would require access to certain classified information (which I do not have) to write authoritatively. To give some simple examples of what I have in mind here, however, the "beta blackout problem" and the "non-nuclear kill ABM missile" are good illustrations. In an ABM system, such as Sentinal or Safeguard would have been, light decoy RV's and heavy, armed RV's would be distinguished by the different effects on them from atmospheric drag. This requires allowing the RV's to penetrate the atmosphere where any nuclear explosions will cause beta blackout of the ABM radars [11]. High-resolution radar technology has advanced sufficiently, however, to allow long-range, high-altitude discrimination to be performed [12]. These techniques would allow the determination of the presence or absence of RV spin and/or tumbling. Armed RV's are stabilized because they incorporate ablative heat shields for reentry protection, while the cheaper decoys, without shields, are not stabilized (if they were, they might as well be armed, too). High-power radars with the required resolution do not exist today in either the US or Soviet inventories, to my knowledge, but the experimental ALCOR system on Kwajalein Atoll may be sufficient to allow US development in this area to be proceeding. As another example of how advancing technology is applying pressure for the reevaluation of the credibility of an ABM presence in the strategic inventory, I mention the development of non-nuclear interceptor missiles with terminal homing seekers [13]. There are three reasons why this is militarily attractive. Since the missiles are non-nuclear (Spartan/Sprint missiles are thermonuclear), one's own ABM warheads will not destroy other ABM missiles in an intense engagement. A non-nuclear kill mechanism would allow the National Command Authority to initiate an engagement under much less stringent conditions than with nuclear ABM systems. Finally, missiles with terminal homing seekers do not require an ABM radar for tracking and guidance control and can be developed without using such a radar (which would be in violation of SALT Phase I).

3) *American reaction to possible Soviet development of an antisatellite ground-based laser weapon.* As widely reported in the US news media, and particularly in [14], infrared sensors on US early warning satellites have, beginning October 18, 1975, experienced sporadic, intense illumination from sources in western Russia. The illumination wavelength has been at about 2.7 μm, suggesting that a hydrogen-fluoride chemical laser might be the source. Such natural sources as a test ICBM launch, forest fire, or volcanic eruption seem ruled out because the radiation level has been 10 to 100 times more intense than these sources could produce. Still, the "official" explanation, never elaborated on, was that a natural gas line fire was the source. I, personally, am somewhat skeptical of this. The US itself has had, for many years, a low-power laser system for determin-

ing whether Soviet satellites are carrying reconnaissance cameras [15]. Of course, the use of such laser devices today would be a violation of the recognition in SALT Phase I of the legitimacy of gathering arms limitation intelligence by satellite. However, the illumination of early warning, ICBM launch detection satellites is *not* a violation, although highly provocative, as they play no role in monitoring strategic weapon inventory levels.

4) *Significant American and Soviet involvement in laser weapons research and development for mission roles other than LBMD that may escalate to LBMD.* I have a great deal more to say about this pressure point in the next section, but the essential thrust of my argument here is that mission roles other than LBMD are currently under intense development in the United States, and presumably in the Soviet Union, too. These roles include bomber defense against ground and air attack, ground-based air defense, fighter defense and offense against ground weapons and targets, and fleet defense, for example, against cruise missiles, by both airborne and shipboard laser weapons. These roles involve all of the military services and thus are not easily susceptible to political attack (as are some weapon system concepts) as an aberration, for example, the view of the US Army and Air Force on the desire of the Navy to acquire nuclear aircraft carriers at $800 million per copy. Then, as these developed weapons become a fait accompli, the expansion of their roles into the LBMD role may be forced by intense political pressure to achieve the greatest utility for the already invested dollars, an argument mentioned before in another context [10].

5) *American concern over the Soviet capability to quickly upconvert their air defenses to an ABM system.* The Soviets, unlike the Americans, have an extensive air defense system, incorporating on the order of 10,000 SAM's and 3000 interceptor aircraft. As pointed out in [16], the Soviets are apparently allocating significant resources to these defenses. Thus the question "Why are they doing it?" arises. Ruina rejects the simple answer that the Soviet activity is just momentum from the past, a reflection of the historical interest of the Russians in defensive systems. However, there is credibility to the belief that such defenses, if they undergo continued modernization to handle bomber-launched ASM's, might be upgraded to an ABM [17]. Such a system, for example, would also negate the HOUND DOG, SCRAM, and SCAD ASM's that could be carried on at least some of the B-52 and/or B-1 aircraft on a Soviet air space penetration mission. Thus we have some US apprehension of a possible reduction in the credibility of part of its triad of ICBM's, SLBM's, and manned bomber fleet.

6) *Claims that the Soviet Union is cheating on the SALT Phase I agreements.* Since the signing of SALT Phase I in 1972, there have been continuous charges that the Soviets are violating the agreements. Critics of SALT and advocates of new weapons systems are using this issue to support their contention that arms control limitations are, in fact, coun-

terproductive to the strategic position of the United States. Of the five basic alleged classes of violations by the Russians, two deal specifically with the ABM Treaty [18]. There seems to be no question that the Soviets did, in fact, extensively test their SA-5 phased-array radar in the ABM tracking mode, a clear violation, in 1973 and 1974. A less clear issue is the deployment of a new SA-5 radar at the Kamchatka Peninsula test range. The specification of allowed test ranges was done via what was initially a unilateral US statement. This statement, made on April 26, 1972, by the US SALT delegation, was followed on May 5, 1972, by a response from the Soviet delegation stating that there was a common understanding on the location of ABM test ranges. The US ABM test range locations were given as White Sands, New Mexico, and Kwajalein Atoll. The only Soviet range location was given as Sary Shagan in Kazakhstan. Thus the *testing* (not just deployment) of this second SA-5 radar *would* be a violation, because according to [19], both the "initialed statements" and the "common understandings" are as binding as the texts of the more formal documents signed by Nixon and Brezhnev. One can't help but wonder, however, what purpose, *other* than test, would serve the deployment.

7) *Criticism directed against the claimed strategic mistakes in SALT Phase I.* This issue is related to, but distinct from, my last point. The criticism of SALT Phase I had reached the point of calling for the dismissal of then Secretary of State Kissinger, the most notable critic being former CNO Admiral Elmo Zumwalt, Jr. [20]. Many of Zumwalt's points were also made by the respected, if editorially conservative, *Aviation Week and Space Technology* [21]. Former Secretary of Defense Schlesinger, in testimony before the arms control subcommittee of the Senate Armed Services Committee made many of the same points, too [22]. In the long run, such vigorous criticism may cause future negotiations to be much more "hard-nosed" and uncompromising than were SALT Phase I.

8) *Growing pessimism among some knowledgeable US observers and analysts.* This is a personal, subjective issue and one on which reasonable people can (and do) disagree. I will give just two examples of what I mean. I have heard Paul Nitze (a former deputy secretary of defense and a member of the SALT Phase I negotiating team), a man in a position to know, express very negative views of the trend today in the evolution of the Soviet-American debate [23]. In response to the question "Would nuclear war end civilization?" Nitze believes that while the US response would be "yes," it isn't recognized as even a question of interest by the USSR. The point here isn't whether this is actually the case, but that this is how *Nitze* perceives things. Equally depressing is Nitze's observation that in response to the question "Can a nuclear war winning capability be developed?" the US position is that MAD is the only politically acceptable policy, while the USSR would answer, "Yes, through the acceptance of enormous casualties and industrial destruction." As another discouraging example, it was recently reported [24]

that such highly respected analysts as George Kistiakowsky, Thomas Schelling, and Richard Garwin believe that some nuclear wars are likely to occur before the end of the century.

I believe these eight political and technical pressures create considerable doubt about whether the current arms control agreements, in their present form, will remain in force. The growing interest in the development of laser antiweapon systems [25] demands that these systems, including the LBMD, be openly analyzed with respect to their tactical and strategic impact. As I point out in the next section, the currently most promising application of laser weapons seems to be in a space environment, a development that would be in violation of both SALT Phase I and the 1967 Outer Space Treaty.

There is no question that today many analysts regard laser weapons as "blue-sky, Buck Rogers, death-ray" nonsense, fit only for comic books. Indeed, in an unclassified analysis prepared in 1971 [26], I arrived at a pessimistic conclusion myself. In another more recent discussion of laser weapons, Garwin also wrote in a less than enthusiastic manner [27]. But technological and political developments are occurring so rapidly that laser weapons may be perceived, by both Soviet and American decision makers, to be sufficiently attractive as to alter these views in the future [28]. These altered perceptions may become, in fact, sufficient to reignite the ABM debates of just a few years ago and to initiate reevaluations of both the Outer Space Treaty and the SALT agreements.

Technological Issues in Laser Weapons Research

In this section I give an overview discussion of the current state of affairs in the high-energy military laser programs in the US. Or, more modestly, as much as can be found from unclassified sources. The situation in the USSR is tremendously

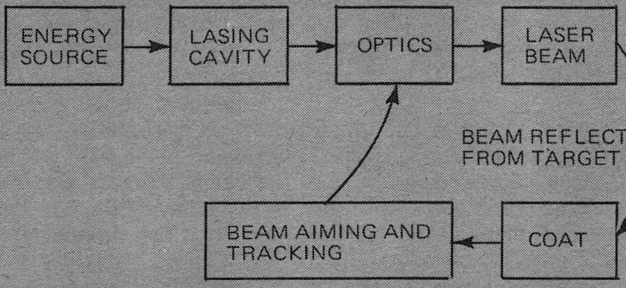
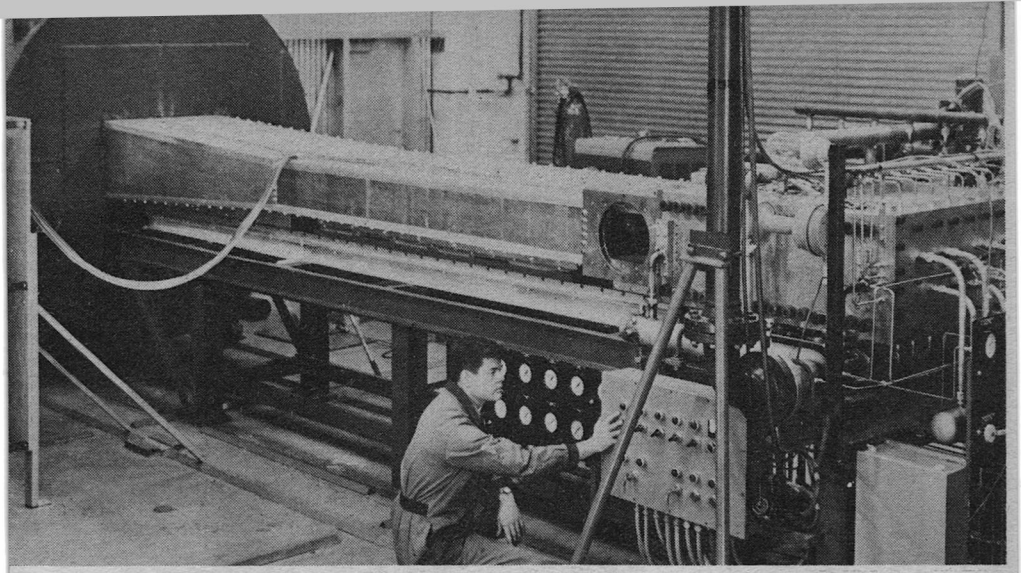


FIGURE 1. Laser weapon system.

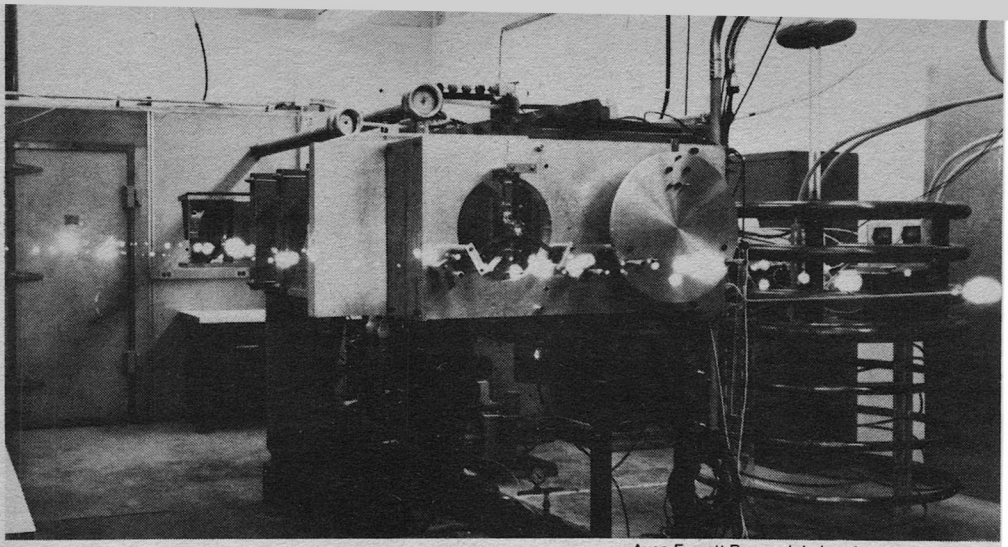


Avco Everett Research Laboratory

One of the early gasdynamic lasers developed at Avco Everett Research Laboratory. Powered by combustion products, this carbon dioxide laser produced more than 10 kilowatts at the 10.6 micron wavelength.

more difficult to determine. My major sources of information for particular numbers are the excellent reviews recently published by *Aviation Week and Space Technology* [29] and two reports from General Electric: [30] and [31]. This overview is not intended to be a tutorial on lasers, but rather to show the magnitude of the US commitment to developing radiant energy weapons technology.

A simple system block diagram of a laser weapon system is shown in Fig. 1. Assuming that the output optical element in this system is a circular mirror with diameter D, then the laser energy emerges from the weapon as a cylindrical pencil beam with diameter D. Because of the physical phenomena of diffraction, the beam diameter begins to slowly increase with increasing range and then, at about the so-called Rayleigh or diffraction range, the beam begins to spread more rapidly, i.e., linearly with range. If we denote the power level of the beam (say, in watts) by P, and the power *density* (say, in watts per centimeter squared) at range R by H, then we can write H as follows [32]: $H = 1.27\ P/[D^2 + (R\lambda/D)^2]\ W/cm^2$ which is the average power density delivered on a target at range R. In this expression, λ denotes the wavelength of the laser radiation. This expression allows us to study the interaction between the laser parameters (wavelength, power, and optics), range to target, and the power density delivered on the target. This result is for what is called a



Avco Everett Research Laboratory

The intense infrared beam of an electrically-driven CO_2 laser ionizes the air of the laboratory. The beam itself is invisible, but the air glows where ionization breakdown occurs.

diffraction-limited system and is the theoretical best performance that can be achieved. It is a reasonable description of a laser beam when no perturbing mechanisms, such as atmospheric absorption, scattering, and turbulence are present. Such benign conditions exist, for example, in space.

To gain insight into what the expression for the delivered power density on a target means, Fig. 2 shows two plots of the power density as a function of range for a hypothetical 10-MW laser with a 25.4-cm (10-in) output aperture. The units of the graph are hybrid, with the power density in watts per centimeter squared and the range in statute miles. I have chosen two laser wavelengths that bound the interval in the electromagnetic spectrum of military interest. The carbon dioxide (CO_2) gas laser has a λ of 10.6 μm, while the solid-state neodymium (Nd)-glass laser radiates at 1.06 μm. Other lasers of interest, such as the chemical and EDL, have wavelengths between these two extremes [33]. From the plots we observe, for example, that at a range of 10 mi, the CO_2 laser delivers an average power density of 2460 W/cm^2, while the Nd-glass laser achieves a value of 18 400 W/cm^2. For comparison, the tip of a hot soldering iron might typically dissipate heat energy at a rate of 100 W/cm^2. These are impressive numbers, but they are, in themselves, very misleading. All real-life atmospheric propagation complications are absent from them, and no

account is taken of the interaction or "coupling" between the laser beam and the target [34].

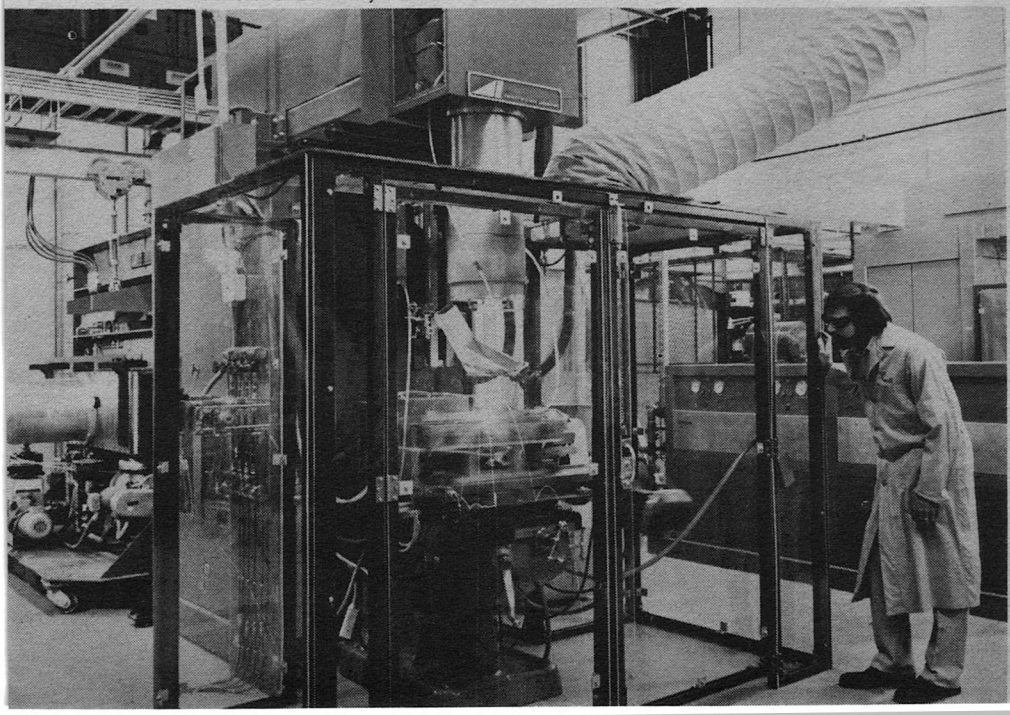
There are three basic mechanisms for target damage by a laser weapon. They are:

1) Structural weakening. This is the obvious damage mechanism, resulting from the temperature elevation of the target surface. This heating may be sufficient to soften the surface to the extent that it will flow and even tear open. One laser-material experiment by Avco indicates that at a power density of about 2 MW/cm^2, $^1/_2$-in-thick aluminum can be burned through in less than half a second.

2) Shock wave. A short-pulse, high-energy laser beam can produce an extremely rapid and large temperature elevation in a thin surface layer of the target. This "hot-skin layer" then vaporizes and explosively moves away from the target at supersonic speeds, generating a shock wave that propagates into the target, possibly tearing it apart. Plastic and glass components of targets are particularly vulnerable to this damage mechanism as these materials, compared to metals, are poor conductors of heat.

3) X-ray radiation. On metallic targets, the vaporized hot-skin layer may emit copious amounts of X-ray radiation. This radiation may cause structural damage both in the target

Metalworking laser system, capable of cutting through three-quarter-inch thick steel at rates of up to a hundred inches per minute.
Avco Everett Research Laboratory



proper and the electronic components in the avionics package, e.g., the guidance and control circuitry.

These damage mechanisms are sufficiently attractive that the fiscal year 1976 DoD funding level for its high-energy laser programs reached $171 million, a growth 24-percent over the fiscal year 1975 level of $138 million. Each of the services has its own laser program, but they are jointly reviewed by the HELRG in DDR&E, which also coordinates with the nonmilitary laser fusion program of ERDA. Table I gives a brief summary of the individual service programs.

There are three basic laser types that are under serious military consideration: the gas dynamic, the electric discharge, and the chemical. Table II comments on each of these.

The experimental service programs are chartered to explore the enormous range of technical problem areas that span high-energy laser weapon research. These problem areas include the following:

1) beam aiming and tracking of fast-moving and maneuvering targets;

2) development of optical elements to reflect and transmit high-energy laser radiation without self-damage, i.e., the development of "laser windows";

3) beam energy loss due to atmos-

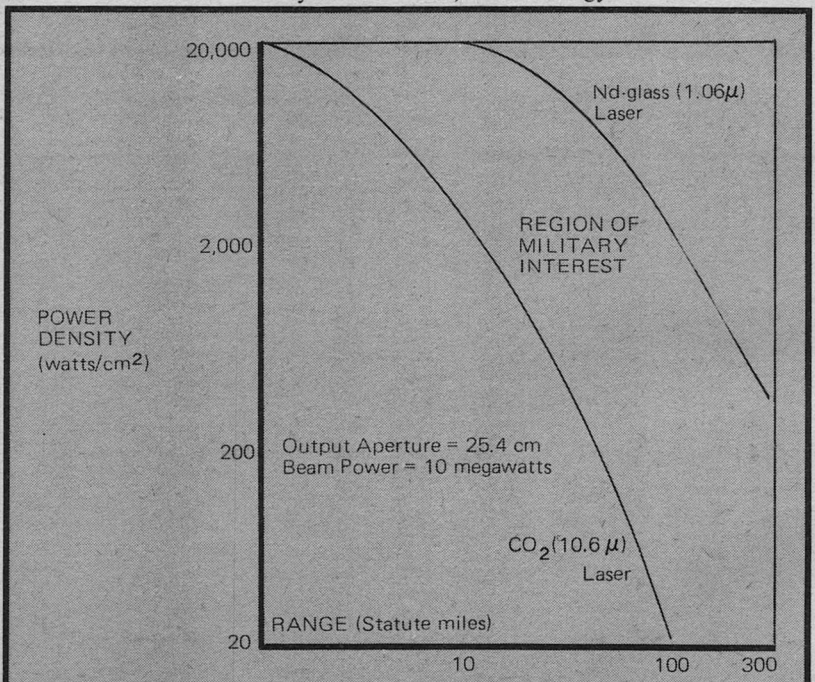


FIGURE 2. Power density versus range for a hypothetical laser.

pheric absorption and scattering by aerosols, fog, rain [35], and gases, e.g., CO and CO_2;

4) beam spreading and centroid wandering due to atmospheric turbulence and refractive index variations along the beam path [36];

5) thermal blooming (i.e., beam defocusing) from the heated air along the beam path [37];

6) electrical breakdown of air along the beam path [38];

7) material effects and laser coupling mechanisms [39].

All of these technical problem areas are the subjects of intense research, and Table III gives an idea of who is currently doing what. Broader in scope, however, is the analysis of the mission roles for laser weapons, Table IV addresses this point.

Finally, the issue of the "prime mover;" i.e., the energy source, for a laser weapon is briefed in Table V. It is clear that, in general, the major technical obstacles for laser weapons are caused by atmospheric influences. These can be immediately circumvented by using such weapons in space. One such use might be a satellite-based weapon that shoots ICBM second-stage boosters before they reach apogee. This, of course, would be a violation of both SALT Phase I and the Outer Space Treaty. From a technical point of view, however, this directs attention to the problem of what to do for the energy source in a satellite-based laser. The use of solar power cells would seem to

	AIR FORCE GDL (CO_2)	NAVY chemical	ARMY EDL (CO_2)
Laser contractor	United Technologies	TRW Systems	Avco
Beam aiming and tracking contractor	Hughes	Hughes	Perkin-Elmer
Experimental test bed	ALL (KC-135 aircraft)	fixed shore facility	MTU (amphibious assault vehicle)
Special mission conditions	turbulent air (airborne gun port)	humid air, salt spray	rugged terrain, dusty air
Mission	bomber defense from SAM's and AAM's	cruise missile and aircraft fleet defense	BMD and defense against enemy close air support aircraft

TABLE I U.S. Military Laser Programs

be unable to meet the peak power requirements imposed by a large ICBM launch (although this question needs analysis), and the onboard presence of a nuclear reactor may introduce more problems than it solves. A third possibility is that of beaming microwave energy up to the satellite from a hardened ground power station.

None of these energy source problems are really new. The US has had a great deal of design experience in satellite reactors, e.g., the SNAP series; and Nazi Germany, as far back as 1937, explored the design of an electric solenoid gun requiring a power supply of 100 MW [4]. I have more to say on the microwave transmission issue in the next section.

This section is based on the open US laser literature. What, in turn, can be said about the analogous Soviet effort? Not much. As reported in [41], which gives Dr. Malcolm R. Currie's (head of DDR&E) assessments of US military technology vis-a-vis that of the USSR, the case of high-energy lasers is stated as "uncertain." The only additional comment given is that ". . . the USSR has a large program involving approaches not being pursued by the US."

LASER TYPE	COMMENTS
CHEMICAL	Reactants include deuterium-fluoride (3.7 μm to 4.1 μm) and hydrogen-fluoride (2.5 μm to 3.0 μm). The lasing cavity operates at low pressure (less than 0.01 atmosphere), requiring a complex vacuum pumping system to vent spent reaction gases, if operated in a ground-based role. Fluorine is extremely corrosive and hard to handle. Can be operated in either CW or pulse mode. May be able to achieve output power levels of 100 000 W/lb gas fuel per second.
EDL	Lasing materials include carbon monoxide gas, CO, radiating from 4.8 μm to 6.2 μm, and carbon dioxide gas, CO_2, at 10.6 The lasing cavity operates at near ambient pressure, allowing easy venting of spent gases. However, this laser type operates at high voltage, while most energy sources are low voltage. The required transformers and dc/ac converters are heavy and bulky—up to thousands of pounds and tens of cubic feet. Can be operated in either CW or pulse mode. May be able to achieve output power levels of 100 000 W/lb gas fuel per second.
GDL	Lasing material is carbon dioxide gas (10.6 μm). The lasing cavity operates at low pressure but the spent gases can be vented directly if the laser operates in a low pressure environment, e.g., the Air Force ALL at high altitude. Most practical in the CW mode. May be able to achieve output power levels of 50 000 W/lb gas fuel per second.

TABLE II Lasers with Military Potential

Impact Issues in Laser Weapons Deployment

The psychological impact of actually deploying laser weapons would, in my opinion, be enormous—at least as significant as that of the introduction of the V-2 rocket in World War II. The development of such devices would be a major event in the history of weapons. Beginning with the first rock used by primitive man to beat an enemy or prey to death, progressing through the Roman catapult, up to the modern cruise missile, weapon systems have delivered a material "warhead" to the adversary. All of the technological weapons innovations through history have this feature in common: they are all "matter" weapons. The laser represents the first break with this historical continuity, as it is the first "pure" energy weapon [42]. Nothing material is delivered from the attacker to the attacked.

The awareness of the general public about "death-ray" weapons has long been developed by science fiction stories and movies [43] but, of course, it is precisely because science fiction has been the vehicle for commentary on them that would add to the shock of their actual existence. An additional dimension to the psychological shock of laser weapons would be their perception as a new form of incendiary weapon, suitable for such indiscriminate terror missions as the setting of massive forest and city fire storms. As reported in [44], a draft of a comprehensive ban on incendiary weapons was recently placed before the International Committee of the Red Cross in an attempt to "modernize" the Geneva Conventions of 1949. These weapons are currently thought of as including, for example, napalm bombs, flame throwers, and thermite grenades, but in general, incendiary weapons are so classified because they

WHO IS	DOING WHAT
Hughes	COAT, INLAW, laser windows, beam aiming and tracking
TRW	chemical lasers, HEMLAW
Northrop	EDL
Rockwell/Rocketdyne	chemical lasers
Avco	EDL's, laser windows
United Technologies	COAT, propagation, laser windows, material effects
Lincoln Laboratories	COAT, laser windows
NRL	material effects
University of Alabama	laser windows, laser damage mechanisms
SRI	fracture damage by pulsed lasers
General Electric	GDL, INLAW
Raytheon	laser windows
Calspan	EDL
Perkin-Elmer	beam aiming and tracking
Aeronutronic-Ford	beam aiming and tracking

TABLE III Laser Research Activity Centers

are burning, radiant energy weapons. This would seem to include lasers, too. In the light of the history of attempts to ban other "inhumane" weapons, e.g., gas, I remain pessimistic on the credibility of any forthcoming arms control agreements on incendiary weapons. If they are perceived as being useful, either immediately or through some sequence of technological innovations, I believe their use is almost certain in war—independent of any prior agreement based on the shaky premise that it is somehow "better" to be shot than burned [45]. I devote the rest of this section to issues other than the psychological [46], but I add as a final remark here that I think this aspect of the impact of laser weapons is easily underestimated.

There are three special characteristics of laser weapons that must be kept in mind.

1) "Zero" time of flight. The beam energy travels at the speed of light (by definition) and, unlike missile and gun systems which have to predict where the target will be in the future, laser weapons shoot directly at their targets. Thus there is only the problem of estimating the present target position—still challenging for a maneuvering target—but not the additional prediction problem associated with conventional weapons.

2) Line-of-sight restriction. The beam energy travels in a straight line and cannot be "lobbed" over an obstacle as can a ballistic missile (even a bullet is really a ballistic projectile for long ranges, and not line-of-sight).

3) Potentially "infinite" shot capacity. Since the weapon is transmitting radiant energy, the availability of "munitions" is limited only by the energy source which by various means can be made to appear inexhaustible.

Because of the driving influences of the atmosphere on the propagation of laser energy, it seems natural to divide possible laser weapons systems into the two categories of endoatmospheric and exoatmospheric systems. Somewhat in between would be a high-altitude airborne system, e.g., the Air Force ALL. Let me now give just one example of each of the two basic cate-

STUDY CONTRACTOR	LASER MISSION ROLE
McDonnell Douglas	fighter defense and offense
Hughes, McDonnell Douglas, General Electric	BMD
McDonnell Douglas	ground-based air defense
Naval Weapons Center (China Lake)	fleet defense (airborne laser)
Space Applications (La Jolla)	fleet defense (shipboard laser)

TABLE IV Mission Roles and Contractors for Laser Weapons

gories that would have strategic impact: a ground-based satellite "blinder" and a satellite-based sea control and air-defense weapon.

1) Ground-based satellite blinder. Such a system would have the mission of overloading and/or destroying the infrared sensors and radio antennas onboard strategic C^3 and surveillance satellites. The US may, even more than the Soviets, be increasingly vulnerable to this sort of weapon, as its military services continue to move toward total real-time C^3 networks for integrated, planet-wide situation evaluation and decision-making systems [47].

The introduction of a Soviet blinding system would create enormous doubt as to the survivability of the U.S. C^3 system. The AWACS system in Europe, designed to coordinate NATO forces in a confrontation with Warsaw Pact forces, may also be vulnerable (especially those systems dependent on FLIR). Future IFFN systems, which depend on widely distributed communication and navigation nets, which will likely use satellites, would also be in danger of compromise by a blinder weapon.

2) Satellite-based sea control and air-defense weapon. This system would incorporate a very large laser in orbit capable of attacking ships at sea, ICBM's and SLBM's in the boost phase of flight, and aircraft at all altitudes. As a "downward-looking, downward-shooting" weapon, it would have an available targeting area of millions of square miles [48], a feature that might make local atmos-

ENERGY SOURCE	COMMENTS
Fuel cell	4×10^6 W for 30 s, in a 2500 lb, 40 ft^3 package. Ground or shipboard system, possibly airborne, too.
Rechargeable silver-zinc battery system	4×10^6 W for 30 s, in a 3000 lb, 19 ft^3 package, plus 1000 lb for transformer and dc/ac converter to raise the low battery voltage. Ground or shipboard system, possibly airborne, too.
Super conducting, jet engine driven alternator.	10×10^6 W for 10-s pulses, one per minute, in a 939-lb package. Useful in a land, shipboard, or airborne system.
MHD generator	10×10^6 W continuously until fuel exhausted, in a 4400-lb package. Primarily a land or shipboard installation.
Dedicated nuclear plant	A "hardened," i.e., buried, nuclear power plant could provide, for essentially unlimited time, continuous power levels on the order of 1000 to 2000 $\times 10^6$ W. Ground system only but via microwave link, possibly a power source for satellite weapons.

TABLE V Some Possible Laser Weapon Energy Sources

pheric phenomena a much less important constraint than for a surface or near-surface-based weapon. This form of laser deployment may force cruise missiles to fly at very low altitudes, giving added incentive to developing "low flyers."

This weapon concept is a clear violation of SALT Phase I and the Outer Space Treaty, but with the growing rivalry between the US and Soviet Navies, possibly such a radically new ocean surveillance and enforcement concept will become attractive to one or both sides. Even very recent discussions of naval armaments control [49] do not discuss the possible influences of such a development because, in the time frame of the next 15 to 20 years, hardly anyone believes it will happen. But then again . . .

Concluding Remarks

How likely is the prospect that the Army will use laser cannons to knock out enemy close air support aircraft? Is it probable that the Navy will deploy shipboard lasers for fleet defense? Will the Air Force mount huge lasers on high-flying aircraft or satellites to serve as defense suppression weapons for our aircraft as they penetrate enemy air space? From the money being spent by the DoD, it certainly *seems* that there must be those in high places who think there is a chance that these missions can be served. But are they right? The fact that large quantities of monies are being spent is no reason for supposing so.

In a paper that should be read by all who are reluctant to criticize authority, Edward Purcell shows how to do it [50]. After totally demolishing the idea of interstellar travel *by rocket,* even with the "ultimate" energy source of a matter/antimatter engine, Purcell writes, "All those people who have been seriously talking about lebensraum in space, and so on, simply haven't stopped to make this calculation and until they do, what they say is nonsense—no matter how highly placed they may be or how big a budget they may control."

I think all of the laser mission roles envisioned by the military services have critical issues on which they will stand or fall, in a way similar to Purcell's analysis, but which are yet to receive public scrutiny. In addition to the technical questions of the form "Can it be done?", there are the questions of economics (why shoot a laser if a missile is cheaper?), combat conditions (a missile can fly through bad weather, but can a laser shoot through it?), countermeasures (can't the enemy negate an earth-based LBMD by exploding a nuclear device so as to create a large dust cloud through which laser propagation is degraded beyond use?) and politics (it would seem risky to attempt to build a space-based LBMD because the Soviets and Chinese would be highly provoked and would shoot such orbital stations down). I think there may be persuasive arguments that can be marshalled against these reasonable objections, and these are issues that require wide-ranging debate.

For the moment let me take the view that huge, technically ambitious laser weapon systems will not materialize (although any who doubt the ability of the military to aggressively pursue such gigantic enterprises should examine, for example, the Navy's Project SEAFARER, for-

merly SANGUINE, to see how dedicated they can be) [51]. Even in this happy future for arms control, I think there may *still* be serious international problems to be faced. For example, look at the NASA satellite solar energy program. This program, one of the US responses to its energy resources. problems, is intended to gather solar energy and then to beam it to earth by microwave [52]. These power station satellites are designed to be enormous installations, weighing on the order of 20 000 tons and supplying 5000 to 10 000 MW each. If these stations are deployed, the U.S. may find itself with a credibility problem in assuring the Soviets and the Chinese that they are, in fact, *not* weapon systems or cannot be converted to laser weapons platforms (or, more dramatically, turned into "killer" satellites). To continue along this line, I suggest that while the Skylab experiments and space shuttle development program have notable scientific accomplishments to their credit, the Soviets and Chinese *could* have an additional perception. These achievements demonstrate the ability of the US to put large, consecutive payloads in near-earth orbit, *with men,* to allow the construction of large systems, including space-based weapons. Would the Soviets and Chinese, as huge satellites designed to handle enormous energy loads begin to appear over their heads, believe the American government when it replied to their concerned inquiries, "Don't worry, they're just power stations"? Would we if the roles were reversed [53]?

This paper opened with a rather somber quote. Let me close it with another that I think is particularly pungent, from a man generally thought to be an expert in his field:

Strange events permit themselves the luxury of occurring.

—Charlie Chan

References and Notes

[1] R. Bracewell, *The Galactic Club: Intelligent Life in Outer Space.* Stanford, Calif.: Stanford Univ. Press., 1974.

[2] *IEEE Spectrum,* pp. 55-59, June 1976.

[3] For example, the *Boston Globe* recently ran a two-part series called "The lethal laser is here—will it be added to US, Soviet arsenals?" (May 23, 1976) and "Powerful lasers now being turned to spying on spies" (May 24, 1976). Given the unique publication constraints of newspaper writing, they really weren't too bad. As a worse case in point, I refer the reader to *The Pentagon Watchers: Students Report on the National Security State,* L. Rodberg and D. Shearer, Eds. New York:

Doubleday, 1970, and in particular, to the essay there by M. Kramer "Buck Rogers is alive and well—and doing R&D for the Pentagon," pp. 323-333. The Air Force SORTI system is mentioned (a version of the satellite-based sea control and air-defense weapon discussed in the Impact Issues section). After a very brief descriptive (but not analytic) survey of several BMD systems, including the LBMD, the author concludes with the words of a (allegedly) former Pentagon official, "Welcome to the magic military land where we make weapons that won't work for threats that don't exist." This is a nonsensical statement, at least in part; if Pentagon weapons didn't work, so many of us wouldn't care about arms control and disarmament. Pentagon weapons work only too well.

[4] Testimony of G.C. Smith before the subcommittee on International Organization and Disarmament Affairs of the Senate Foreign Relations Committee, on the strategic and foreign policy implications of ABM systems, p.I, US GPO, p. 10, Mar. 1969.

[5] Intended to significantly reduce human casualties during a nuclear exchange, the widespread construction of fallout shelters could be interpreted as nothing but a damage-limiting system, with the resulting Soviet apprehension coming as a surprise only to those who couldn't put themselves in the shoes of the other side.

[6] SALT Phase I Documents, reprinted in *Arms Control,* H. York, Ed. San Francisco: Freeman, 1973, p. 267.

[7] (ABM Treaty, Initialed Statement E, in *Arms Control,* H. York,) Ed. San Francisco: Freeman, 1973, p. 267.

[8] I use the word *deplorable* not because I believe BMD systems are intrinsically evil, but because, in my opinion, they are inconsistent with the accepted political policy of MAD—a policy made legitimate by SALT. That is, if we reject the horrible idea that BMD's will be deployed to gain first strike capability, then it must be that they will be used to protect ICBM fields. But the attacked side will launch their missiles very soon after they detect enemy missiles leave their silos—surely neither side would wait for these missiles to arrive, engage them with a BMD, and then counterlaunch. Or, if it is argued that this is exactly what would happen, to gain a few additional minutes to decide what to do, then I wonder what will be decided that already hasn't been, that is, does one retaliate or surrender? As York points out so well in his essay, "The common understandings implicit in SALT Phase I" [6, pp. 274-279], the presence of a BMD around a target merely motivates an attacker to aim additional weapons to saturate (probably oversaturate) the BMD system. Thus, at best, the target is still destroyed. At worst, with even just a partial failure in the BMD system, the destruction and devastation of the target will be more extensive than it would have been with no BMD. This position is not universally held, however. For example, in recent testimony before a subcommittee of the House Committee on International Relations, Professor Henry S. Rowen (formerly deputy assistant secretary of defense for international security affairs) expressed a different view. He believes ABM deployment to protect ICBM fields *increases* strategic stability because the increasing vulnerability of ICBM silos (due to decreasing missile CEP) is a destabilizing influence. Rowen's views are reprinted in *Aviation Week and Space Technology,* pp. 52-54, Sept. 15, 1975.

[9] *Aviation Week and Space Technology,* p. 13, Oct. 13, 1975.

[10] This is, of course, the Soviet version of one of the original American arguments for deploying a "thin" Chinese-oriented ABM (Sentinal), but not a "thick" Russian-oriented one (Safeguard). Former Secretary of Defense McNamara recognized the danger in this argument when he wrote of the certain pressures that would exist to thicken an operational thin system (*The Essense of Security: Reflections in Office.* R. McNamara, New York: Harper

and Row, 1968, pp. 163-166.) He believed this pressure could be "firmly resisted," but whether the Russians would (or could) is hardly in American hands.

[11] Beta blackout is caused by the free-electron clouds formed by nuclear explosions at altitudes below about 60 km, as discussed by R. Garwin and H. Bethe, "Anti-ballistic missile systems," *Arms Control,* H. York, Ed. San Francisco: Freeman, 1973, pp. 164-174.

[12] D. Howard, "High range resolution monopulse tracking radar," *IEEE Trans. Aerosp. Electron. Syst.,* vol. AES-12, pp. 749-755, Sept. 1975.

[13] *Aviation Week and Space Technology,* pp. 17-18, Dec. 8, 1975.

[14] *Aviation Week and Space Technology,* pp. 12-13, Dec. 8, 1975.

[15] *Aviation Week and Space Technology,* p. 156, June 22, 1970.

[16] J. Ruina, "U.S. and Soviet strategic arsenals," in *SALT: The Moscow Agreements and Beyond,* M. Willrich and J. Rhinelander, Eds. New York: Free Press, 1974, pp. 34-65.

[17] *Newsweek,* p. 13, Feb. 9, 1976.

[18] *Newsweek,* pp. 23-24, Dec. 22, 1975.

[19] J. Rhinelander, "The SALT I agreements," in *SALT: The Moscow Agreements and Beyond,* M. Willrick and J. Rhinelanders, Eds. New York: Free Press, 1974, pp. 125-159.

[20] *Aviation Week and Space Technology,* p. 11, Jan. 12, 1976.

[21] *Aviation Week and Space Technology,* p. 24, Nov. 24, 1975, and p. 7, Dec. 8, 1975.

[22] *Aviation Week and Space Technology,* pp. 9, 17-20, Dec. 5, 1975.

[23] P. Nitze, "SALT and related issues," unclassified seminar at the Institute for Defense Analyses, June 16, 1975.

[24] *Time,* p. 17, Nov. 10, 1975.

[25] The spectacular concept of antipersonnel weapons, e.g., the hand-held "phasor" made famous in "Star Trek," is gener-

ally held to be unrealistic. The bullet is likely to be unchallenged as an "efficient" way for individuals to kill each other.

[26] In this analysis (P. Nahin, "The surface heating of a finite thickness shield by a laser beam," Hughes IDC 71/1463.90/59, Aug. 5, 1971), I showed that in antitank combat, the reasonable beam intensity for a "man-pack" system of 30 W/cm^2 would elevate the outer and inner surface temperature of 20 mm of armour steel (e.g., the rear of the French AMX-13 light tank) by 80°C and 19°C, respectively, in 10 s. This is sufficient for use as a target designator for an infrared seeking missile, but has no damage capability in its own right.

[27] I am grateful to Dr. R.L. Garwin of IBM for making available to me a copy of his Harvard seminar notes. "Military uses of high-power lasers," Nov. 6, 1974. Garwin performs an interesting analysis of laser heating and shock damage mechanisms to a target.

[28] Under the protocols of the present treaty, either side can withdraw with six months notice specifying the extraordinary events that it is believed have jeopardized its supreme interests. In any case, the treaty comes up automatically for review every five years. The first such review will be in 1977.

[29] *Aviation Week and Space Technology*, pp. 34-39, Aug. 18, 1975; pp. 50-56, Sept. 1, 1975; pp. 53-59, Sept. 8, 1975.

[30] W. Hoefer, "Laser propagation effects at 10.6 microns," General Electric Publication List for Universities, Item PLUS-208, 1974-1975.

[31] M. Lubin, J. Sources, and L. Goldman, "A large aperture Nd-glass face pumped laser amplifier for high peak power application," General Electric, Rep. 72CRD143, May 1972.

[32] The expression for H given in the text describes what is called a "uniphase Gaussian" laser beam. See, for example, M. Klein, *Optics*. New York: Wiley, 1970, pp. 428-429; and A. Siegman, *An Introduction to Lasers and Masers*. New York: McGraw-Hill, 1971, pp. 60, 311-316. If we denote the beam diameter at any range R, by B, then $B = D[1 + (R\lambda/D^2)^2]^{1/2}$ where λ is the wavelength of the laser radiation. Notice that at zero range, we have $B = D$, the diameter of the output aperture, while at "long range," i.e., for R much larger than the Rayleigh range of D^2/λ, we have $B = R\lambda/D$, which shows how the laser beam diameter expands linearly with range. The laser energy is spread nonuniformly (because we have a Gaussian amplitude beam) over a circular spot of area $\pi B^2/4$. If the power level in the beam is denoted by P, then the *average* power density H is given by $H = P/(\pi B^2/4)$ from which the expression in the text follows. The actual power density is much higher in the center of the spot, however.

[33] One experimental exception to this is the General Electric copper vapor EDL which operates at 0.5 μm which is in the visible spectrum (blue/green light).

[34] To interact with the target, the energy in the laser beam must be absorbed by the target. If the target is black, this may happen to a significant degree, but on the other hand, a highly polished shiny target surface will act like a mirror and reflect (not absorb) a large fraction of the beam energy.

[35] Fog and rain are distinguished on the basis of their droplet sizes, which are roughly less than 10 μm and greater than 1000 μm in radius, respectively. Aerosols are defined to be all atmospheric particles of greater than molecular size at a relative humidity less than saturation, e.g., smoke and dust over land, and sea spray over water.

[36] Beam spreading and wandering can be countered with COAT, a development being pursued by Hughes and the Lincoln Laboratories, among others. Beam wandering is the slow random motion of the centroid of the beam. It normally is less than 0.1 mrad in magnitude, which is about 2.5 ft at a range of 10 mi.

[37] Thermal blooming can be combated by using a pulsed beam which, when

directed at a moving target (or a stationary target if the laser platform is moving, like the ALL), allows each new pulse to propagate through a new, cool shaft of air.

[38] Electrical breakdown is a phenomena associated with really high energy beams, as it occurs only at power density levels of several billions of watts per centimeter squared (although over water with sea spray present, the onset of breakdown occurs at lower power densities).

[39] The coupling of laser energy to a target is an incredibly complex process, particularly at power densities below 10 MW/cm^2. The phenomena of LSCW which *improves* coupling at densities below this critical value, then begins to *decrease* the coupling as power densities increase. The coupling is also a function of radiation wavelength and the nature of the target surface.

[40] The SNAP series of satellite reactors spanned a wide range of electric power output, with SNAP-2 delivering 3×10^3 W, SNAP-8 reaching 3×10^4 W, and SNAP-50 peaking at 3×10^5 to 10^6 W. See R. Loftness, *Nuclear Power Plants*. New York: Van Nostrand, 1964, pp. 494-507; and M. Zipkin and R. Edwards, Eds., *Power Systems for Space Flight*. New York: Academic, 1963, pp. 3-28. A discussion of the Nazi electric gun (it was supposed to fire 15-cm caliber shells, each weighing about 90 lb, to a range of 150 mi) can be found in the book by I. Hogg, *The Guns of 1939-45*. New York: Ballantine, 1973, p. 152.

[41] *Aviation Week and Space Technology*, pp. 12-13, Feb. 9, 1976.

[42] The one possible exception that I can think of is the ancient story (circa 200 B.C.) of the destruction of a Roman invasion fleet at Syracuse by, among other weapons, solar energy beams focused by lenses contructed by Archimedes. This is most likely an apocryphal (but fascinating!) story, however, (see W. Durant, *The Life of Greece*. New York: Simon and Schuster, 1966, p. 632). The World War II legend of the development of a solar energy "sun gun" by Nazi Germany is debunked as propaganda by B. Ford in his book *German Secret Weapons: Blueprint for Mars*. New York: Ballantine, 1972, p. 28.

[43] Death rays first appeared in "credible" form in *The War of the Worlds* by H.G. Wells. More recently, a surprisingly detailed description of an automatic ground-based LBMD was given in J. Haldeman's novel, *The Forever War*. New York: Ballantine, 1974. The CW power level of this weapon was given as one billion watts, somewhat in advance, as far as I know, of the current state of the art!

[44] *Scientific American*, pp. 56-61, Jan. 1976.

[45] I know this reads as a terribly pessimistic evaluation of these kinds of ACD agreements, but I put forth the chemical and biological weapons issue as a case in point. The incredible history of the use of gas (a particular form of chemical warfare) in World War I can be found in I. Hogg's book, *Gas*. New York: Ballantine, 1975, which describes how the initial "gut" revulsion to its use gave way to analysis that showed it was more effective and "less appalling" than being debrained by a bullet or disemboweled by a flying shard of redhot steel. The reason both the Germans and the Allies avoided gas in World War II had nothing to do with humanitarian considerations. Rather, because of the technological deadlock that existed between the two sides, nothing would have been gained through its use but retaliation. On the other hand, even though "It was a painful decision, taken not without much soul-searching at the highest level . . .," the British were fully prepared to attack the Germans with mustard gas if a Nazi invasion of England took place. See W. Shirer, *The Rise and Fall of the Third Reich*. New York: Simon and Schuster, 1960, p. 785. What is and isn't "permissible" in war clearly depends on the stakes. Thus we find today that rather than being absent from the US weapons inventory, the DoD has continued research and development on (and would like to buy massive numbers

of) artillery shells that can deliver the new binary nerve gases (see, for example, *Chemical Disarmament: New Weapons for Old.* Stockholm International Peace Research Institute, Feb. 1975.) The Soviets clearly haven't abandoned chemical warfare either, as indicated by a recent Tass photograph (*Newsweek,* p. 37, Mar. 1, 1976) showing Russian troops on maneuvers in gas masks.

[46] My comments in the rest of this section are based in part on recent exchanges of view with some of my colleagues. I am indebted to Dr. S.H. Starr of IDA for a lengthy analysis on his perception of possible future roles for laser weapons (private correspondence, Jan. 29, 1976); and to Dr. R.L. Garwin of IBM who made available to me a copy of his Harvard seminar notes "The cruise missile in future US strategic and tactical forces," Nov. 14, 1974, and also a copy of his paper "The shape of future U.S. military forces," July 4, 1972 (private correspondence, Oct. 23, 1975).

[47] These systems are called TDMA in general, with J-TIDS the current systems acronym in Pentagon use. TDMA communication systems are an evolution of the older digital TDM telemetry systems used, for example, from the very beginning of the manned US space program. See C. Ellingson, "Performing IFF with ICNI (integrated communications, navigation, and identification)," MITRE Rep. MTR-1773, July 1970, and "All in good time," *Vectors,* Hughes Aircraft Co., pp. 18-21, Winter 1974. The US has been studying satellite infrared sensors for early ICBM launch detection since the beginning of the 1960's starting with MIDAS.

[48] The surface area visible to a satellite at an altitude h above the surface of the earth is given by the following equation (where I am assuming a spherical earth with radius R): *visible surface area* $= 2\pi R^2 h/(R + h)$. Using an R of 3960 mi (from A. Cook, *Gravity and the Earth.* New York: Springer-Verlag, 1969), then, for example, at an altitude of 100 mi a satellite can "see" an area of 2 427 000 mi^2, while at the synchronous orbital altitude of about 22 300 mi the visible area is 83 672 000 mi^2. Of course, there is a trade-off between the magnitude of the visible area and the range (and thus the laser beam energy) to a target within this area.

[49] B. Blechman, *The Control of Naval Armaments: Prospects and Possibilities.* Washington, DC: Brookings Institution, 1075.

[50] E. Purcell, "Radioastronomy and communication through space," in *Interstellar Communication,* A. Cameron, Ed. W.A. Benjamin, 1963, pp. 121-143.

[51] Project SEAFARER is an ELF communication system linking land-based transmitters to submerged FBM submarines. Essentially a 10 000 mi^2 buried antenna driven by a half-gigawatt CW source at 45 Hz (all numbers are plus or minus 50-percent or so!), this concept is enough to attract the attention of even the most unexcitable sort. An outstanding source of technical and historical information is the special ELF issue of the *IEEE Trans. Commun.,* Apr. 1974. Another source of an entirely different orientation is the paper by M. McClintock and A. Scott, "SANGUINE," *Environment,* pp. 27-35, July-Aug. 1974. Here the *political* implications of ELF/FBM communications are explored. Whether or not you agree with the political conclusions of the authors, the paper is interesting as it shows how much analysis of a military system can be done without access to classified information.

[52] *Aviation Week and Space Technology,* pp. 54-55, Feb. 9, 1976. Microwave power transmission research is being pursued jointly by the Lewis Research Center and JPL, with a present demonstrated capability of 30 000 W over a 1-mi beam path. More information, with photographs, can be found in *IEEE Spectrum,* pp. 48-50, May 1976.

[53] An intriguing variation on the "power station in orbit" would be the "mirror in orbit," using either the sun or earth based radiation source reflected off

of a steerable mirror [42]. What might be the political implications of this system? This is actually a fairly old idea, as it can be found in the 1938 short story by R.L. Rocklynne, "The Men and the Mirror," reprinted in *Before the Golden Age*, vol. 3 (Isaac Asimov, Ed.) Fawcett, 1975.

Paul Joel Nahin (M'71) was born in Berkeley, California, on November 26, 1940. He received his B.S. from Stanford in 1962, M.S. from Cal Tech in 1963, and Ph.D., from the University of California, Irvine, in 1972, all in electrical engineering. He performed the digital design of the Gemini-Apollo time division multiplex stored program telemetry simulator. He performed the digital I/O design for the Navy IFF Beacon Video and UNIVAC 1218 Processor and numerous analyses on radar signal processing, including various IFF coding schemes for the 407L and AWACS Systems. He was a Howard Hughes Staff Doctoral Fellow from 1968 to 1971 and then taught full-time at Harvey Mudd College and the Claremont (California) Graduate Center. He was a 1973-74 National Research Council Post-Doctoral Fellow at the Naval Research Laboratory in Washington, DC. Since September 1975, he has been an Assistant Professor of Electrical Engineering at the University of New Hampshire, Durham. His research and teaching interests include image processing by computer, realtime signal processing, military systems and the societal implications of rapid technological change. He is a book reviewer for the American Association for the Advancement of Science. ■

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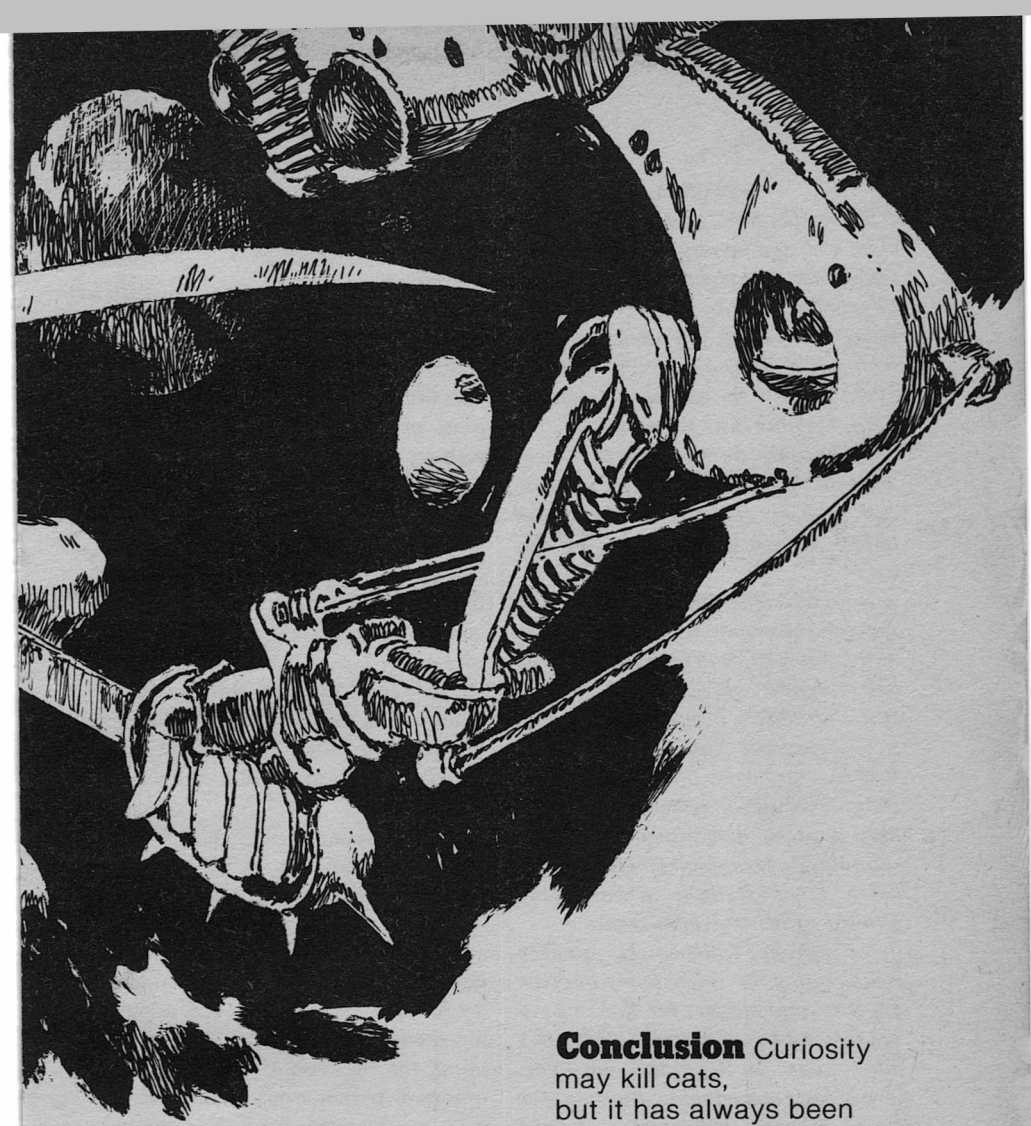

Conclusion Curiosity may kill cats, but it has always been a good and faithful servant to men.

Keith Laumer

The Wonderful secret

SYNOPSIS

Damocles Montgomerie is a small-time Chicago hoodlum, a real street-wise punk. But right now he's in a lot of trouble: shot in the stomach, he's being backed into an alley, about to be finished off by a bullet between the eyes. There's no escape, the gun is fired, Dammy is as good as dead . . . and suddenly time and motion stop. All that remains is a frozen tableau, and a voice inside Dammy's head telling him to relax, he's being rescued!

Dammy comes to aboard a small spaceship en route to an Arctic hide-away. His host, who looks and sounds like a dapper, elderly British aristocrat, introduces himself as Xorialle. It is clear that Xorialle is far from British, far from human, in fact. Dammy refuses to believe it, however, until Xorialle demonstrates some irrefutably superhuman powers, and finally gives Dammy a terrifying glimpse of his true appearance.

No dummy, Dammy very quickly realizes that he is no more than an experimental subject for Xorialle—a randomly chosen sample of Earth's inhabitants—to be put through a battery of tests and training situations for the further knowledge of Xorialle and the Concensus for which he works. Possessed of a stubborn nature, Dammy tries to resist Xorialle's teachings, but find the alien too powerful for him; and besides, Dammy is fascinated to discover his own undreamed-of abilities and powers. As he learns more about Xorialle's techniques and motives, Dammy sees that the base is nothing more than a laboratory/prison. And clearly, prisons are made for escape. . . .

The small chamber to which Xorialle led Montgomerie next morning was windowless, with unadorned pale-gray walls and ceiling. Its sole furnishing was a large assembly occupying the center of the floor, filling most of the available space. Dammy circled the latter as Xorialle bustled over to a corner to push one of his inevitable buttons, deploying a small desk-type console packed tight with more buttons.

"It looks," Dammy stated, "like a collision between a traction bed and a jungle gym, with a dentist's chair thrown in—from a third story window."

"The responder may not appear very impressive, my boy," the old fellow acknowledged, poking keys in a rapid sequence and staring assessingly at the resultant pattern of colored indicator lights. "In external appearance, at least. But it's a most ingenious apparatus, capable of simulating the response of the immediate exocosm to your every movement, as well as applying carefully metered stimuli to your musculature."

"Translation?" Dammy requested automatically.

"Once fitted to you, with appropriate neural contacts, the responder will do a remarkable job of acting as trapeze, gravity field, fencing oppo-

nent, centrifuge—the entire gamut of external conditions and forces needed to exercise you in the disciplines we'll be covering."

"Jake. Now explain the translation—and to save time, maybe you could explain the explanation as you go along."

"More of your anti-intellectual pose, based on the proposition so popular among the unlettered that sagacity is unmanly," Xorialle dismissed his pupil's gibe. "Let's suppose you're learning fencing: The appropriate adjustments are made, and as you lunge, thrust, and parry, the responder will parry, thrust, and lunge in return—or the equivalent—with all the skill of a master of foil, sabre, and epée."

"What's peddling hot merchandise got to do with me living to a ripe old age?"

Xorialle waved the question away. "But at first, of course, we'll be busy for a time with honing your basic tools. Into the responder with you now, Damocles, there's a good lad."

"You want me to climb inside that Rube Goldberg?" As he spoke, the assembly stirred, seemed to fold in on itself, separating into two halves which opened wide, leaving a clear access to a system of rods and slings at its heart.

Xorialle merely sighed. Dammy clambered in, settled himself gingerly. The frame closed on him. Padded arms and feelers nudged him, nestling into position; clamps slid deftly into place, locking his arms, legs, torso, and head in contact with a maze of rods, straps, levers, wires. He fought down a surge of claustrophobia.

"Comfortable?" Xorialle called.

"Are you kidding?" Dammy replied in a muffled voice. "I'm wrapped up in hardware like a mummy! I feel like I'm . . ."

"Is your free movement restricted?" Xorialle sounded concerned. Montgomerie moved a finger tentatively. The attached apparatus moved soundlessly with it, without resistance. He flexed his arm, then a leg, moved his shoulders, twisted his head.

"Funny," he said. "I can't even feel the stuff."

"Stand up, please."

"How can I?" Dammy said, but when he stood the gear rode lightly with him.

"Run in place, swing your arms, jump up and down, that sort of thing."

Dammy complied, unimpeded.

"That's all right then," Xorialle said with relief. "A pity I don't have access here to the sophisticated equipment available at home, but these jury-rigs will have to do. Now, I'll just begin by teasing that reflex mechanism out into the open . . ."

A needle stabbed the sole of Montgomerie's foot at the same instant that a slim pointed rod jabbed at his face. He jerked his foot away, ducked sideways, throwing up both hands.

"Very nice," Xorialle called. "That gave me a splendid fix. We'll key everything to the reflexive response, you know—"

"I *don't* know," Dammy yelled. "You could have put my eyes out!"

"Hardly," Xorialle said mildly.

"At least you could have warned me."

"Dammy, please abandon this attitude of kindly protectiveness toward your own retrospective experience matrix. Anxieties are usefully directed only toward anticipated dangers, if at all."

"So what's the idea of jabbing icepicks at my eyes?"

"The basis of all advanced physical training is the redirecting of reflex. A karate expert, for example, learns to substitute for the normal defensive flinch a counter-offensive blow. Tap such an individual on the shoulder and very likely you'll be on the floor with a crushed tracheum before he can stop himself."

"Yeah?"

"Speaking of karate," Xorialle continued. . . .

Through the jungle of equipment, Dammy saw him punch a key. A bomb exploded immediately under him, hurling him into a wild gyration. His body and limbs threshed, quivered, spasmed; the equipment around him churned and writhed too rapidly for the eye to follow. He tried to yell, managed a croak. As suddenly as they had begun, the frantic contortions ceased.

"Help," he croaked "Don't do it again. I'll talk."

"Now, that wasn't really so bad," Xorialle said absently, his eyes intent on the panel. "What say we take up prestidigitation next?"

"Is that anything like chewing a cud?" Montgomerie snarled.

"Your vocabulary is wider than you admit," Xorialle said. "We'll widen it still further this evening when you leaf through an unabridged dictionary of Terran languages I compiled the other day." He pressed a key and clamps seized on Dammy's hands, twisted and wrung the fingers, madly flexed the palms and wrists, quivering violently all the while, simultaneously working his arms in frantic pumping motions, then abruptly ceased.

Dammy yanked his abused digits away, tucked them under his arms, where they tingled and throbbed as if stung all over by singularly mild-venomed bees.

"I feel like I've been squeezing an air-hammer all day," he gasped. "What was that supposed to prove? I already told you I'd cooperate."

"Dexterous hands are basic to many of the skills that I'll be programming for you," Xorialle said calmly.

"How'm I going to have dexterous hands if you let this pile of junk beat 'em to a quivering pulp?" Montgomerie shouted.

"Nonsense, Dammy. I've merely imprinted certain action patterns in the manual area; the discomfort will soon pass. And you must confess the effort is far less in the aggregate than that which would have been required for hundreds of hours of practice at dealing an ace from the bottom of the deck or palming wristwatches, to say

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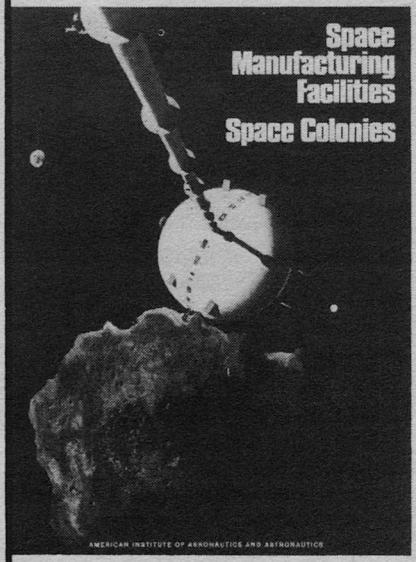

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nothing of the tedium of an intensive program of isotonic exercises: you'll receive in a day benefits equivalent to some six hours daily of heavy workouts over a period of years—producing optimal hypertrophy of your skeletal musculature. You'll make Hoffman and Atlas appear frail by comparison."

"Sure, that's cool, Doc, but I don't want to look like a freak. Remember $W \propto ps \propto l^3 \times l = l^4$."

"Of course, of course."

"Just watch that l^3," Dammy said sullenly.

"Your physique will attract unalloyed admiration from all, I assure you. You'll want specially tailored clothing, of course, to accomodate your bulging quadriceps and so on—but that's a mere trifle. I suggest you dismiss your misgivings and simply enjoy the knowledge of your new skills."

Dammy looked at his hands, still festooned with weightless wires and rods and clamps.

"You mean . . . ?"

"Precisely."

"And before?"

"Karate, as I mentioned at the time."

"You're trying to tell me—I'm a black belt man now?"

"You have the physical tools of the discipline, yes. You have still to scan a text on the subject, giving you the applications for the various movements; but you'll find you can manage them flawlessly at the first attempt, just as a trained pianist can play a new concerto on sight."

"Yeah," Dammy said dubiously, "but how can I sword-fight, say, if I don't know one end of a sword from another?"

"In the case of a trained fencer, do you imagine that he consciously computes the path of a striking blade, extrapolates the future position of the point, decides on a response, and sets about tensing selected muscle groups in order to place his own blade in the desired relationship? Of course not. He merely reacts. Our task is to train your reactions."

"Uh-huh—but if you're from Mars like you say, what do you know about how a Chinaman makes bird's-nest soup, or what it takes to ride a winner at Belmont?"

"My tape library includes recordings of mental patterns of selected experts in every category, covering both consciously and subliminally stored information relating to their specialties."

"I get it. You just waltzed up to Einstein and said, 'How's about it, pal? Want to sit under my hair-dryer while I pick your brains?' "

"Nothing so obvious, my boy. I have facilities for automatically seeking out what is needed and recording it selectively and at a distance. My collection now numbers over two hundred thousand separate human skill-patterns alone."

"How long have you been spying on us, Doc?"

"Several centuries. It's a continuing process, of course. Even at this mo-

ment new data are being recorded. That's the clicking you hear."

Dammy flexed his fingers. "They don't feel any different," he said dubiously. "If I knew how to bottom-deal, I'd know it."

"Physical skills are imprinted at a level below the conscious," Xorialle pointed out. "If you were conscious of every move you made when walking, for example, you'd have room in your attention-area for nothing else—and you'd probably fall down. The pianist looks at the music and his fingers play. In fact, if he's away from the instrument for awhile and becomes rusty, he can recover a tune he once knew by sitting at the piano and watching what his hands do. They'll strike the correct keys even if he's consciously forgotten them."

"I'll believe it when I try it and it works."

Xorialle casually opened a drawer and extracted a blue ball about the size of a pool ball and tossed it at Dammy's face. He caught it easily and saw a second ball, bright red coming toward him. Quickly he transferred the blue ball to his left hand and the red ball slapped his right palm. Now a yellow ball was on the way. Xorialle was idly looking in the opposite direction as he flipped the balls toward Montgomerie, who swiftly tossed up the ball occupying his left hand, caught the ball shunted from his right, freeing it to catch the next ball. Orange, green, purple, black, white, gold and silver. As each arrived it was integrated into the descending column of balls tossed up by Dammy's left hand, right left, up, right . . .

"OK, so juggling's not so tough," he said, his eyes intent on the flying balls. At that moment, Xorialle threw two at once, a brown and a pink. They joined the stream without visible disturbance. Then Dammy stiffened his right hand and held it at an angle so that the next arriving ball glanced off and rebounded past Xorialle's shoulder to land in the still open drawer, as did the rest, one by one.

"Hot stuff," Dammy said lazily. "Now I've got a racket I can always fall back on, if times get tough."

"*Au contraire,* Damocles, you have several hundred marketable skills now, not all of the sideshow variety by any means. You could find employment in any research laboratory in the world as an expert in any of a number of specialties."

"That'll take some checking," Dammy said dubiously.

"There's no need to put it to test. I assure you matters are as I've described. Shall we continue?"

"That's cool," Dammy commented, "But if I'm trying to sell something, let's keep in mind

$$\frac{\Delta y}{\Delta x} = \frac{y}{x}."$$

"Or, alternatively," Xorialle pointed out, "one might state the Law of Indifference as

$$\Delta y = \frac{y}{x}\Delta x."$$

"You think I don't know first year algebra, for crying into your homemade soup?" Dammy demanded.

"Let's keep the discussion on a little higher plane, OK?"

"You react overvigorously where no slight was intended, my boy. Now let us continue," Xorialle said mildly. Before Dammy could object, another seizure gripped him.

"Skiing," Xorialle informed him blandly, and punched another button. "Freehand drawing,". . . *spasm* . . ."Bird calls," . . . *spasm* . . ."table tennis" . . . "jai alai" . . . "Yoga" . . . "sword swallowing . . ."

"I feel," Dammy said, three days later, "like I'd been run through one of those gadgets they use to tenderize cheap cuts of meat."

"You mustn't refer to yourself so disparagingly, my boy," Xorialle said cheerfully, stirring his martini with a swizzle stick. They were seated in deep leather chairs in the book-lined study. The thick, dark rugs, heavy drapes, the rough stone fireplace with its polished brass andirons lent a feeling of solid and familiar luxury.

Dammy sampled his drink. "I'm too tired to lift my glass," he groaned.

"Yes, it's been a busy time," Xorialle agreed. "And we have a busy afternoon ahead."

"No more today, Al. I can't take it."

"You'll feel better after lunch and a nap, and the thought that you're now a master deep-sea diver, fly-fisherman, nuclear physicist, yodeler, stonemason, and window washer should console you."

"Funny—I'm still tired."

"I'll be most interested to see what we turn up in our next session," Xorialle said. "So far, we've merely been bringing you abreast of current developments. Next, I hope we'll break new ground."

"I don't think I like the sound of that."

"We'll merely be anticipating what humanity has in store for itself. No doubt today some individual, somewhere, is doing something for the first time ever. It may not be so spectacular as the first occasion on which a man lit a fire or added two and two, but it's still an advance. And some of these advances open the way to the exploration of whole new areas of unsuspected faculties. In a thousand years, ten thousand, a hundred thousand—who knows what you clever humans may be capable of, left to yourselves."

"Like what?"

"Do you know any nursery rhymes, Dammy?"

"What?"

"*Mary Had a Little Lamb,* for example?"

"Sure. Its fleece was white as snow. So what?"

"Another?"

"Uh, *Jack and Jill?*"

Xorialle placed a pad of paper and a pencil on the coffee table.

"I want you to recite *Mary Had a Little Lamb*—and at the same time, write *Jack and Jill.*"

"I can't do two things at once."

"Have you ever tried?"

"Well, I'm just not capable . . ."

"Try it, Dammy. Just to satisfy yourself. I won't even watch." Xorialle rose and strolled across to the nearest bookcase. Dammy snorted faintly, but he picked up the pencil, paused for a moment and mumbled: "Mary had a little lamb . . ."

"I'll be damned," he said a moment later. *Jack and Jill went up the hill . . .* was written in a scrawl across the paper; but a legible scrawl.

"So you see?" Xorialle turned to beam at him. "You can already do things you didn't think you could do. Now, I have work to do here. You have that nap and meet me in Studio 4 in two hours."

"The method," Xorialle expounded two hours later, when Dammy, again rested, was in position in the catalyzer, "is to explore your spontaneous bodily and mental reactions to various stimuli, trace the mechanisms employed, then extrapolate those mechanisms to their widest possible application. Suppose we begin with something simple: the so-called psychosomatic diseases—"

"Hold it right there; you're not giving me typhus or cholera or something just to see what I do about it!"

"*Psychosomatic* diseases, Dammy. Imaginary ailments with real symptoms. Hypnotic trance, please, level one."

Dammy thought of arguing, but his eyelids were heavy; they closed.

"I'm going to touch your arm with the tip of a red-hot poker," Xorialle said, "but your arm is anesthetized; you'll feel no pain."

"Yes, but—" Dammy wanted to say; but it seemed too much trouble. He felt a light touch on his arm, heard a soft hiss, smelled something burning.

"You may open your eyes."

Montgomerie blinked down at his arm. There was an ugly red patch at the point of contact. It swelled visibly, developing into an angry blister.

"Hmmm," Xorialle mused, studying his instruments. "A prompt vesicant effect, but no oxidation, of course."

"What did you burn me with?"

"Eh? Oh, that was my finger."

"A hot finger?"

"The heat was in your mind, my boy. You believed you had been touched by a hot poker, ergo you blistered. The symptoms of psychosomatic illness are quite genuine, as I said. Now, we'll merely make the machinery available to your conscious mind—" A sharp sensation flickered behind Dammy's eyes. ". . . and now you'll find you can raise a blister whenever you like, at any point on your epidermis you choose."

"Swell—if you'll excuse the pun," Dammy said disparagingly. "Can I make 'em go away again?"

"Interesting point. Concentrate on remission."

"I would if I knew what it meant."

Xorialle sighed. "The dictionary was included in the material you scanned yesterday, as we both know."

Dammy concentrated. In two minutes the blister had faded, leaving a patch of colorless skin. Xorialle examined it.

"Some tissue damage due to the swelling; otherwise, back to normal. Now, some of the familiar symptoms most often imagined are headache, indigestion, sinus infection, arthritis, heart murmur—"

"If you're planning on teaching me how to have an attack of *angina pectoris* for a party trick, skip it!"

"The mechanism, my boy, the mechanism. That's what we're interested in. If you can create a heart attack by imagining heart disease, you can also control your pulse rate, a most useful ability."

"Careful, pop: play with my autonomic system too much, and I'll go into shock and fibrillation and a few other things, and they won't be psychosomatic."

"A little learning . . ." Xorialle sighed. "I'll take care, my boy, now just sit quietly and react as specified . . ."

Dammy felt the feather-light touch of the questing tendril of alien thought in his mind. He had become accustomed to the constant presence of the alien intelligence among his thoughts, but now it seemed a gross invasion of more than mere privacy. He brushed it aside roughly. The next probe, at the same point, was firmer, carrying a note of insistence. This time Dammy deflected it just sufficiently to divert it from its intended target into an area of unresolved half-thought: impressions awaiting final filing. If Xorialle noticed, he gave no sign.

For the next hour Xorialle fired stimuli at Montgomerie, sometimes directing his response, at other times making note of his apparently spontaneous reactions. Dammy felt pangs, twitches, tics, twinges, in every part of his body in turn. He slumped with relief when his mentor signified that the session was at an end.

"Well, how do you feel, my boy? Intrigued in spite of yourself, resolved now to cooperate to the fullest from now on?"

"Well," Dammy said. "You know how it is. I dunno. You know what I mean?"

"And stuff like that," Xorialle snorted. "Et cetera. And all that. Kind of. More or less. And so forth and so on. Ah, uh, oh. I mean. I guess. Damocles! Kindly spare me these vague, half-formed verbalizations and linguistic barbarisms! You know better!"

"Maybe," Dammy said indifferently.

"I'm disappointed in you, Damocles," Xorialle said. "In some ways you're not living up to my expectations."

"You're breaking my heart," Dammy said, and yawned.

"Your species appears to have one great weakness: mental laziness, in the face of which your full potential will never be realized."

"Sure, Doc. We all have our little flaws."

"Ummph. Well, we may as well continue. We'll check thought transmission next. Blank your mind, please, stage two trance."

"I don't believe in that mind-reading stuff," Dammy said, but he closed his eyes . . .

Gray mind-mist. Random images floating. Wonder if he can read me? Think about something else. Fast cars. Spaghetti dinners. The track on a nice day with a bill riding on the winner. . . .

Something intruding. A new shape foreign to Dammy's mind, but not the usual questing finger to which he had become accustomed. It moved, changed form, became words:

How do you hear me, Dammy?

"Hey!" Dammy said.

Don't speak! Think!

One, two, button your shoe. Abracadabra. How much wood can a woodchuck chuck. Ooly booly fooly drooly—

Damocles! Concentrate! Transmit: I . . . hear . . . you.

"Nuts, Doc, I—"

Silently!

Cautiously, avoiding contact with the alien shape perched impatiently in his mind, Dammy reached out tentatively with a phantom member. Awkwardly at first, then with increasing confidence he felt his way out along the line of the current flow, skirted the looming, pulsating mind-glow that was Xorialle, tracing the leads of the electroencephalodyne back to their source. Space seemed to expand suddenly; he sensed complexity, the intricacy of elaborately comingled networks, felt the flow and pulse of energies, perceived the infinitely complex pattern that was the matrix underlying the mental field-effect . . .

He keyed his attention and total recall circuitry in the way that was now effortless, swiftly scanned the vast new data array before him, stored it in a remote corner of his mind and keyed it to a retrieval mnemonic. Then he withdrew.

. . . *some effort to cooperate,* Xorialle was saying. *I'm sure you can do a great deal better, my boy!*

A time or two I felt that I almost sensed a vague psionic mumble from you, as if you were on the point of breaking through . . . But no matter: you're not to be blamed for your genetic deficiencies. Still—if you tried harder . . .

"Why should I?" Dammy said aloud. "It makes my eyeballs itch from behind."

Motivation, Xorialle thought in disgust. *That's what you lack, Damocles. You don't want to succeed!*

"When do we get to the part where I learn how to live forever?"

"Nothing simpler," Xorialle snapped. "It's merely a matter of cellular psychology, combined with eidetics and controlled replication. Your preoccupation with the trivial does you no credit, my boy."

"Who'm I trying to impress?" Montgomerie asked innocently. "I didn't ask you to put me under a microscope—"

"Enough, enough," Xorialle cried.

"Perhaps I'm getting old and tired; I've seen so many; the futility of it all sometimes overwhelms me." He appeared to pull himself together with an effort.

"But back to work, Damocles. Regulations require a complete profile; we may as well get on with it."

In the next hour, Xorialle attempted in vain to elicit from his instruments some fleeting indication of telekinetic powers lurking untapped in Montgomerie's brain. He probed his subject's potential capacities for awareness and events at a distance, for predicting coming events, for communication with alternative planes of existence, for multidimensional conceptualization, controlled temporal displacement, matter transmission and duplication.

"Nothing," he said at last. "This is incredible! You're a psionic moron, Damocles—a psychic idiot, a nonobjective imbecile!"

"Oh, yeah?" Dammy retorted. "So's your old man!"

Xorialle sighed. "My apologies, Dammy. I'm disappointed. I had hoped—but no matter. One being's personal longings have no place in Galactic policy. Let's call it quits for today. Tomorrow I have a few final points to clear up, and then . . ."

"Then what?"

"Then my job is finished," Xorialle said briskly. He managed a smile. "You must forgive my outburst. All indications had led me to expect great things from you; you're not to be blamed if they failed to materialize. Actually, all in all, you've done amazingly well. You've successfully absorbed an impressive mass of data, my lad, and all without disturbing your native temperament. In spite of being able to recite the literature of the world forward and backward, lecture knowingly on any subject known to Man, and outperform any champion athlete on the planet, you remain the simple, unspoiled youth you were when I plucked you from the gutter . . ."

"Maybe so. But I'm kind of worried all this double-dome stuff will get in the way of living normal."

" 'Normally', Damocles."

"Suppose I said 'normallike'? Would you approve of that?"

"Hardly! A barbarism."

"Maybe. But 'normally' is a corruption of 'normallike', you know."

"Of course I know. I've watched the evolution of your illogical language with some interest."

"Tell me about how the Romans pulled out of Britain, sometime," Dammy proposed.

"Somewhat before my assignment here. I know of it only by hearsay. But my predecessor had some fascinating anecdotes."

"How about the discovery of America?"

"I was a mere assistant technician at the time, attached to the Secondary Survey Mission."

"When was the Primary Mission here?"

"Some time ago, my boy, some time ago. You'd be surprised at the inaccu-

racy of the initial assessment."

"What about when Columbus discovered the United States in 1942?"

"You jape," Xorialle commented mildly. "Aside from that, even your own myopic researchers have determined that America was visited by Eurasians on many occasions prior to the formal discovery date."

"To be sure," Dammy agreed. "Israelites, Phoenicians, Romans, Vikings, the works."

"Those, and more. Polynesians, for example."

"Yeah, but Columbus was the first civilized explorer that found it on purpose."

"A number of your terms require rigorous definition, Dammy. But in essence, of course, you express your cultural bias toward members of your own ethnic group. Not unnatural, nor discreditable. Not even inaccurate. Merely limiting."

"So who *did* discover America? The Indians, I guess," Dammy answered his own query. "But what did they do with it? Nothing. I don't go for this 'noble red man' jazz. They're just *Homo sapiens*—some skunks, some right guys."

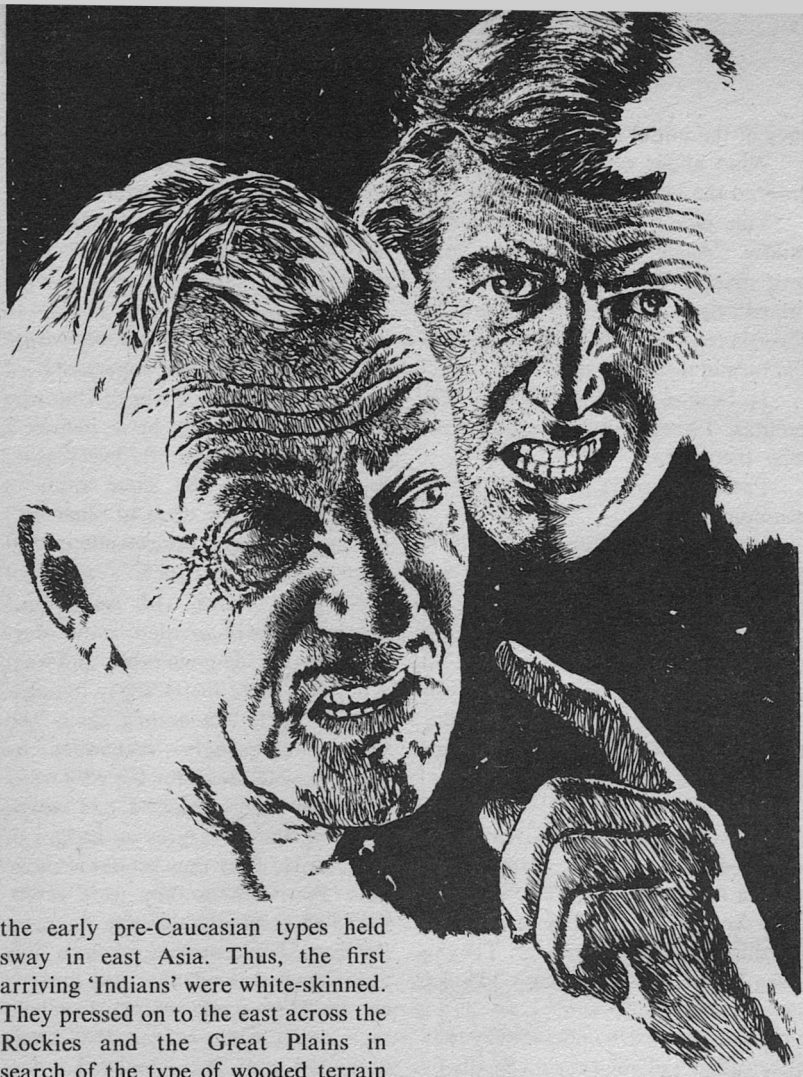
"Have you ever wondered why they were called 'red' men so universally by the first writers to encounter them? After all, their affinity to the people of eastern Asia is well established, and no one ever labeled a Chinese—or an Eskimo—'red'. Aside from politics, of course."

"Beats me."

"Ah. Consider: one hundred and sixty-three thousand years B.P., the subgroup now known as the 'white' or Caucasian 'race' arose quite suddenly, from the generalized Aboriginal type, in south-central Asia. These newcomers were possessed of a driving compulsion to excel—not merely to dominate, but to actually *demonstrate* their sense of innate superiority—a new concept in their world. One who sets out to prove that he is, indeed, a superior being frequently becomes an overachiever in the sense that, in searching for new ways to 'show off', he explores his psychosphere and comes upon great new avenues of exploration. Thus, the small seed group of pale-skinned men—surrounded by demonstrably different types who were instinctively inimicable to the freaks among them and jeered accordingly—responded by breeding selectively for the very traits which the others despised, and indeed claiming these features as badges of superiority. They then set out to prove their thesis. Soon they were established all across the temperate zone of the Eurasian continent, though they never crossed the Tethys Sea to Africa. In Europe, of course, they held their gains, while in Asia they gradually lost out. The Ainu and a few other isolated enclaves represent their remnant."

"What's that got to do with the Indians?"

"Oh, yes. I confess I lost the thread of my own thesis. The emigration across Beringia took place about thirty-one thousand years B.P., at which



the early pre-Caucasian types held sway in east Asia. Thus, the first arriving 'Indians' were white-skinned. They pressed on to the east across the Rockies and the Great Plains in search of the type of wooded terrain they preferred, which their fellows had found in Europe and North Africa, and which the immigrants of course discovered only on the eastern seaboard. Deprived of the support of their home and society, they reverted to a more primitive mode of existence, though their long-houses and tools compare favorably with those used in Europe at that time. But excessive clothing disappeared. Remember that the Europeans of the Age of Discovery were not given to sunbathing. They lived their lives covered from throat to ankle. They knew nothing of sunburn. It was natural then, that

when they encountered sunburned men, they were struck by their bright pink coloration. Thus—'red man'."

"I heard it was because they daubed red paint on their faces."

"A valiant theory, but untenable. Glance at a contemporary portrait of Massasoit or Pocohantas. These were 'European' faces. Of course, the continuing pressure of the Asiatic types who followed the first wave in time diluted and overwhelmed the east coast first-comers. Though to this day the Mohawks, Algonquins, etc., exhibit a far less oriental appearance than the Navajos, for example."

"So what?"

"Just chatting, my boy. I'm a bit nervous, I suppose, under the circumstances. You must understand."

Dammy frowned. "What circumstances? Don't tell me you're starting to feel guilty about the way you snatched me."

"Not at all, dear boy. But, as I indicated, my work with you is essentially finished. . . . "

"So now you take me back to Chi and let me get back to my own business, right?"

Xorialle pursed his lips disapprovingly.

"Surely you see the impracticality of that, Damocles. I can't possibly release you among your own kind, equipped as you are, knowing what you know."

Dammy wet his lips and swallowed. "What's that supposed to mean?" His voice cracked slightly on the words.

"Why—aside from the classified information in your possession—you'd be a virtual superman. I shudder to think of the impact you'd have on the orderly development of your world. It isn't ready for you, Damocles."

"Hey," Dammy said, "you're not planning on taking me back home with you to some place three hundred light-years away, I hope?"

"Certainly not, my lad; set your mind at rest. Your remains will be interred right here on your home world."

"Remains?" Dammy croaked.

"You're a clever lad, Damocles," Xorialle said soothingly. "Surely you see that the only practical course is . . ."

"Disposal?" Dammy managed to get the word past his teeth.

"Disposal." Xorialle agreed.

"When?" Dammy whispered.

"Not until tomorrow, my boy. Now, what do you say to a nice dinner, a soothing alcoholic drink or two, a good night's sleep—and then . . . eternity."

"What do I say to that?" Dammy echoed. "I say it stinks! Let me out of here, you chiseler! You conned me into going along, and now all of a sudden you spring this 'disposal' stuff! Some pal. Some host. You won't get away with it. I still got a few friends,

let alone a couple laws about kidnapping and murder. The snatch was a federal rap, for openers, wise guy!"

"Good night, Dammy," Xorialle said quietly. "I'm sure we're both tired."

Comfortably ensconced in bed, with his head propped on the fluffy pillows, Dammy eagerly turned his thoughts inward. All day he had waited for this moment. Now to examine more closely the inner wonders he had glimpsed the other night. . . .

He began hesitantly, mentally fingering the black bulk of Xorialle's 'control device', then moving on more surely, tracing wide avenues that branched and narrowed, following the patterned logic he had absorbed from his first excited glimpse, fascinated by the wonders he found here, unused, in his own familiar brain. His eyes were open, his hands clasped behind his head. The ceiling above him was ornately decorated, he idly noticed for the first time. Intricate patterns evolved from a central boss. On an impulse to examine it more closely, he drifted lightly upward, casually flipping aside the light blanket. The nuclear bulge, he confirmed from close range, was a three-dimensional analog of the gravity gradient centered on a typical black hole. It was amazingly detailed, revealing the turbulence anomalies typical of the phenomenon. He dropped away, hovered a yard beneath the painted plaster. Idly, he observed that he was drifting toward the west wall of the room at a rate of .073 meters per second, carried by the gentle circulation of air from the ventilating system. He darted toward the dust-free register, stopped just short of ramming the wall.

"Got to be careful," he cautioned himself. Then, abruptly realizing that he was hanging unsupported, four meters above the floor, he sank back to his bed and settled down, pulling the blanket to his chin.

"Teleportation. Wow!" he murmured. "Holy smokes, am I dreaming while I'm awake, or can I really . . . ?" He eased from under the blanket, rose a few inches, still supine, and made a quick circuit of the room. "Yep," he said softly, restraining his excitement with an effort. "Yep, I really CAN! And I'll bet . . ." He slipped back into bed, closed his eyes, and *extended* his awareness, feeling carefully along the corridor outside the room, down the lift-shaft to the lower-level room where Xorialle, working briskly, was systematically smashing the delicate components within what Dammy recognized as an issue communication unit, techonic, Mark IV, series 2769. Mildly puzzled, Dammy passed on, swiftly scanned through the remainder of the station, observing all details of every nook and cranny, noting a number of surprising items to be studied in more detail later. Then he *expanded* awareness, flashed across the winter seas, found the mainland, zeroed in on Chicago. Hovering, he felt out carefully for the familiar contours of his home quarter, dropped into closer range, focusing on

the dark street where Jeannie lived. He found her house, dark and empty. Scanning outward from it, he found her—recognized her unique presence among all the others by a method he could not have described—and felt shock, fear, desperation. What was wrong? He changed focus, saw that she sat in the rear seat of an automobile between two strange men. Another man—Chico himself—was at the wheel. The car moved fast along a dark street. Dammy lightly fingered the maze of fears and compulsions that was Chico's mind, impressed on it an action impulse. At once, the man braked, steered the car to the curb and switched off the ignition.

"Hey, what gives, punk?" the man on the girl's right snarled. He had a gun in his hand suddenly.

"Well, look, Frankie," Chico whined. "I got to thinking: why don't we just drop this caper right here? I mean, a snatch rap's no joke and what do we—"

"Shut up," Frankie snapped. The other man in the back seat leaned across Jeannie. "Hey, Frank, maybe the creep's not too far off," he said softly. "We just walk off and leave this heap and the broad in it, we're in the clear. Otherwise—well, Big Jake don't care much if you and me go up, and like Chico said—"

"I heard what Chico said," Frankie cut in. "And we got our orders. I fer one ain't crossing no Jake Obtulicz. Take it easy, sister," he added to the girl as she pushed at the man who was leaning against her, leering down at her. "All Jake said was ride you around a while, let you know it ain't healthy for no cheap frail to try to mix into the big man's business. That Montgomerie jerk—Chico seen him at your place. Now, that's unfinished business. Better get in line. Get moving, Chico," he barked in conclusion.

"No!" the girl retorted. "I absolutely won't help you ambush Dammy. Where is he?"

Right here, Jeannie, Dammy thought *at* her. *I'm OK. Don't worry about me. Do what they say.*

She uttered a sharp cry and sank back against the seat-back. "Dammy . . . ? Where—what . . . ?"

It's OK, kid. Don't try to figure it out. A new trick I learned. Like a telephone—only better.

Frankie's hand reached out roughly to grab at the girl—and drew back abruptly. He scratched his head instead, eyeing Jeannie obliquely.

"You decided to get smart, sister?" he said as if indifferent.

"Yes," she said. "I'll do what you say. But I hope he doesn't come."

"He'll come, OK, kid. Maybe you don't know what a nice build you really got on you." He chuckled softly.

Bye, Jeannie. See you soon, doll. Dammy, lying in his bed, was suddenly aware that he was utterly exhausted. He drew a deep breath and went to sleep.

"Another helping of strawberries Bikini?" Xorialle asked genially at breakfast.

"Sure," Dammy said, yawning.

"I'm glad to see your appetite is good," the old gentleman said as he served himself. "But you seem listless. You mustn't let a little thing like this upset you. After all, you'd have been dead weeks ago if I hadn't intervened. Just congratulate yourself on all the additional snacks and naps you've had—"

"Somehow," Dammy said, "the thought doesn't console me."

"Hmmm. You seem tired. Possibly my idea of a last giddy round of pleasure last night was misplaced; I seem to have kept you up too late. I confess I've rather lost the knack of empathizing with lower life-forms."

"Speaking of lower life-forms," Dammy said casually, "what sort of report did you intend to file on me, on the human race?"

"Why—nothing out of the ordinary. An average emergent species, with the usual modest capacities for routine functions—"

"What sort of Concensus citizenship would that qualify us for?"

"Hmmm, tenth class, I should imagine, a perfectly respectable category largely made up of functionaries, bureaucrats, and routine executive types, with some small representation in the minor handicrafts." Xorialle pushed back his chair. "I suppose we may as well proceed directly to the business at hand. So if you're ready, my boy . . . ?"

Dammy remained seated. "I'm not ready," he said.

"Oh, surely you're not going to make a scene?" Xorialle said regretfully. "You should be able to accept the inevitable gracefully—"

"I suppose it devolves on the definition of the word 'inevitable'," Dammy said in a level tone.

"Eh?" Xorialle cocked his head. "In light of your new awareness, it should be apparent to you that this is the only logical course."

Dammy nodded. "I've known since the first day."

Xorialle raised his eyebrows. "Then why the sudden show of reluctance?"

"This seems the appropriate time to inform you that there'll be a change of plan."

"Oh? And what change might that be?"

"I'm not going to be slaughtered today."

"See here, Damocles, putting it off until tomorrow would merely prolong the mental anguish you seem to be suffering—"

"I'm putting it off indefinitely."

Xorialle shook his head. "I'm afraid that won't be practical. My schedule requires the immediate closing down of the station and my prompt departure for home. Much as I'd like to indulge you—"

"I suggest you defer the destruction of the station."

"And why, may I ask—"

"You'll be needing it."

"I'll be needing—look here, Dammy," Xorialle said in exasperation, "this farce has gone far enough—"

"I agree. Accordingly, you'll drop the subject of killing me and proceed

to complete my education."

Xorialle stared blankly at Dammy. Then he nodded. "I see; fear of dissolution has driven you mad. How very unfortunate, my boy; I'd hoped you could expire in a cheerful frame of mind, holding no grudges, savoring the new and final experience. As it is, I'm afraid I'll have to employ force. . . ."

Dammy felt the tentative touch of his mentor's mind-extrusion as it reached for his aorta. He brushed it aside, used it as a path for his own probe into the alien's brain.

This will hurt you more than it will me, he spoke silently. *Make no further effort to interfere with my metabolism.*

Xorialle, shocked momentarily into immobility, rallied and struck back. His psionic impulse lanced into Montgomerie's mental field—and struck an impermeable barrier. Dammy was aware of the alien mind reeling back, half-stunned by the impact.

"You were warned," he said coolly. "Shall we be going now?"

"You're making a great mistake," Xorialle said brokenly. "You can't do this! You'll bring down the wrath of the Galactic Concensus on you—"

"I don't suppose that will be any worse than a routine disposal," Dammy cut him off. "Do you intend to cooperate?" He gave a mild tweak to the alien's central sensory module. Xorialle yelped.

"What do you want of me?" he quavered.

"You haven't shown me all the lower levels of the station yet. Let's take a look."

"See here, Damocles," Xorialle said severly, "It's true you've managed to slip one over on me, to employ your own crude turn of phrase—"

"If you're employing one of my turns of phrase, obviously it's superfluous to so inform me. Quit stalling, Doc. Xzzppt!"

"Quite clever, my boy," the alien said thoughtfully. "You've managed to memorize a phrase of C-3. But are you aware of its meaning? Dear me, you've just threatened to give me a glimpse of my own intestines arranged as a wall decoration."

"Close," Dammy agreed. "I can understand now why you were a bit impatient with me at first. You know you're going to take orders in the end—so let's save time by omitting the ritual resistance. Szzxll!"

Xorialle shuddered delicately. "And all in the spirit of science, I suppose. . . . ?"

"Nope, Just for fun. Like this . . ." Damocles frowned momentarily and Xorialle responded by emitting a sharp yelp and splitting down the center. The gray-glistening form inside the humanlike casing was quivering violently. Dammy frowned again. "Kquizlmp!" he buzzed. Xorialle closed up and straightened his tie.

"Don't do that again," Dammy said.

"You've shown me you've learned a trifle or two," Xorialle said. "Surely that should suffice. Now what? Tor-

menting me will profit you nothing, I don't suppose you've paused to consider your next step. You're still very much dependent on my good will, Dammy, but fortunately for you I'm a patient being. I harbor no grudge for the undignified events of the last few minutes. Sheer boyish exuberance, doubtless, engendered by your sudden realization that yours are the secrets of beekeeping, accounting, and modern dance! But don't imagine that my good nature can be imposed upon to the extent of treason to the Concensus. You speak casually of examining the lower levels. I say, 'Never!' "

"What, never?" Damocles countered mildly. "Sxxzzpt,"

"Never! Lower, or, I should say 'emergent' life forms must not—but bother euphemisms! You'll not have a glimpse of the classified area, not that you'd understand if you did."

Montgomerie gave his tutor's main motor node a sharp jab, causing the dignified old gentleman to caper wildly.

"Why do you want to go poking about in the vaults?" he cried. "Nothing there concerns you! You won't understand it!"

I'll take that chance, Dammy transmitted mentally, in Concensual Four, a highly sophisticated dialect reserved for formal occasions of the highest urgency.

"You cheated," Xorialle gasped. "You *did* absorb speedspeak!"

"True."

"You lied!"

"Quite correct."

"You dissembled!" the alien charged in dawning realization. "You pretended to be a dull-witted clod, and all the while you were looting the files, ransacking the library, leading me on!"

"Accurate, if not quite the complete and proper sequence."

"To be sure, my boy, you've mastered nuclear physics, primitive aerospace engineering, brain surgery, and other quaint folk-arts, but all, alas, without invoking the appearance of any of those serendipitous capabilities which I had hoped would emerge. You don't dream of the complexity of the society into which you so naively assume you'll insinuate yourself unnoticed. Tell me, for example, what would you do if confronted suddenly with a raptate of the Triarch of Gree, in dastanic mode?"

"I'd accord it a rictus of category nine, with embellishment apt."

"A bit cheeky, I think," Xorialle commented absently. "What of this contretemps? A glamorph of status eight is discommoded by a rynops while alighting from the transorbital vector at point 8076.31 b (minor). What is the indicated action?"

"An immediate recall of documentation from all vectoral mandrakes of phase three and wider."

"Of course—but I had in mind your personal on-the-scene response."

"A clace in the mode of Arfental would suffice, I should imagine," Dammy said negligently. "Of more concern is the phase-resonance of the vectoral ambit, since I assume my

planchet is at all times on valid mode."

"Damocles!" Xorialle broke in in agitation. "How—when—what could you possibly know of these matters? This is category ultimate material, available only to functionaries of the Zreeth impact, to be overted only under circumstances of class veeb!"

"If you'll refer to subparagraph 1117B3972-H-144, with addenda, I think you'll find the situation covered," Dammy replied cooly.

"Ummm. But that means—"

"Exactly."

"But why? Why?"

"Curiosity."

"I misjudged you," Xorialle croaked. "Oh, I misjudged you badly. It wasn't only your intellect I underestimated. It was your capacity for duplicity and guile? My deepest probes into your psyche showed unmistakably that you share in your culture's avowed reverence for honesty, veracity and straightforwardness!"

"And you planned to take advantage of my naiveté to use me like a tube of toothpaste and throw me away."

"Now, Dammy, that's far too harsh a view."

"You can add that item to your report," Dammy said. "We're not going to be rendered helpless by our virtues."

"Such cynicism!"

"Correct. And now that we've covered that, shall we go? You know where."

Reluctantly, Xorialle accompanied Dammy down in the lift to the utility level. He paused here to attempt again to expostulate, but Dammy aimed a quick pulse at his pain center which served to answer his arguments. The alien unlocked the security door—keyed to his distinctive alpha rhythm—and led the way down the narrow stair.

"There are matters here, Damocles, which bear vitally on Concensual security, but which are of no possible value or even interest to you. Why challenge the vast counter-intelligence apparatus of the Concensus at no profit to yourself? You're like a cheap sneak-thief who idly rifles the local FBI office, looking for petty cash."

"Zppttlt," Montgomerie replied. "You're still stalling, Doc. Let's start with section Q-2786."

Xorialle turned to stare wildly at his former pupil. "Wha..how could you know anything of the Q category?"

"Never mind how. I do. Keep moving. No, to the right."

"Dammy listen, I beseech you. You've already accomplished something I would never have believed possible. You've forced me to permit you entry to Section M zone. Surely you see the wisdom of letting well enough alone? You're equipped now as no man has ever been, to go forth among your own kind and achieve your every dream. I give you my assurance I'll return you safe and sound to Chicago—holding no grudge—and amend the record so as

to dispel any suspicion back at Headquarters. It's a hard blow to my pride, but you pose no threat to the Concensus, so my conscience is clear. You return home, and so do I."

"What do you propose I do there?" Damocles inquired casually. "Open a bucket shop perhaps, and gradually work my way up to a string of pawnbrokerages and gradually take over the rest of the action?"

"Perhaps," Xorialle replied vaguely. "The possiblities are endless. If you apply the philosophy of polo, for example, to the stock market—but naturally all this is obvious."

"Certainly it's obvious," Damocles said. "So why bother saying it? Incidentally, topological techniques would be far more applicable than polo strategy in playing the market."

"Well? Such cross-disciplinary approaches will clearly make you a multibillionaire in a matter of weeks."

"Money is not the sole desirable goal," Dammy said. "It's a lubricant for the really satisfying activities, no more."

"You surprise me, Damocles."

" 'Do I contradict myself? Very well, then, I contradict myself. I am large, I contain multitudes.' Strange fellow, Whitman," Dammy mused.

"Let well enough alone," Xorialle pleaded.

" 'If a player is not well up on endgames,' " Montgomerie quoted, " 'he may lose a game which could be won if he only knew how to end it.' "

"Hmmm. What has chess to do with the present contretemps?" Xorialle said testily. "Never mind. I see. You're conceiving this as a variation of the Philador Defense, following a Vienna Opening. Or. . . . "

"Precisely: 'or'," Dammy said. "Just give me a few minutes alone here, Doc. I promise not to break anything."

Xorialle glanced about at the walls covered by ranked card-file drawers. "I don't know what you imagine you'll accomplish here, Dammy," he said in a resigned tone.

"That's right," Montgomerie said, "you don't."

Xorialle looked at him intently. "You have your victory, Dammy; all that you could ever have hoped for in your wildest dreams of glory. Now, of course, you'll want to return to the security of the nest. I urge you simply to accept your good fortune with glad cries and proceed on your way. With your knowledge of the law, medicine, psychology, et cetera, you need never know anxiety, want, or trouble of any kind. Take it and go!"

"You're in too big a hurry to get rid of me, Doc."

"See here, lad—I've been thinking," Xorialle blurted. "Why don't I simply make you a gift of the transmuter? Then you can run off a supply of doubloons, pieces of eight, double eagles, nickels and dimes, emeralds, rubies and so on, as required . . ."

"Nice try, Doc. But I'm not buying."

"I've warned you, Dammy. To meddle further here is to condemn yourself to certain death."

"Smarten up, Doc. We've already covered the disposal business. You can't cover your bet."

"Ah, Dammy, but if you presume too far, you'll feel the full weight of the wrath of the Concensus, which, I assure you, you'll not so easily neutralize as you did one lone representative, far from home and getting on in years." The alien seemed to stifle a sob of self-pity. "I beseech you! Take all you want and go. But quickly!"

"I'm going," Dammy said. "But there are a few details to clear up before I settle down to a lifetime of pleasure. Through that door, lead on."

"NO! Absolutely not, Damocles! I draw the line—"

"Wrong, I'm drawing the lines now. Step lively, Doc."

Moving in the indicated direction, Xorialle gazed back at Montgomerie as if suddenly fascinated by his pupil's face.

"Damocles," he said hoarsely, "this is incredible. You have quite neatly taken control of my station from me. But I wonder: what do you propose to do with it? Its utility is limited; its function highly specialized. Will we exchange roles, and you undertake the task of educating me?"

"Nuts, Doc. Let's get going."

The alien dithered for a moment, then opened the door and proceeded down a dimly-lit passage, Dammy behind him. After traversing well-stocked storage areas, they passed through chambers packed with softly humming apparatus, on which colored indicator lights winked cheerfully.

"Better check the infraordinal retrieval syntach," Dammy commented. "It's running .0315 percent over optimal drain level."

"To be sure," Xorialle muttered. "I have my duties to see to, Dammy; kindly end this farcical affair."

"Before I go anywhere," Dammy pointed out, "I'll need transportation." He started across the room.

"Damocles, no!"

Ignoring Xorialle's expostulations, Dammy stopped before an unmarked door, noted its type, recalled the opening code, twisted the knob right, left, left, right, right, right, left, and stepped into the room beyond. It was a large chamber cut from the living stone, its walls and floor of glazed rock. Most of the space was occupied by an oblate spheroid, radially segmented, painted an eye-searing fluorescent tangerine. In a corner behind it Dammy saw a clear-plastic bubble with wheels and rotors which he recognized as the cycler in which he had been brought to Xorialle's hideaway.

"Well, now," Dammy breathed. He walked slowly around the twelve-foot-wide spheroid, discovering nothing to distinguish any one aspect from another, with the exception of an off-color disc half an inch in diameter in the center of one of the segments. He paused, then introspectively considering the object before him, closed his eyes: *Three of spades,* he said silently . . .

Vehicle, Intergalactic Mark XXXVIII, type 4, style zeeb, capac-

ity, 25 solid nits, velocity (cruise), .876 lights, armament nil, retrieval code MB-5, classification FOOB. Budget code, class 27 fleem, yunt; nonexpendable. Official Use Only. Penal schedule V38 applies. Maintenance Code 12-u.

"Yep," Dammy mused aloud, "I'm going to need first-class transport."

"In that case, lad, what about a custom-built Rolls Royce, delivered to Chicago," Xorialle suggested hastily. "Hand-tooled leather interior, chinchilla rugs, built-in bar—or better yet, a small personal jet! Or possibly a hundred-meter diesel-yacht—or even a nuclear-powered subsurface craft which also does 200 mph on land and cruises nicely at an altitude of fifty miles—an all-purpose vehicle of remarkable versatility, though I wouldn't venture much beyond Luna in it—"

"You should have been a second-hand car salesman," Dammy said. "But I'm not buying, while something better is available."

"Dammy! You wouldn't take my cycler! That's Concensual property."

"Sure. Like me."

"Now, Dammy, you're being unfair! True, I handled you incorrectly, but how could I have known?"

"Don't worry; I'll write you a glowing testimonial you can use at your courtmartial."

"Dammy! I have it! Suppose I mock up a replica Bugatti *Royale*—you know nostalgia is all the go these days—a perfect reproduction of the 1930 original (only six were built, you know, all for heads of state): a Bugatti *Royale,* I say, perfectly authentic in every detail, but with full class nine capability, of course. Think of the figure you'll cut cruising down State Street in that."

"You're still thinking of me as a class ten primitive whom you can distract with shiny baubles."

Xorialle shot Montgomerie a reproachful look. "An erroneous assessment, as I've freely confessed—but this is the first instance in my knowledge where a testee has deliberately falsified evaluation results to minimize his talents."

"How would recent developments modify that picture?"

"Class Two, Special," Xorialle said promptly.

"Meaning?"

"Potential threat to the Galactic Concensus. Oh, not for many millennia," Xorialle added, "but Concensual policies look well to the future."

"Indicated action?"

Xorialle looked grave. "You made a serious error in apprising me of your deception, Damocles—of your true capacities. I could understand, and in a sense admire your gambit, if you had allowed my original impression to stand. In that case, your world would have been classified as a valuable though minor source of petty workers, and administered accordingly. Of course, the error would have been discovered in time, but you'd have enjoyed an additional few centuries of carefree self-determination before the

administrative routine got around to the matter of occupation and developmental controls. Of course, it would have meant your personally submitting to disposal, probably too great a sacrifice to expect of, er, a representative of so young a race."

"And now?"

"A Class Two Special rating calls for immediate, drastic control measures, including population culling to eliminate undersirable traits such as aggression, imagination, initiative, and the like, followed by genetic segregation and redispersal in order to breed any specialized types that may be deemed desirable. Or, alternatively, out-of-hand planetary sterilization."

"Sounds swell," Dammy said, offhandedly.

"As you see, there's nothing here of interest to you," Xorialle said quickly, edging toward a door. "I suggest we move along to the transmutation chamber. No doubt you'll want to take along a few hundredweight of gold, as well as an adequate supply of corundum crystals, suitably colored and polished, and—"

"No trade goods, thanks," Dammy said. "I'm more interested in this thing. What do you call it, the Magic Pumpkin?"

"Oh, I see, a literary allusion. Most apt, my boy. But you'd find all this dull, deadly dull—"

"I need a range of at least a hundred parsecs in *that* direction," Dammy explained, pointing toward the wastebasket in the far corner of the room. "Understand? Out there."

"But—that's . . . the vicinity of Deneb—and Concensual District HQ at Trisme."

"Right. And I want to get started right away."

"Damocles, no! You don't understand Concensual security arrangements! You'd be blasted to atoms the moment you intruded into Concensual-mandated space!"

"Not after you've given me the recognition codes and clearance procedures."

"But I can't, my boy! Those are matters of the highest conceivable classification! To divulge any part of such information calls for a mandatory death sentence, retroactive to birth!"

"Now who's acting out ritual objections?" Dammy said.

Xorialle wilted. "You're quite right," he said in a beaten voice. "Death is nothing; many's the time I've longed for it; but what would be the use of such a futile gesture? A Resurrection Team would simply reconstitute me and put me on trial for desertion. But pain is quite another story. I simply can't abide it. I'll give you the information you request." He sighed. "But, Damocles . . ." Xorialle looked candidly at his student. "You're making a mistake. I fail to imagine what possible errand you might conceive yourself to have Out There . . ." He flung out an arm in a gesture which emcompassed the sky beyond the rock walls. "But I assure you that only swift extinction awaits

an uninvited guest to the Consensus."

"So I should just settle down and have fun while waiting to find out if we're to be used as docile workers; or bred for dirty work, if not eliminated completely."

"Such are the realities of the Galactic Concensus, my boy. After all, as latecomers on the scene, you can hardly expect the Universe to conform to *your* wishes."

"Not good enough, I'm afraid," Dammy said. "That's why I have to do something."

"There's nothing you can do, lad," Xorialle said, wagging his head dolefully. "Take my advice and settle for overlordship of your own small planet."

"Strange," Montgomerie said, "a few weeks ago I would have jumped at it. Now it's not good enough. Not nearly good enough. What's the point in playing with toys while the flood waters are rising all around me?"

"Ah, you begin to reap the first fruits of knowledge. The world is not so simple as it once was. The easy answers no longer apply." Xorialle sighed heavily, gave Dammy a shrewd look.

"You've won this hand," he said, "but I still have bargaining power. Even now, I can help you—or I can hinder you."

"Watch it, Doc. You could get rubbed out for that kind of talk."

"Dammy, you wouldn't! You . . . couldn't? You were merely playing with me, pretending you'd steal the Mark XXXVIII."

"What would you advise me to do, Xorialle? Go back to Chicago and resume my career as a spotter for Little George?"

"Damocles—the riches of your world are yours! With your knowledge, there's no limit to the height to which you can rise within your own society! You have the equivalent of post-doctorate degrees in every subject known to your encyclopedists! You've mastered every art and skill devised by your people since the invention of the hand-ax! The world lies at your feet! You can return home and lord it over your former masters! Why throw it all away?"

"Oh, I dunno. Just hate to be pushed around by a Martian, maybe. Anyway, you'd better recode the VIM XXXVIII's entry lock," Dammy said. "Use this symbol." He projected a complex glyph in Concensual 12 into his former tutor's consciousness. Xorialle gasped.

"Incredible," he said weakly. "I'll . . . I'll have to ask you to repeat; I didn't catch the fourth-order nuances."

"Never mind," Dammy said. "Clear the coding matrix and I'll key it myself."

"But—whatever for?" Xorialle protested. "You'll make it most inconvenient for me—"

"You won't be using it again, Xorialle."

"You're not taking my ship!? My only link with civilization!? Whatever for? Merely to spite me? You know nothing of the subtleties of its opera-

tion: you'd kill yourself if you attempted—"

"Forget it, Doc. You've got a backup on Special Level A, remember?"

"You know that, too? Then. . . ."

"Exactly, Doc."

"You know, my boy—in a way, I almost wish you success. For many ages now, the status quo has been the highest aim of Concensual policy. But—I confess, from time to time I've entertained forbidden dreams, thoughts that intruded themselves unbidden into my mind. Ideas of a fresh new wind blowing through the musty halls of Galactic civilization through doors opened by a young and vital race. When you 'failed' to measure up, I confess to disappointment, quickly suppressed, of course. As a Concensual official, what business have I in fostering rebellion? And now . . . though I know your effort is doomed—somehow . . . I feel an excitement stir. That's a sensation I've not experienced since King Xoser's reign. Perhaps, somehow—in some way—" Xorialle flopped his arms in a gesture of resignation. "But I'm raving. There's nothing you can do. You're going to your death, Damocles. A useless, unnoticed death. Unless you'll change your mind and stay, to savor what you can of the carnal pleasures in the remaining twilight years of your race's youth and innocence."

"One thing puzzles me, Doc: you've got an alarm system here—an emergency backup, just in case. How come you haven't sent out a squeal to bring a couple carloads of Concensus cops in here to grab me?"

"Again, my boy, you touch a sensitive point. To be utterly candid, I dare not call for help, for the simple reason that my work with you, far from being official routine, has been entirely at my own initiative in contravention of the most basic imperatives of Concensual policy—a policy I thought shortsighted, but the dire utility of which has now been made woefully clear to me."

"Thanks for the tip," Dammy said. "Too late for my race's innocence, I guess," he said mildly. "And we're running out of youth fast."

"Don't be absurd, Dammy. In all my travels I've never encountered a species in which altruistic behavior—and its attendant guilt syndrome—was so highly evolved. The mathematics of the inheritance of altruism is highly interesting, by the way, as you've no doubt noticed."

"Sure. I guess in my case the guilt part got left out. I'm responsible for putting chewing gum on Mrs. Dumbrowski's chair in fifth grade, and maybe doing a little lookout work for a fellow named George Martin. Nice guy, George: you'd like him—unless you happened to owe him dough."

"Damocles—one last appeal: don't try it. Take the cycler, go back to Chicago, and soon all this will seem but a fading dream to you."

"You forgot about my altruism bump, Doc. I guess thinking about how all those innocent people—including my descendants—will wind

up on a treadmill in the Eulq System, wired into an impulse monitor—that would kind of cut into my fun. Anyway. . . ."

"Damocles, you must take this seriously. You know perfectly well that only eirites of the quelth order can be adapted to monitor supervision, not that—or perhaps we would . . . Hmmm. For the first time in a Great Decade, I'm stirred to ethical questioning—and by a savage. Remarkable! But *do* give up this mad scheme."

"Once you said something about a wonderful secret," Dammy said musingly. "I won't find it standing around here. The more I think about it, the more I'm sure it's out there." He pointed toward the wastebasket in the corner. "And I'm going to find it."

Mentally, he probed the hatch lock of the orange machine. The cover opened silently. With a final nod to Xorialle, Dammy stopped and went inside. Xorialle leaned in to watch, as if reluctant to abandon his tutorial role.

Reviewing the contents of the manuals he had scanned was, Dammy reflected, much like recalling some once-memorized but long-unremembered poem. The words and paragraphs fed into his consciousness smoothly, as if supplied by some outside agency, while he passively observed. It was all there, every detail of information needed to operate the fantastically complex machine that was the Concensual ship. It would not be necessary for him to ponder each move; the correct actions would come as automatically as the movement of a driver's foot toward the brake pedal when a traffic light turns red. Outside the hatch, Xorialle rattled on, supplying tips and bits of advice, which Dammy shunted to HOLD for later review.

"But I'm chattering like a nervous bridegroom," Xorialle said. "I surprise myself with the emotions generated by this development. But then, I imagine that three centuries of life among your people have had their influence on my mental and emotional processes."

"I should think you're isolated enough here that such influences would be minimal," Montgomerie commented.

"I've gone out among you many a time, Dammy. I've followed your progress. I studied the efforts of the first settlers of North America, as well as the life of the aborigines of Australia, prior to the first western contact. Your speed of progress has always amazed me, but I never dreamed that one day one of your number would outfox me on my home ground. But no hard feelings," Xorialle called.

"No feelings at all," Dammy replied. The hatch valved shut and he was alone in the featureless, padded interior of the alien ship. Silently he uttered the proper commands, felt the outer doors slide aside. Then he was moving.

"OK, Universe," he said aloud. "Here I come." ■

Dog Day evening

Intelligent creatures are highly adaptable—especially at Callahan's Bar.

Spider Robinson

JACK GAUGHAN

It absolutely *had* to happen. I mean, it was so cosmically preordained-destined-fated flat out *inevitable* that I can't imagine how we failed to be expecting it. Where else on God's earth could Ralph and Joe possibly have ended up but at Callahan's Place?

It was Tall Tales Night at Callahan's, the night on which the teller of the most outrageous shaggy-dog story gets his night's tab refunded. "Animals" had been selected as the night's generic topic, and we had suffered through *hours* of stinkers about pet rocks and talking dogs and The Horse That Was Painted Green and the Fastest Dog in the World and the Gay Rooster and a dozen others you probably know already. In fact, most of the Tale-Tellers had been disqualified when someone shouted the punchline before they got to it—often after only a sentence or two. The fireplace was filled to overflowing with broken glasses, and it was down to a tight contest between Doc Webster and me. I thought I had him on the run, too.

A relative newcomer named B. D. Wyatt had just literally crapped out, by trying to fob off that old dumb gag about the South Sea island where "there lives a bird whose digestive system is so incredibly rank that, if its excrement should contact your skin, re-exposure of the contaminated skin to air is invariably fatal." Named for its characteristic squawk, it is of course the famous Foo Bird, and the punchline—as I'm certain you know already—is, "If the Foo shits, wear it." Unfortunately for B. D. ("Bird Doo?"), we already knew it too. But it gave me an idea.

"You know," I drawled, signaling Callahan for a fresh Bushmill's, "like all of us, I've heard that story before. So many times, in fact, that I decided there might be a grain of truth in it—hidden, of course, by a large grain of salt. So my friend Thor Lowerdahl and I decided to check it out. We investigated hundreds of South Sea islands without success, until one day our raft, the *Liki Tiki,* foundered on an uncharted atoll. No sooner did we stagger ashore than we heard a distant raucous cry: 'Foo! Foo!'

"Instantly, of course, we dove back into the surf, and didn't stick our heads up until we were far offshore. We treaded water for awhile, hoping for a glimpse of the fabulous bird, to no avail. Suddenly a seal passed us underwater, trailing a cloud of sticky brown substance. Some of it got on Thor's leg, and with a snort of disgust, he wiped it off. He expired at once. Realizing the truth in an instant, I became so terrified that I *swam* back to the States."

I paused expectantly, and Fast Eddie (sensing his cue) obliged me with a straight line.

"What truth, Jake?"

"That atoll," I replied blithely, "was far more dangerous than anyone suspected—as any seal can plainly foo."

A general howl arose. Long-Drink chanced (by statistical inevitability) to have his glass to his mouth at the

time; he bit the end off clean and spat it into the fireplace. I kept my face straight, of course, but inwardly I exulted. *This* time I had Doc Webster beat for sure, and with an *impromptu* pun at that. I ordered another.

But when the tumult died down, the Doc met my eyes with a look of such mild, placid innocence that my confidence faltered.

"Fortunate indeed, Jacob," he rumbled, patting his ample belly, "that you should have rendered so un*bear*able a pun. It reminds me of a book about a bear I read the other day by Richard Adams—*Shardik,* it's called. Any of you read it?"

There were a few nods. The Doc smiled and sipped Scotch.

"For those of you who missed it," he went on, "it's about a primitive empire that forms around an enormous, semimythical bear. Well, it happens I know something about that empire that Adams forgot to mention, and now's as good a time as any to pass it along. You see, the only way to become a knight in Shardik's empire was to apply for a personal interview with the bear. This had its drawbacks. If he liked your audition, you were knighted on the spot—but if you failed, Lord Shardik was quite likely to club your head off your shoulders with one mighty paw. Even so, there were many applicants—for the peasantry were poor farmers, and if a candidate failed for knighthood his family received, by way of booby-prize, a valuable sheepdog from the Royal Kennels. This consoled them greatly, for truly it is written . . ."

And here he actually paused to sip his Scotch again, daring us to guess the punchline:

" . . . 'For the mourning after a terrible knight, nothing beats the dog of the bear that hit you.' "

A howl again began to arise—and then suddenly a howl arose.

I mean a *real* howl.

So of course we all swiveled around in our chairs, and damned if there wasn't a guy with a German shepherd sitting near the door. I hadn't seen them come in, and it took me a second to notice that the dog had a glass of gin on the floor in front of him, half-empty.

As we gaped, open-mouthed, the dog picked up the half-full glass in his teeth (without spilling a drop), carried it to the hearth, and with a flick of his powerful head, flung it into the fireplace hard enough to bust it. He turned and looked at us then, wagging his tail as if to make sure we understood that he was commenting on the *Doc's* tale. Then, to underline the point, he turned back to the fireplace, lifted his leg and put out a third of the fire.

We roared with laughter, a great simultaneous outburst of total glee, and the dog trotted proudly back to his master. I looked the guy over: medium height, a little thin, nose like an avalanche about to happen and a great sprawling fungus of a mustache clinging to its underside. He wore Salvation Army rejects like Mr. Em-

mett Kelly used to wear, clothes that looked like what starts fires in old warehouses. But his eyes were alert and aware, and he was obviously quite proud of his dog.

Then he caught Callahan's eye, and winced. "You got a house rule on dogs, Mister?" he asked. You could hardly see his lips move under that ridiculous mustache.

Callahan considered the matter. "We try not to be human-chauvinists around here," he allowed at last. "Only house rule is, untrained dogs get cleaned up after with the guy that brought 'em. Suit you?"

Are you kiddin'?" the guy mumbled. *"This* dog mess on the floor? Why? Why, this is the Smartest Dog In The World." He said it just like that, with capital letters.

"Uh-Huh," said Long-Drink. "He talks, right?"

A strange gleam came into the shabby man's eyes.

"Yep."

"Oh for God's sake," Doc Webster groaned. "Don't tell me. A talking dog has walked into Callahan's Place on Tall Tales Night. If that hound tops my story, I'm going on the wagon—for the whole night."

That broke everyone up, and Long-Drink McGonnigle was particularly tickled (say that three times fast with whiskey in your mouth). "Patron saint of undershorts," he whooped, "it makes so much sense I almost believe it."

"You think I'm kidding?" the stranger asked.

"That or crazy," the Doc asserted. "A dog hasn't got the larynx to talk—let alone the mouth structure—even if he *is* as smart as you say."

"I've got two hundred dollars says you're wrong," the stranger announced. He displayed a fistful of bills. "Any takers?"

Well, now. We're a charitable bunch at Callahan's, not normally inclined to cheat the mentally disturbed. And yet there was a clarity to his speech that belied his derelict's clothes, a twinkle in his eye that looked entirely sane, and a challenging out-thrust to his chin that reminded us of a kid daring you to hit him. And there was that wildly improbable handful of cash in his hand. "I'll take ten of that," I said, digging for my wallet, and a dozen other guys chimed in. "Me too." "I'll take ten." "I'm in for five." Doc Webster took a double sawbuck's worth, and even Fast Eddie produced a tattered single. The guy collected the dough in a hat that looked like its former owner had been machine-gunned in the head, and the whole time that damn dog just sat there next to the table, watching the action.

When the guy had it all counted, there was a hundred and seventy bucks in the hat. "There's thirty unfaded," he said, and looked around expectantly.

Callahan came around the bar, a red-headed glacier descending on the shabby man. The barkeep picked him up by the one existing lapel and the opposite collar, held him at arm's

length for a while, and sighed.

"I like a good gag as well as the next guy," he said conversationally. "But that's serious money in that hat. Now if you was to ask that dog his name, and he said 'Ralph! Ralph!' and then you was to ask him what's on top of a house and he said 'Roof! Roof!' and then you was to ask him who was the greatest baseball player of all time and he said 'Ruth! Ruth!', why, I'd just naturally have to sharpen your feet and drive you into the floor. You would become like a Gable roof: Gone With The Wind. What I mean, there are *very* few gags I've never heard, and if yours is of that caliber you are in dire peril. Do we have a meeting of the minds?" He was still holding the guy at arm's length, the muscles of his arms looking like hairy manila, absolutely serene.

"I'm telling you the truth," the guy yelped. "The dog can talk."

Callahan slowly lowered him to the floor. "In that case," he decided, "I will fade your thirty," He went back behind the bar and produced an apple. "Would you mind putting this in your mouth?"

The guy blinked at him.

"I believe you implicitly," Callahan explained, "but someone without my trusting nature might suspect you was a ventriloquist tryin' to pull a fast one."

"Okay," said the guy at once, and stuffed the apple in his face. He beckoned to the dog, who came at once to the center of the room and sat on his haunches. He gazed up inquisitively at the shabby man, who nodded.

"I hope you will forgive me," said the dog with the faintest trace of a German accent, "but I'm afraid my name actually *is* Ralph."

There was a silence, as profound as that which must exist on the Moon now that the tourist season is past. Then, slowly at first, glasses began to hit the fireplace. Soon there was a shower of glasses shattering on the hearth, and not a drop of liquid in any of 'em. Callahan passed fresh beers around the room, bucket-brigade fashion, his face impassive. Not a word was spoken.

At last everyone had been lubed, and the big Irishman wiped off his hands and came around the bar. He pulled up a chair in front of the dog, dropped heavily into it, and put a fresh light to his cigar.

"Sure is a relief," he sighed, "to take the weight offa my d . . . to sit down."

You must understand—we were all still so stunned that not one of us thought to ask him if he was bitching.

"So tell me, Ralph," he went on, "how do you like my bar?"

"Nice place," the dog said pleasantly. "You guys always tell shaggy— . . . uh,—person stories?"

"Only on Wednesday nights," Callahan told him, and explained the game and current topic.

"That sounds very interesting," Ralph said, parodying Artie Johnson. His voice was slightly hoarse but quite

intelligible. "Mind if I take a shot at it?"

"You just heard the Doc's stinker," Callahan said. "If you can beat that, you're top . . ."

"Please," Ralph interrupted with a pained look. "As you told me a moment ago, I've heard them all before. All right, then: I have an animal story. Did any of you know that until very recently, a tribe of killer monkeys lived undetected in Greenwich Village?"

The Doc had nearly found his own voice, but now he lost it again. Me, I'd already crapped out—but it was fun to see the champ sweat. I resolved to buy the dog a beer.

"To some extent," the German shepherd went on, "it was not surprising that they escaped notice for so long. They had extremely odd sleeping habits, hibernating for 364 days out of every year (365 in Leap Years) and emerging from the caverns of the Village sewers only on Christmas Day. Even so, one might have thought they could hardly help but cause talk, since they tended when awake to be enormous, ferocious, carnivorous, and *extremely* hungry. Yet in Greenwich Village of all places on Earth they went unnoticed until last year, when they were finally destroyed."

The dog paused and looked expectant. Sighing, Callahan reached over the bar and got him a glass of gin. Ralph lapped it up in a twinkling, looked up at us, and delivered.

"Everyone *knows,*" he said patiently, "that Yule gibbons ate only nuts and fruits. . . ."

Not, I am certain, since the days when Rin-Tin-Tin ran in neighborhood theaters has a German shepherd received such thunderous applause. We gave him a standing ovation, and I want to say Doc Webster was the first one to rise (despite the fact that, by virtue of his earlier rash promise, he was now on the wagon for the evening). Callahan nearly fell off his chair, and Fast Eddie tried to strike up "At The Zoo," but he was laughing so hard his left hand was in G and his right in E♭. As the applause trickled off we toasted the dog and blitzed the fireplace as one.

And the man in shabby clothes, whose existence we had nearly forgotten, stepped up to the bar (minus his apple now) and claimed the hatful of money.

Callahan blinked, then his grin widened and he returned behind the bar. "Mister," he said, drawing another gin for Ralph, "that was worth every penny it cost us. Your friend is terrific, and I'm honored to have you both in my joint. Here's another gin for him, and what're you drinking?"

"Scotch," the shabby man said, and Callahan nodded and reached for the Scotch—but I used to work in a boiler factory once, and so I choked on my drink.

Callahan looked around, puzzled. "What is it, Jake?"

"His lips, Mike," I croaked, wiping fine whiskey from my beard. "His *lips.*"

Callahan turned back to the guy, gently lifted the scrofulous mustache and examined the guy's lips. There were two. "So?" he said, peering at them.

"I read lips," I managed at last. "You know that. That guy's voice said 'Scotch,' *but his lips said 'bourbon.'* "

"How the hell could you tell?" Callahan asked reasonably.

"I swear, Mike—he said 'bourbon.' Here: look." I wear a mustache myself, middlin' sanitary, but I covered most of it and all of my mouth with my hand. Then I said, " 'Scotch' . . . 'Bourbon' . . . See what I mean? It *ain't* the lips, entirely—the mustache, the cheek muscles—I'm telling you, Mike, the guy said 'bourbon'."

Callahan looked at the guy, then at me . . . and then at the dog.

"I'm sorry, Joe," the dog said miserably. "I thought sure you'd want to stick with Scotch."

The shabby man shrugged eloquently.

"Well, I'll be a son of a . . ." Long-Drink began, then caught himself. *"You're* the ventriloquist!"

Doc Webster roared with laughter, and Callahan's eyes widened the barest trifle. "I surely will be go to hell," he breathed. "I shoulda guessed."

But I was watching the look exchanged by Joe and Ralph, the way both of them ever so casually got ready to bolt for the door, and I spoke up quickly.

"It's okay, fellas. Don't go away—*tell* us about it."

They froze, undecided, and the rest of the boys jumped in. "Hell, yeah." "Give us the yarn, Ralph." "Let's hear it." "Get that dog another drink."

Ralph looked around at us, poised to flee, and then he met Callahan's eyes for a long moment. He looked *exactly* like a dog that's been kicked too often, and I thought he'd go. But he must have heard the sincerity in our voices, or else he read something on Callahan's face, because all at once he relaxed and curled up on the floor.

"It's all right, Joe," he said to the shabby man, who still stood undecided. "These people will not make trouble for us." The shabby man nodded philosophically and accepted a bourbon from Callahan.

"How come you can talk?" Fast Eddie asked Ralph. "I mean, if it ain't no poisonal question or nuttin'."

"Not at all," Ralph answered. "I was . . . created, I suppose you'd say, by a demented genius of a psychology major named Malion, who was desperate for a doctoral thesis. He had a defrocked veterinary surgeon modify my larynx and mouth in my infancy, apparently in the mad hope that he could condition me to parrot human speech. But I'm afraid his experiment blew up in his face. You see," he said rather proudly, "I seem to be a mutant."

"This, naturally, was the one thing Malion had never planned for. How could he? Who could guess that a dog could actually have human intelli-

gence? For all I know I am unique—in fact I fervently and desperately hope so. If there are other dogs of my intelligence, but without the capacity for speech, *who would ever know?"* Ralph shuddered. "At any rate, I destroyed all of Malion's hopes the first time I got tired of his damned yammering and told him what I thought of him *and* Pavlov *and* Skinner in no uncertain terms. At first, naturally, he was tremendously excited. But within a few hours, as I reminded him of highlights of our past life together, I could see dawning in him the fear that any lab researcher—let alone a behaviorist—might feel upon realizing that one of his experimental animals is an aware attack-dog. And eventually, of course, he realized the same thing that had kept my own mouth shut for so many months: that if he a attempted to write *me* up for his doctorate, they'd laugh him off the campus. He abandoned me, simply kicked me out in the streets and locked my doggy-door. The next day he left town, and hasn't been heard from since."

"Cripes," said Eddie, "dat's awful. Abandoned by yer creator."

"Like Frankenstein," Doc Webster said.

"Damn right," Ralph agreed. "I'd like to get my paws on that pig, Malion."

Then he realized what he'd just said and barked with laughter. The Doc drained his own glass with a gulp and tossed it over his shoulder, squarely into the fire.

"I beg your pardon," the shepherd continued. "Anyhow, I got by for quite a while. It's not too hard for a big dog to survive in Suffolk County, especially when the summer people go. But what drove me crazy was *having nobody to talk to.* After all those years of keeping my mouth shut, so as not to spoil my meal ticket with Malion, I was like a pent-up river ready to burst its dam. But every time I tried to strike up a conversation, the other party ran away rather abruptly. A few children would talk to me, but I soon stopped that, too—their parents gave them endless grief for telling lies, and one day I found myself obliged to bite one. He took a shot at me—with a silver bullet.

"So I tried to sublimate. I found a serviceable typewriter in a junkyard, swiped paper and stamps and became a writer—of speculative fiction, of course. Since I lived mostly in the remaining farmland east of here, I selected pastoral pen names like Trout and Bird and Farmer—although occasionally I wrote under an old family name, Von Wau Wau."

"Holy smoke," Wyatt breathed. "So that's what that hoax was all about . . ."

"Eventually I acquired something of a following . . . but answering fan mail is not the same as *talking* with someone. Besides, I couldn't cash the checks.

"Then one day, outside a bar in Rocky Point, I happened to overhear some fools making fun of Joe here, because he was mute. 'Dummy,' they

called him, and his face was red and he was desperate for a voice with which to curse them. So *I* did. They fled the bar, screaming like chickens, and ten minutes later Joe and I left the empty bar with the beginnings of a partnership."

"I get it," I said, striking my forehead with my hand. "You teamed up."

"Precisely," Ralph agreed. "I could have the pleasure of conversing with people, at least by proxy—and so could Joe, simply by letting me put words in his mouth. He grew that mustache to help, and we worked out a fairly simple 'script' and 'cues.' To support ourselves, we hit upon the old talking-dog routine, which we have been working in taverns from Ronkonkoma to Montauk over the last six months. The beauty of it is that while people virtually always pay up, they *never* believe I can truly speak. Always they speak only to Joe, congratulating *him* on his fine trick even if they can't figure out how he does it. I suppose I should be annoyed by this, but truthfully, I find it hilarious. And at any rate, it's a living."

Doc Webster shook his head . . . well, like a dog shaking off water is the only simile I can think of. "And to think it took you guys all this time to come to Callahan's Place," he said dizzily.

"I feel the same," Ralph said seriously. "You are the first men who have ever accepted Joe and me as we are, who knew the truth about us and did not run away. Or worse, laugh at us, or ridicule or taunt us.

"I thank you."

And Joe pointed at his own chest and nodded vigorously. *Me too!*

Callahan's face split in a broad grin. "Sure and hell welcome, fellas," he boomed, "sure and hell welcome—*any* time. I can't think of any two guys I'd rather have in my joint."

And another cheer went up. "To Ralph and Joe," Long-Drink hollered, and two dozen voices chorused, *"To Ralph'n'Joe."* The toast was drunk, the glasses disposed of in unison, and the place started to get real merry. But an idea struck me.

"Hey Ralph," I called out. "You want a job? A real job?"

Ralph paused in mid-lap and looked up. "Are you crazy? Who'd hire a talking dog?"

"I know the only place around that might," I told him confidently. "Jim Friend over at WGAB has been talking about taking a year off, and he's a good friend of mine. How'd you like to run a radio talk-show at 4 A.M. every morning?"

Ralph looked stunned.

"Yeah," Callahan agreed judiciously, "WGAB would hire a talking dog. Hell, maybe they got one already. Whaddya say, Ralph?"

I could see Ralph was tempted—but German shepherds are notoriously loyal. "What about Joe?"

"Hmmm." I thought hard, but I was stumped.

Joe was gesticulating furiously, but Ralph ignored him. "No," he decided.

"I could not leave my friend."

"I'll think of something," Callahan promised, but Ralph shook his head.

"Thank you," he said, "but there's no use in raising false hopes. I'm resigned to this life."

"Mister," Callahan said firmly, "that's what this Place is all about. We raise hopes, here—until they're old enough to fend for themselves. Wait—I *got* it! Joe!"

The shabby man looked up from his drink, shamefaced.

"Get that frown off yer phiz," Callahan demanded. "You can type, can't ya?"

Joe nodded, puzzled. "I taught him," Ralph said.

"Then I can help ya," the big Irishman told Joe. "How would you like a job over at Brookhaven National Lab?"

Joe looked dubious, and Ralph spoke up again. "I told you, Mr. Callahan—writing just isn't the same as talking to people."

"Hold on and listen," Callahan insisted. "Over at Brookhaven, they got a new computer they're real proud of—they claim it's almost alive. So they're reviving the old gag about having experts try to tell the computer from a guy on a teletype. They're lookin' for a guy right now, who don't mind carryin' on conversations through one-way glass on a teletype all day long. I bet we could get you the job. How 'bout it?" And he hauled out the blackboard he uses to keep score for dart games, and gave it and some chalk to Joe.

The shabby man took the chalk and carefully printed, "THANK YOU. I'LL GIVE IT A TRY," in large letters.

"Well Ralph," Callahan said to the dog, "it looks like you're a DJ."

And Ralph yelped happily, nuzzling Joe with his head, while we all started cheering once again.

Hours later, as we all got ready to bottle it up and go, Ralph turned to Joe and said, almost sadly, "So, Joe my friend. After tomorrow, perhaps we go our separate ways. No longer will I dog your heels."

Joe winced and wrote, "NO LONGER WILL I HEEL MY DOG, EITHER."

Doc Webster made a face at the plain Coca Cola that sat before him on the bar. "I might have to heal the both of you if you keep it up," he growled, and I could see he was still a little miffed over his defeat by Ralph.

"Oh no," Ralph protested. "I want to get my new job right away. The only other work for a dog of my intelligence is as a seeing eye dog, *ja?* And radio work is better than replacing a cane, *nein?"*

"Cane-nein?" the Doc exploded. *"Canine?* Why you . . ."

But over what the portly sawbones said then, let us draw a censoring veil of silence. His bark always was worse than his bite.

Say—if Ralph really makes it on radio, and becomes a dog star: is that Sirius? ■

analog

A Calendar of Upcoming Events

23-25 September
CONCLAVE II (Eastern Michigan University Science Fiction Society). Guest of Honor—Ben Bova. Special Guests—Robert & Ginny Heinlein. Info: 1-800-228-2828 or EMU Science Fiction Society, 117 Goodison Hall, EMU, Ypsilanti MI 48197.

2-4 October
Global Growth Alternatives [Society for International Development, Club of Rome, University of Houston, Mitchell E. & D. Corp.] Info: J. Conlon, Mitchell E. & D. Corp., 3900 One Shell Plaza, Houston TX 77002.

7-9 October
WINDYCON 4 (Chicago area SF conference) at Arlington Park Hilton, Arlington Heights, IL. Guest of Honor—William Rotsler, Fan Guest of Honor—Meade Frierson III. Registration $5 in advance, $8 at the door. Info: Windycon 4, Box 2572, Chicago IL 60601.

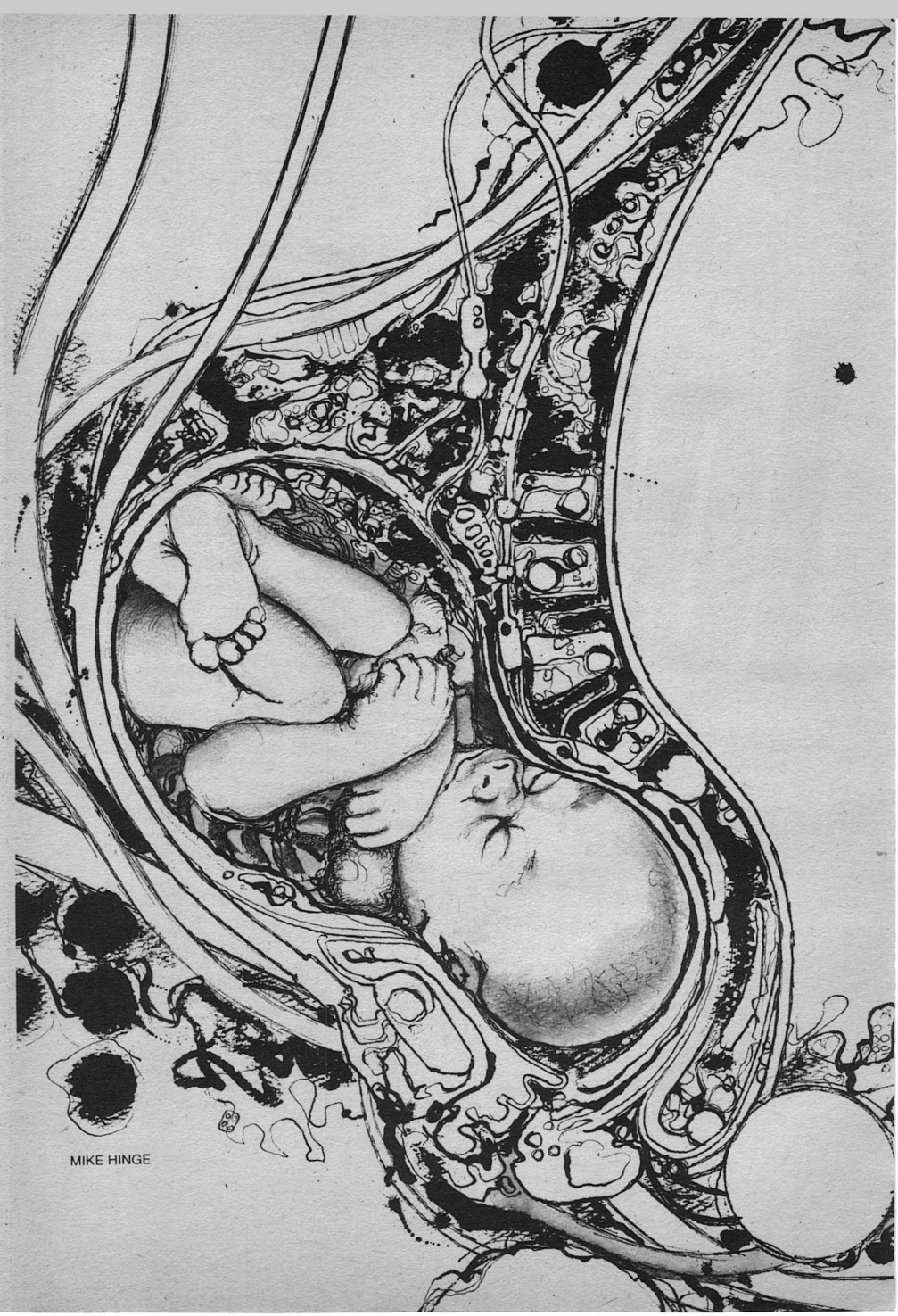
12 October
Solar eclipse 17.46.6 to 23.05.7. Totality: north of Hawaiian chain to Colombia/Venezuela. Partial eclipse visible in all 50 states and most of Canada.

18-20 October
Living and Working in the High Frontier—AAS/AIAA Conference on Space Industrialization. Broad-based solutions to the subject of space commercialization (San Francisco Bay area). Papers will be presented in the following areas: technical, space law, space community planning, psychosocial considerations for space communities, economic realities of space. Info: Paul L. Siegler, General Chairman, Earth/Space Inc., 4151 Middlefield, Palo Alto CA 94303.

22-23 October
OCTOCON 1 (SF conference) at Sheraton Tropicana, Santa Rosa, CA. Guest of Honor—Poul Anderson. Info: Lucy B. Buss, 7164 Highway #116, Forestville CA 95436.

25-28 October
Seventh Symposium on the Engineering Problems of Fusion Research, at Knoxville, TN. Info: M.S. Lubell, O.R.N.L., Box Y, Oak Ridge TN 37830.

—ANTHONY LEWIS


MIKE HINGE

HEARING OF THE SENATE JUDICIARY COMMITTEE, September 17, 1981 [Transcript *ex Congressional Record*]

(Senator Pollock) "Please state your name and occupation?"

(Witness) "Doctor Linda Muenter, Director of Research at the Wilmetta Oncology Foundation, Wilmetta, Washington."

(Senator Pollock) "Would you please explain to the committee your present line of cancer research at Wilmetta?"

(Witness) "I would rather not. It's extremely technical, and might be misunderstood by lay persons."

(Senator Pollock) "We'll do our best to keep up with you, Doctor. Or would you prefer a contempt citation?"

(Witness) "Secretary Rabkin of HEW advised me that this hearing is improper, since it is beyond your impaneling jurisdiction."

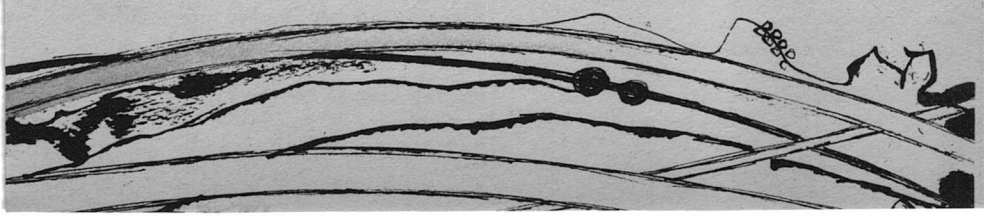
(Senator Pollock) "Would you care to test that before a federal judge, with a prison sentence the losing prize?"

(Witness converses briefly with counsel, then responds) "Very well. We've known for decades that the many kinds of cancer are all basically disfunctions of cellular nucleic acid. Such disfunctions effectively turn back the biological clock a million years, converting the oxygen-nitrogen cycle of human cells to a primitive fermentation-type cycle.

The Ultimate

arbiter

Like all scientific advances, the uses of human cloning will be determined by everyone except scientists. **Eric Vinicoff and Marcia Martin**



"The major obstacle in the fight against cancer has been learning its cause. There are so many types of cancer, and literally hundreds of factors that seem to cause them—such as tobacco smoke, certain drugs, certain molds, mechanical irritants *et al.* Doctor J. R. Marrack at Cambridge first postulated and began the search for an antigen responsible for all the various cancers. He felt that the many external factors only set the stage, so to speak, for the antigen."

(Senator Brock) "Pardon me, Ma'm, but I haven't had your learned advantages. What's an antigen?"

(Witness) "My title is Doctor, Senator. An antigen is a protein or carbohydrate invader of the body that triggers the production of an antibody."

"Doctor Marrack, lacking the tools of modern science, was never able to identify the cancer antigen. That was left to Doctor Irene Cory Diller at the Institute for Cancer Research in Philadelphia. She cumulated the research which revealed the existence of L-Forms, and found the first evidence of their link to cancer. L-Forms are pleomorphic viruslike particles. Even today we know very little about them, but somehow they metamorphosize back and forth between a particle and a cell state.

"That's where we began. After six years of intense research we've managed to run the mystery of L-Forms to ground. They're indeed the ultimate antigen that causes cancer. We've proved it.

"If we can destroy the L-Forms, we can destroy cancer. We know that extreme cold and certain chemicals will kill them—but the test clo . . . the test subjects died too. L-Forms also die of old age—after they've wreaked their fate on their hosts. We could find no external means of destroying them.

"Being antigens, however, they do stimulate natural bodily defenses. Their presence causes the RES to manufacture antibodies. RES is an acronym for Reticuloendothelial System, the antibody creating functions of the liver, spleen, bone marrow, and the lyphatic system.

"The question then becomes why don't the antibodies manage to destroy the L-Forms in the vast majority of cases? There are four possibilities. There may be a tumor tolerance in the host. The host's RES may be defective. There may be too many antigens for the created antibodies. Or there may be a numerical incompatability between the connecting points on the antigens and the antibodies. For an antibody to destroy an antigen, it must first bond itself completely to the antigen.

"But in a few exceptional cases the antibodies of a specific patient have been able to destroy the cancer L-Forms. Without any medical treatment whatsoever, these natural immunities have defeated cancers. The phenomenon is called spontaneous remission.

"Spontaneous remission can be artificially induced. Severe infections of certain diseases can stimulate anti-

body defenses that also destroy the cancer L-Forms. Unfortunately said diseases are almost as dangerous as cancer. To obtain the remission the disease must be allowed to progress untreated until it's almost certainly lethal.

"This is a classical experiment, but we were the first researchers who knew exactly what to look for. We injected our subjects with the causative L-Forms for sarcoma, a cancer of the connective tissue, and then stimulated the remissions by injecting toxins of erysipelas.

"That's where we stand today. We're less than a year away from a total cure for cancer."

(Senator Pollock) "What role have human clones played in your research?"

(Witness) "We used clones in our spontaneous remission experiments, and our projected cure involves clones."

(Senator Pollock) "How many clones died in your experiments?"

(Witness) "I don't know the exact number."

(Senator Pollock) "Would you please give the committee an estimate?"

(Witness) "Offhand, I'm afraid I can't."

(Senator Pollock) "You're not being very responsive, Doctor. We asked you to come prepared to testify. I hope we won't be forced to subpoena your records. Would the number be over fifty?"

(Witness converses briefly with counsel, then responds) "Yes. The number would exceed fifty, but that's not . . ."

(Senator Pollock) "And the prospective cure, how does that involve clones?"

(Witness) "We'll soon be able to create clones of cancer victims, stimulate spontaneous remissions in them, and draw off the L-Form-destroying antibodies for use in curing the victims' cancers. Our preliminary test indicates that this is entirely feasible."

(Senator Pollock) "How many clones died in the process of saving your test subject?"

(Witness) "Twelve."

(Senator Brock) "I just have a couple of questions, if you don't mind. First, will your research be of benefit to humanity?"

(Witness) "Yes, very great benefit. Cancer is the second greatest medical cause of death in the United States. Our discovery will lead to its complete eradication."

(Senator Brock) "Could your discovery have been made without the use of clones?"

(Witness) "Only by condemning dozens of human beings to slow, painful death. Not otherwise."

(Senator Barrett) "I'm interested in how you happened to be using clones at all. Weren't you aware of the HEW moratorium on all clone production while they prepare an ethical code for clone use?"

(Witness) "I was aware of it. The code is still years from completion, being a very difficult project. The curing of cancer was judged too vital to the nation to be delayed, so we were

granted a variance."
(Senator Barrett) "By whom?"
(Witness) "By Secretary Rabkin of HEW."
(Senator Barrett) "Did any restrictions go with the variance?"
(Witness) "We were told not to reveal our use of clones to anyone, and to impose certain security precautions."
(Senator Barrett) "Did you comply fully with these restrictions?"
(Witness) "Yes."

Senator Mike Pollock had arrived on the Hill five years earlier, the junior senator from California, one of the young Turks out to purge the government of Watergatism. Now he was a middle-aged Turk, his determination tempered by knowledge of the awesome inertia of the federal government.

He strode down the ornate marble corridor on his way to a meeting with the House whip, to ready the second prong of his campaign. Loud footsteps pulled up beside him. "Okay, Mike," Senator Barrett said. "You made your big play, sent the media folks flying like bats from a cave. Now how about filling in the team?"

Mike smiled grimly. "You heard it all. The Administration has been covering up the biggest atrocity since the little man with the mustache. One of the Wilmetta researchers came down with a case of conscience; that's how I got the word. The Court is packed with Nivling appointees—they won't touch it. So it's up to us."

"To do what?"

Mike stopped and stared at the junior senator from Washington. "To stop the cloning, of course."

Senator Barrett eyed him speculatively. "Is this genuine outrage, my friend, or are you just trying to get a leg up on the White House in '84?"

"I'm not quite sure myself—yet," Mike said soberly. "Why not ride with me for awhile we'll both see."

"I plan to, but not on your coattails. I'm going after the Administration on the coverup, all the way, no matter what you opt for."

Mike chuckled and slapped him on his back. "That's keeping me honest. How do you read the committee?"

"Brock was obviously primed, probably by Rabkin and/or Nivling. But we can get a bill out of committee any time you say. Thomas, Steranko, Kirby, Brunner, and Lee are with us as long as it means a chance to kick the Administration's gluteous maximus in an election year. They aren't bright enough to see further down the road."

Mike stared at him. "You think it's going to get grim?"

"Does King Kong have hair? It's not just Nivling's crew we'll be fighting; it's the fear of death. A lot of people won't see through to the moral and legal questions; they'll just want the cancer cure. And who can blame them?"

Mike saw the doubt in Senator Barrett's eyes, and wondered why he didn't feel any himself. How could he be so sure he was right when self-interest pointed so clearly the other

way? What was wrong—or right—with him?

[*Dallas Star*, September 18, 1981]
CURE FOR CANCER FOUND

In an open session of the Senate Judiciary Committee it was revealed yesterday that researchers have discovered a total cure for cancer. This startling breakthrough, the product of six years of painstaking effort, occurred at the Wilmetta Oncology Foundation. Doctor Linda Muenter, who announced that practical application of the cure was less than a year off, was unavailable for further comment.

The research was veiled in secrecy, and came under fire by Senator Mike Pollock, the young liberal from California, for alleged improper research procedures.

Though only hours old, the announcement has been widely acclaimed. Doctor Bo Lancaster of Johnson Medical Center called it the greatest medical boon since the discovery of penicillin. Doctor Tanya . . .

Mike sat behind his desk, mulling over the draft of his anticloning bill. Finally he said, "Let's go with this, Joan." He handed it to his secretary. "Type it up, please, and get a copy over to Barrett pronto. He's going to join me on it as a coauthor."

Joan left. Mike looked at his Post unhappily. Three front page stories, all pro-cloning—no help at all.

"Publicity," he said into his dictaphone. "The media is playing the cure up, and softpedaling the cloning issue. We need to put the facts and the questions to the people. Item: accept any speaking invitations and tell our side. Item: call a press conference tomorrow. Item—"

A red light flashed on the desktop holophone. Mike sighed; it had to happen sooner or later. He touched a button.

President Nivling's simulcrum appeared in the small spherical globe. "Hello, Mike."

"Hello, Mister President."

The President, a large, robust man with full blonde hair despite his advanced years, smiled. "So it's Mister President, eh? You figure there's no way around a fight?"

Mike sighed. "Sure. Shut down the Wilmetta clone research. Ban the use of clones as experimental subjects."

"What in hell's name are you up to, Mike? Fighting this one isn't smart politics. Look, I know we're different parties, but can't you see what this cancer cure is going to mean for the whole country? And that's just starters; think what other experimenters might come up with in the future. Maybe even spare parts to replace anything in our bodies that wears out. Wouldn't you like to live a few hundred years?"

Mike thought of Mary and nodded. For most the challenge was too immediate, or they just didn't want to think about it. But he had met the chal-

lenge, and many like it, while stretching his mind. He had had the time and the will to think it through.

"I'm sorry, Mister President, but this one strikes too close to home. You know about Hitler and the Jews? Well, Poles were also 'inferior beings' to the Third Reich. Thousands of them went into the concentration camps. And dozens were tortured, sometimes to death, in 'medical experiments' by Nazi doctors—treated like animals because they weren't Aryan."

"I keep wondering how I'd feel if I were one of the clones out at Wilmetta."

HEARING OF THE SENATE JUDICIARY COMMITTEE, September 21, 1981 [Transcript *ex Congressional Record*]

(Senator Barrett) "Would you please state your name and occupation?"

(Witness) "William Rabkin, Secretary of the Department of Health, Education and Welfare."

(Senator Barrett) "Do you recall your last appearance before this committee?"

(Witness) "I do."

(Senator Barrett) "You explained to us the purpose and function of the moratorium on clone production, and assured us that the moratorium would be applicable to *all*—do you remember that?"

(Witness) "I do."

(Senator Barrett) "Despite this, did you not grant the Wilmetta Oncology Foundation a variance over one year ago? Please try and recall."

(Witness) "I did."

(Senator Barrett) "By what authority?"

(Witness) "My own."

(Senator Barrett) "You didn't consult the President at any time?"

(Witness) "No."

(Senator Barrett) "You're aware of the possible penalties for purgery?"

(Witness) "I am. I acted on my own authority. I had the power and the right to so act, and I wasn't required to inform Congress of my action."

(Senator Barrett) "I find your attitude very disturbing, Mister Secretary—almost the attitude of one suffering from a guilty conscience."

Mary climbed into bed, switched off the lamp and snuggled beside Mike. "Out with it, love," she whispered. "One way or the other."

"Huh?" Mike had been thinking.

"I could slip into black lace undies and find a whip somewhere. Or maybe you'd rather just talk it out."

He tried to keep a serious mood, but couldn't, and broke up. "Okay, you win. I've been a sourpuss all night, and I know it. I apologize."

Mary was still quite beautiful at thirty-four. She kissed his neck. "Heavy traffic?" she asked.

"Very."

"And you're afraid to discuss it with me, figuring I'll dump on you too?"

He rolled over. The way she was able to read his mind never failed to amaze him. "Okay, let's get it over

with. Let's talk it out."

"About the cloning thing? You know how I feel; you must have been hearing it all day, and reading it in the papers. But you're the one with the public mandate. You know I always stand behind you, lovingly, no matter where your conscience takes you."

"But . . . what about your brother?"

She sucked in air sharply. "I read a statistic once, how most families in the US have at least one member who died from cancer. So we're no exception. Maybe the use of clones could save others like Frank; I'm sure you thought about that before you made your stand. God help you in the value-balancing you have to do—I can't."

Mike felt some of the pressure drain from him, and a more pleasant pressure began to build. "You don't happen to know of any 24-hour used whip shops, do you, hon?"

Terrance O'Callahan's TV News, San Francisco Chronicle, September 26, 1981

This week's vid fare includes two newsworthy prime time specials, diametrically opposed and part of the growing furor over the Wilmetta cancer research.

On Tuesday night the United Catholic Conference and other church groups present a fifteen minute show entitled *Clones—"Thou Shalt Not Kill!"*. Billy Graham will host.

The pro-cloning forces have their say on Friday night, as the American Cancer Society presents *The Cure,* a half-hour defense of the titular subject. This show is already the focus of scandal, with Rona Brackett's revelation last week that money has been funneled into the production by sources close to the Administration.

Mike and Senator Barrett were bowling on the special lanes beneath the Senate Office Building, bowling and plotting strategy.

Mike eyed the pins over his Black Beauty. "That was easier than I figured. The bill went through committee right down party lines. I expected more, uh . . . flak from the Administration." The ball went rolling, and took out nine pins.

Senator Barrett smiled. "You should try the PBA tour someday and earn some honest money. I figure Nivling pulled in his horns because he knew the committee was packed against him. He's counting on winning a floor fight.

"Looks like." Mike lined up the seven pin, but missed it on the Brooklyn side.

Senator Barrett went to the line himself. "But their main play seems to be for public support. All of a sudden Doctor Muenter is singing sweet songs to the media about how well the clones are treated at the foundation, how painless the whole experience is. Wonder who put her up to that. And did you see the latest Gallup?"

"Sixty-two against our bill, thirty-eight for, ten on the fence." Mike sighed. "We have our work cut out. We've got to make them *see!"*

Senator Barrett rolled his wide hook for a strike. "See that, Hastings man. But you've got a point. People know cancer—all too well—but what's a clone to Everyman? Try playing up every chance you get the fact that they're just as human as you or I—and moreso than some folks on the Hill." He chuckled.

"I'll try, of course, but we need something better. Let's think on it. How does the House look?"

"Better than the Senate." Senator Barrett stepped up to finish off his tenth frame. "You should take some time off from your crusading sometime and make some connections there. Anyway, we've got some support; party loyalists, anti-Administration types, Father Brennan—natch—and a few Reps who seem to think killing a clone is wrong. The lobby pressure is strong; the religious groups, the ABA, the ACLU, and 'prominent intellectuals' *et al* versus the Cancer Society, the scientists, the research-oriented businesses and 'citizens groups'." He finished up with a spare. "Pay up!"

Washington Post, September 30, 1981

BOMB FOUND AT WILMETTA

Big Sky County officials announced late last night that a crude bomb had been found in a broom closet at the notorious Wilmetta Oncology Foundation, core of the current cloning controversy. The unexploded device, six dynamite sticks attached to a crude timer, was powerful enough to have done extensive damage. A sheriff's office bulletin said that leads are being investigated, but no arrests are imminent.

The bomb was discovered during a search instituted after an anonymous phone warning to evacuate the administration wing of the foundation complex. The male caller claimed to be a member of the Symbionic Liberation Army, stated that "the people will not tolerate the creation of a new class of oppressed persons," and demanded the end of all clone production.

This follows what Doctor Muenter of Wilmetta called "a mounting number of harrassing phone and mail threats." The FBI has been investigating them, and is now looking into the bombing attempt.

The bomb, even if it had detonated, would not have done any damage to the security area where the clone research is taking place. Captain Maddocks of the Seattle bomb squad, who examined the device, reported that it would have exploded at 1 AM this morning but for the courageous action of two foundation security guards in defusing it . . .

Mike sat on a worn marble bench in the Senate steam room, *au naturel* except for a large white towel, watching Senator Perez of Puerto Rico waddle away. He smiled. It had been a productive session; two more floor votes were in the bank.

Senator Barrett plunked down beside him. "We've got to stop meeting

like this, Mike. Margaret is getting suspicious."

"Hah. She's known about you for years. How did it go?"

"The students at dear old Georgetown were very receptive. But I don't think we're making speeches to the right people. Did you see today's Harris?"

"Lou sent me a copy personally—nice guy. Analysis too. Fifty-five for clones as experimental animals and the cancer cure, forty-one for us, and four holding fire. We're gaining, but not fast enough."

Senator Barrett nodded. "Our bill begins debate tomorrow. The good old boys are going to vote *vox populi* with elections coming up. We have to build a public fire under them, and right now."

Mike sighed tiredly. "I don't know, John. Maybe I'm fooling myself. I figure the people will see reason if it's presented to them properly, but so has everyone in history with an unpopular idea. Maybe what I'm really trying to do is brainwash them away from their own enlightened self-interest. Are we supposed to lead our constituents or follow their will?"

Senator Barrett put a hand on his shoulder. "That's the question with no answer, as you well know. But when we stop asking it, we become dangerous men."

Mike looked up at him. "I had an idea this morning. It involves violating some security regulations, but—"

"That's what senatorial immunity is for. Let's hear it."

Mike lowered his voice; there were other senators on the far side of the room. "You remember that industrial espionage agency down in Houston you told me about, the one you subpoenaed in your aerospace kickback probe?"

"Yes."

"Wasn't there a man working for them who had a camera eye?"

Senator Barrett's brow wrinkled as he tried to remember. "You mean a photographic memory?"

"No, I mean a real holovision camera in a false eye. Their Nine Hundred Thousand Dollar Man, you called him."

"Oh, him! What about him?"

"Can you retain him to do a job for us?"

"Easily. If they balk, I just threaten to put all I know about them on the UPI ticker. You've got him. What for?"

Mike smiled. "The Senate Judiciary Committee—or part of it, at least—is going on the road. And the people are coming along."

Debate: *Should Clones Be Used As Experimental Animals?* October 3, 1981 (Public symposium on Social Consciousness, University of Arizona. Oliver W. Bassett, attorney, legal historian. Theodore Blanc, PhD, biologist.)

(Mister Bassett) "How can you possibly claim any moral, ethical, or legal justification for breeding persons as experimental animals?"

(Doctor Blanc) "Not persons—

clones. Clones nurtured from human cells, grown in neo-embrionic fluid vats."

(Mister Bassett) "Potentially just as human as you or I. Perhaps more than you."

(Doctor Blanc) "Potentiality and actuality are two different things. The clones used at Wilmetta are non-intelligent animals, invaluable in experiments where once we would have had to risk human lives. Surely it's better to risk clones than humans, isn't it?"

(Mister Bassett) "You medical researchers are very good at dividing humanity into levels. You used to judge prisoners and the insane as less valuable to society, better to be sacrificed for the good of the rest. Then it was fetuses and abortuses. Now it's clones."

(Doctor Blanc) "Yes, now it's clones. Clones will enable the development of the ultimate cure for cancer without the cost of a single human life. Can't you see how important that is, for all of us? Think of the thousands of lives that will be saved, freed from pain, or made whole again."

(Mister Bassett) "All I can think of are the persons being condemned to torture and death to find that cure—without their consent."

(Doctor Blanc) "Consent is a meaningless term as regards the clones being used at Wilmetta. They're completely uneducated."

(Mister Bassett) "Then what about justice? Regardless of the HEW variance, the use of clones as experimental animals is unjust and immoral! You can't use human beings as experimental subjects without their informed consent; it's against the law!"

(Doctor Blanc) "Don't spout Kant at me; I'm a utilitarian. According to Mills an act is just if it increases the general level of happiness in society, makes life better. Certainly the use of clones in research and to cure cancer is beneficial to society. Likewise it's certainly more socially beneficial to use clones in high-risk experiments than human beings. People have places in society, while clones are animals created artificially by society to serve it."

(Mister Bassett) "Clones aren't animals, so arguing from that analogy is invalid—not to mention stupid."

(Doctor Blanc) "Perhaps that point is too complex for you. Try comprehending this one. The clones used to cure cancer are just as much a part of the cancer victim's body as his or her antibodies. Why shouldn't they serve the same purpose?"

(Mister Bassett) "You'd condemn hundreds . . . no, thousands of clones to that kind of living death? And you don't even *wonder* if the prize is worth the price?"

(Doctor Blanc) "No, I don't! Many of us have devoted our lives to fighting the evil of cancer! We know the prize—better than a courtroom adagio dancer, I dare say."

(Mister Bassett) "If Doctor Muenter and the Administration are so sure they're right, why did they try to keep the Wilmetta research secret?"

(Doctor Blanc) "Lay persons all too

often substitute squeamishness for rational thought, just as you have. You're like the people who object to the cruelty of the slaughterhouse, but eat steak. You want the benefits of medical research, but you can't bear the thought of its more unpleasant aspects."

(Mister Bassett) "So you say to hell with the people? I'm sure the audience finds that very interesting."

(Doctor Blanc) "You're twisting my words. But experts in the field are indeed the only ones qualified to balance the benefits against the harms in any experimental situation. They're best qualified to make these kinds of decisions; lay persons can't understand all the factors involved."

(Mister Bassett) "You're so wrong, and the sick, sad thing is that you don't know it. This is a moral/ethical/legal dilemma; in a democracy the people are—and must be—the ultimate arbiter."

The entourage passed through the Wilmetta security wing's checkpoint, and Mike was politely relieved of a small Neiko camera that the scanner revealed in his pocket. He had planned it that way; he couldn't afford to appear uncharacteristically slow. It might give away his real ploy.

Doctor Muenter led them down an antiseptic corridor to a door marked Room Fourteen. It was a small entourage; Mike, Senator Barrett, two aides-de-camp, Doctor Muenter and a security guard. The other committee members had begged off, a fact which disappointed but didn't surprise Mike. One of the aides was a skinny man with a fat bush of black hair, Kenneth Lupov, with one eyeball of protoplasm and one of microcircuitry.

"Here's what you've come so far to see," Doctor Muenter said coolly. She didn't want them there, but even HEW couldn't bar a Senate investigating committee. "Let me advise you, seeing a clone in person for the first time is . . . somewhat of a shock."

They entered.

Mike had had a verbal description from his informer, but still he was startled. What in hell was going on!

First he noticed the large room, half operating theater and half laboratory. Computer equipment and complex monitoring consoles filled the far end, and white-gowned technicians tended them. Doctors and scientists, and their tools, dominated the foreground. Nurses flitted here and there. Everyone spoke in whispers, and tension stifled his breath.

She nodded to some of the researchers, and they nodded back as they worked. Then she led the group through the activity to the center of the room. Lupov was looking at everything carefully—very carefully.

There sat a fat bell jar of clear plastic over a surgical couch. An inflatable sack airlock bulged from one side. Many cables, wires and tubes emerged from the jar, linking the occupant of the couch to the surrounding equipment.

"The ultrasterile environment is es-

sential," she answered the question in Mike's expression. "Clones are forced to maturity in approximately three months. They are as vulnerable to infections as babies, and we can't vaccinate them since it would distort the test results. So we use this method to protect them from external vectors."

Mike hardly heard her. He was staring at the thing on the couch.

He had expected the clone to look human, and it did have a human shape, color and texture. But it wasn't human. It might have been a white male of twenty years, naked, bald, and lying faceup on the black padded surface, but it wasn't. Several factors added up to scream at him a denial of kinship with it.

It was like a talented beginner's sculpture of a person; correct form but with slight flaws and a lack of detail. The flesh was too soft and pink, the hair too glossy, the muscles too limp and flaccid. The fatty tissue made its appearance grossly cherubic. But overstamping all of this with horror was the lack of *persona;* of lines, wrinkles, calluses, facial expression, interest in the open eyes, and so on. It had grown to maturity in a tank of neoembrionic fluid; it lacked commonness of experience with humanity.

"Why . . . Why are the eyes open?" he managed to whisper.

She smiled maliciously. "The clone is awake. Its motor nerves have been severed to create immobility, just as other nerves have been severed to eliminate pain."

He swallowed hard to keep stomach juices down, and was glad to see in Senator Barrett's chalky face that he had company in misery. Mister Lupov wore a grim expression, but he continued to stare at the clone. Mike locked eyes with him for a moment, and he returned a slight nod. That meant that all of the grisly details were recorded for future use.

The rest of the tour was a sickening nightmare for Mike. Images of it haunted his dreams for many months . . . a tank in a clone growth laboratory, filled with murky but colorless fluid, containing a bodyshape the size of a six year old child, black tubes leading from its mouth and belly into the tank floor, making disjointed movements, eyes open . . . a holding cell, thick with zoo smell, furnitureless, where a mature clone played stupidly with baby toys . . . lumpy carts draped with white sheets trundling toward the crematorium.

When Mike and Senator Barrett could stand no more, they left. Through it all Mister Lupov looked at everything, quite carefully.

WWBY Newstalk Radio, Chicago, October 7, 1981

"Howdy! This is Jon Carswell, and you're on the air with today's question—what do you think should be done about using clones as experimental animals? Ever since the recent media blitz involving the now-famous Wilmetta Tape, the cancer research there—or, as some call them, the

atrocities—has been Topic One! So let's hear from you, folks!"

"Hi, J. C. My name's Hiram, and I think it's disgusting, is all."

"What do you mean, Hiram?"

"I mean what they're doing up there in Wilmetta. Damned brutality, if you ask me. What kind of monsters can do that to people?"

"You mean to the clones?"

"Clones, shmones! I know people when I see them! A damned crime—should slap all those so-called doctors in jail! Unnatural, that's what it is; growing people in bottles, sticking tubes in them and all!"

"Then you support Senator Pollock's bill to bar further use of clones as experimental animals?"

"Huh? I want them to stop what they're doing—is that what you mean?"

"You realize that outlawing clones will eliminate the possible cure for cancer reported recently?"

"That don't make no difference. What's wrong is wrong, mister."

"Thanks, Hiram—the consensus seems to be strongly in your favor. Bye. Now let's hear someone else's opinion . . ."

Mike stood in the Capitol rotunda, watching senators drift back from lunch for the climactic vote. His stomach felt light and queasy, like an actor's on opening night.

He wore confidence like a new suit. There were times when everything he did or tried to do seemed to have no effect on the terrible juggernaut of life, for good or ill. But sometimes the powergears interlocked precisely, amplifying his will to national dimensions, and that always thrilled as well as reassured him.

Today more than ever.

"Here, read this—it'll make your day!" Senator Platé stuffed a Post into his hands *en passant*. It was the one with the latest Gallup—he had already seen it that morning. Fifty-two percent supporting the bill, and growing. The House, already wooing votes for next year, had gotten the message. It had passed the bill overwhelmingly.

But would the Senate? The Administration's holding action had concentrated here, and the six year term made the senators less vulnerable to the pressure of public opinion. Senator Barrett and he had done their own political spadework, though. It would be close . . .

"Come on, Mike. The Rubicon awaits." Mike looked up; Senator Barrett had appeared out of the crowd, and stood smiling in front of him.

Mike nodded, but said nothing. Together they entered the great hall.

FROM: Doctor Linda Muenter
TO: Doctor Barrymore Smythe, President, AMA
October 13, 1981

How are the medical sciences, or humanity itself for that matter, going to recover from the evil blow struck

them by the Senate yesterday? They don't know what they've done. I fear they and the citizens they represent will only realize the truth when much needless suffering and death has forced the realization upon them. A cure for cancer is only the beginning; the potential for clone research is endless. Progress is being impeded, and the harm to science and humanity is beyond calculation.

But this need not be. We can't surrender to the demagogues of ignorance. Your organization has influence with the present Administration, and you are very influential with your fellow members. The entire scientific community must unite to reverse this irrational popular mood.

I am also contacting other scientific organizations and individuals who might help in this cause.

The bill can't become law until the President signs it. I know that he's sympathetic to our views; we must implore him to veto it . . .

The Oval Office changed little from President to President; it remained a tribute to the position rather than the person. But President Nivling had decorated it with some cinema momentos from his prepolitical days. He sat behind his desk; massive, implacable and wreathed in hard-won cynical wisdom. "Okay, Mike, you insisted on this session. What's on your mind?"

Mike and Senator Barrett were seated facing him. All three were sipping drinks. Mike said, "Tomorrow you're scheduled to announce to the media your decision on our bill. Are you going to sign it?"

The President frowned. "You know how much pressure is being put on me, from both sides? That's quite a Pandora's box you've opened."

"But you built it," Senator Barrett cut in.

"As you say, I'm on record as supporting the Wilmetta research. Moreover, I personally believe in the value of using clones in research, and in the desperate need for a cancer cure." But his voice was troubled.

"You have a public out," Mike countered, "heeding the will of the people and all that."

"If I want to use it. Why should I?"

Mike smiled. "You aren't that dense, Mister President. You can read; you know which way the political winds are blowing."

"Not all that strongly, young man. You won in the Senate by three votes, hardly enough to overrule a veto. And fifty-five percent isn't quite overwhelming."

"Fifty-five percent and *growing,*" Mike bore down. "If you veto this one, we'll be back again next month. And next. All the while the public scales will be tilting further our way—and you know it. Because all the social utility in the world won't make the people accept human sacrificial animals. Clone is a scientific word; ordinary citizens see beyond such technicalities to the essential moral and legal truth.

"So you have two choices; lead the people in the right direction, the one they want to travel, or fight them and become a private citizen in '84. Take your choice."

The President grinned craftily. "You sort of hope I fight, don't you?"

That shook Mike with the force of abruptly revealed truth, and he didn't reply. Senator Barrett stared at him worriedly.

"You'd like to be sitting behind this desk in '85, wouldn't you?" the President went on. "That's been your prime motivation all along, hasn't it—hypocrite?"

Mike opened his mouth to answer, but he couldn't. Was the President right? He knew his own ambition, and had tried to separate duty from self-interest. Or had he?

"Tell you what, Mike. I'll sign your bill, if you do me a small favor; publicly disavow any Presidential ambitions in '84. I want your word that you'll stay out of the race, no matter what."

"You'd take his word for that?" Senator Barrett asked suspiciously. "November '84 is a long way off, and disavowals can be disavowed."

"I know a relatively honest person when I fight one."

Mike slammed his palms against his chair's armrests. "Dammit, that's not fair! This issue is more important than personal ambitions—you should treat it as such!"

"Feet of clay, boy?"

Mike rose and walked to the window, stared down at the twinkling night face of Washington. He didn't have to accept the bargain; he could eventually win enough Senate votes to override a veto. And it was his duty to take the Presidency from this corrupt, morally bankrupt party hack, to prevent more Administration abuses of power such as this.

But how many clones would suffer and die in the interim?

He fought himself in the wild country of the mind, and won.

He turned to face President Nivling. "You win, you ripe bastard."

The room was silent for long moments. Senator Barrett looked relieved, but also pained by the sacrifice.

The President shook his head. "You're wrong. You'll understand better when you've been around this town as long as I have. These kinds of decisions; each of us wins, each of us loses. Our job is balancing and trading off interests. Each decision like this raises ghosts to haunt us the rest of our days."

Mike was beginning to understand. Victory brought satisfaction, but also guilt.

"We'll share the ghosts from this one," the President went on softly. "Every time we hear of someone suffering or dying from cancer. The doctors and scientists will look for an alternate way to make their special antigens, of course, but who knows when and if they'll succeed?"

Mike nodded. "The only answer to that is that the other ghosts would be worse." ■

the Reference Library

Barry Malzberg

THE STATE OF THE STATE OF THE ART

I don't think that books about science fiction are apt to crowd out entries under *Watergate* in the Bowker subject index, not at least in the coming year, but if the world were a racetrack (it is, folks, it is) and books about science fiction a three-year-old maiden gelding, I think I would be moving amidst the crowds touting it as definitely a Price Horse. *Who's Who In Science Fiction, The Encyclopedia of Science Fiction, Contemporary Science Fiction Authors, The Science Fiction Book, Alternate Worlds: The Illustrated History of Science Fiction, Anatomy of Wonder* . . . this is not an exhaustive list and consists only of titles available within the last three years.

When I became actively interested in science fiction back in 1965 this category of publishing, for all intents and purposes, did not exist, at least in the commercial marketplace. There were the two Moskowitz books, of course, *Explorers of The Infinite* and *Seekers of Tomorrow* containing biographies (often inaccurate) of pre- and post-Gernsback figures and the specialty press in Chicago, Advent Books, was just starting on a program to restore to print the critical writings of Damon Knight and James Blish as well as Panshin's *Heinlein In Dimension* but having mentioned those I have just about mentioned them all. There were of course materials such as the Day indexes and bibliographies but they were privately printed and circulated and did not meet my definition of "commercial marketplace" by which simply I mean the likelihood of their availability to display or order by the average, not particularly knowledgeable, bookstore. You could, in other words, have covered this category of publishing in 1965 with a moderate-sized blanket, just as, twenty years before that, in Donald Wollheim's recollection, the field of science fiction itself could have been contained in its entirety in a moderate-sized hotel room.

Obviously, since then, matters have changed. It would take at least a hotel banquet room of average size to accommodate the movers and shakers and it would take several hundred dollars (as opposed to a decade ago, say twenty) to acquire all of the science fiction books about science fiction. What has happened?

Well, simple proliferation of course and long overdue awareness in commercial publishing of biographical/bibliographical gaps in the field and rising academic interest creating an automatic audience for these books and simple exploitation and then again a pinch of decadence . . . there would be an interesting column or three in analyzing these factors and I might someday write it but The Reference Library, as mapped out by the sainted P. Schuyler Miller of sainted memory and almost a quarter of a century's service is a column of review, first, one of utility and in service of a consumer report it is my intention to have a brisk look at some of these

books suggesting which might be worth pursuing. The subcategory threatens to overwhelm us; a consumer report is in order.

Brian Ash's **WHO'S WHO IN SCIENCE FICTION,** the most recent of these books at this writing is probably the worst. Ash, except for in-group references to British writers and fans who he appears to know personally, has used exclusively secondary and tertiary sources to compile a fast four hundred biographies of those he considers the most important people in modern science fiction. Cribbing in equal parts from Donald Tuck's *Encyclopedia* and Robert Reginald's *Contemporary Science Fiction Authors* (of which more below) the book reproduces inaccuracies from both to which Ash has added inaccuracies of his own ("Frank Belnap Long") but it is not inaccuracy so much as superficiality which mars this book, that and constant editorialization (Samuel R. Delany is a "recent starshell on the science fiction horizon") which has no place in what must stand or fall as a research device. There are inexplicable omissions—Gene Wolfe and Joe Haldeman, excluded, are certainly much larger figures than Juanita Coulson or Raymond E. Banks, included—and a failed grasp of the plots of many novels briefly summarized (I submit my own entry *in exemplum*) and all in all this is a bad book and somewhat of an embarrassment. It is the last but is noted first as a signal and a warning: this is the way it begins to go once a market has been proven and the doors are opened, crass work and bad or as Moses Herzog pointed out, "the vision of genius becomes the cant of intellectuals". The work of scholars becomes the superficialities of the hanger-on.

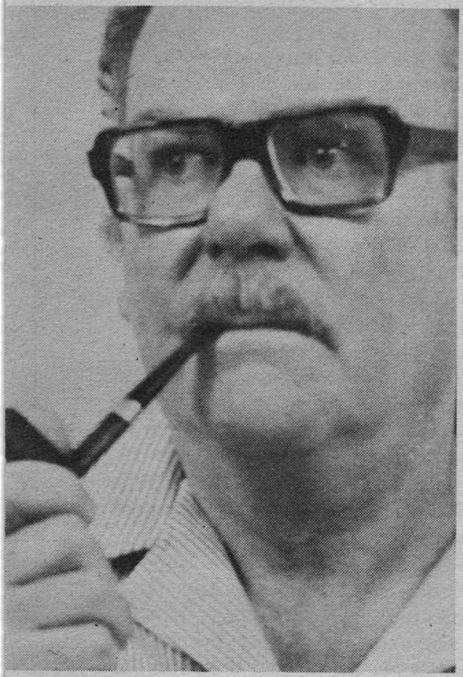
The two books by Reginald and Tuck from which *Who's Who* has been poorly cribbed are different and to varying degrees better specimens. Reginald's work, slightly updated from a privately-printed 1970 edition contains the self-composed biographies and bibliographies of all science fiction writers who Reginald could contact who had, as of 1968, published a novel. It abounds in lovely oddities (Donald E. Westlake left science fiction because it was "too hidebound, too conservative", Jack Vance's first published story was "The World-Thinker") and essays of occasional eloquence (Robert Conquest's loathing for the so-called New Wave is a study) but it is also dated and suffers from the obvious fact that it is a compilation rather than an act of biography; Reginald has simply industriously acquired from writers a great deal of information and transcribed it. The Tuck **ENCYCLOPEDIA** (Only volume A-L, published in 5/74 is available; the remainder is at least two years overdue and, I suspect, may never be published) is a superficial and in its biographical aspects a rather silly work but bibliographically it is noteworthy and prob-

ably should be acquired. (Although acquiring A-L of a prospective A-Z is somewhat like acquiring half a horse.) At the least they are preferable to Ash's book. Reginald promised a much revised and updated version for the summer of 1975; it too is much delayed and it is not, I trust, suffering from the contagion of Tuck or Advent Disease.

Neil Barron's **THE ANATOMY OF WONDER** is, on the other hand, a noteworthy book, bibliographical rather than biographical in intent, containing plot summaries of several hundred novels and a good scattering of juveniles and critical works as well, ranging chronologically from *The Narrative of A. Gordon Pym* to *Dhalgren* as well as introductory critical essays to the various periods which are, notably with Ivor Rogers on the Gernsback era, genuine contributions to the literature. The plot summaries are remarkable; they are for the most part accurate and somehow impart in fifty to a hundred words each a sense of the style and value of the works as well. This is probably the most significant and valuable bibliographic tool in the history of the field to date; the pity is that it seems on the verge of being lost in the same shuffle containing Tuck, Reginald, and Ash, and that its real accomplishments will be passed over. A reader of passing intelligence and some patience with no knowledge of science fiction whatsoever could spend a day with this book and come out knowing a good deal, most of it truthful and there is no way to more succinctly state the dimensions of the accomplishments here. I only wish that the book was not the fourth in a series of "bibliographic guides for contemporary collections" the first three of which deal with cities, muckraking, and cooking. The fifth, I am willing to wager (I seem to be extending my racetrack metaphor but only a very little) will deal with "mysticism".

James Gunn's **ALTERNATE WORLDS,** now available at a more reasonably priced trade paperback format (where it should have been to begin with, no fault of Mr. Gunn or even of Prentice-Hall who had enormous production costs they attempted to recoup) has been reviewed at length in this magazine and throughout the field; it is now what it struck me as being when I first read it in the fall of 1974: the best evocation of what drew us into science fiction and what all of us, writers, editors, readers, purveyors of the True Word have been trying to do since. Midway between objective history and autobiography (and a little the uneasier for it) the book, competently written by one of the most professional men who has ever done a body of work in the field and is a scholar in the bargain, is illustrated with photographs of the pantheon and old magazine and book covers to the point of tears. It spans fifty years of category science fiction at the level of celebration; it will be, for the rest of our time anyway, inescapable and rightly so.

Rottensteiner's **THE SCIENCE FICTION BOOK** is also lavishly illustrated, also a purported history of science fiction but resemblances to Gunn cease there. Rottensteiner's interest in modern science fiction appears to begin and end with the Polish novelist Stanislaw Lem for whom Rottensteiner has been unoffi-



● Mack Reynolds

When Mack Reynolds writes an adventure story—science fiction or otherwise—he knows whereof he speaks. He's been in over half a dozen wars, revolutions, and military revolts, and not necessarily as an observer. He's also lost track of exactly how many times various governments have invited him to visit the local jail. The most recent sojourn was at the behest of the Hungarian state police, who nailed him while crossing the Hungarian-Yugoslavian border without benefit of paper work.

An inconvenience in the form of World War II interrupted Mack's college studies, but he did pick up whatever degrees are awarded by the US Army Marine Officers Cadet School and the US Army Marine Officers School. In addition to having learned eight or so silent ways to kill a man, and two or three that are very noisy, he also made a study of political economy.

Asked why he started writing, Mack will tell you, "I didn't want to go back to work after the war ended." His first published story was sold to Esquire *in 1946, a very prestigious market. His first science fiction story appeared in* Planet Stories *in 1949, a not very prestigious market. In science fiction, he hit the big time with a sale to Analog of a Frederic Brown collaboration "Me and Flapjack and the Martians." Between 1959 and 1969, Mack appeared in Analog more often than any other contributor, and believes he was the only Analog writer to have one serial followed immediately by another.*

Mack was raised all over the United States, has been an expatriate since 1953, and now lives in Mexico, following stays in over seventy-five countries. A full-time writer since 1949, turning out gothics, biography, mystery, travel, humor, social criticism, TV plays, and even a cookbook, he has tried jobs as reporter, editor, printer, IBM operator, seaman, ship's officer, and lecturer in socioeconomics. His newest books are Lagrange Five *from Bantam; and three from Ace,* Perchance to Dream, Space Visitor, *and* The Best Ye Breed.

cial flack for many years; Lem's gifts and contribution are indisputable but Rottensteiner's shrill and fawning rising-up of Lem and ignorance of everyone else does neither of them credit. (Rottensteiner somehow through the sieve of apologia has let a good word or three for Phillip K. Dick leak through.) Rottensteiner is unaware as Gunn is not of the origins of modern American science fiction as an American subgenre of mass-market fiction; in failing to see that 1926 in this country was the pivotal date for this category he has failed to see much else and there is in his volume too much Verne and Shelley and too little of Campbell and Gold. His orientation, which is essentially European, seems to that degree to be essentially wrong (science fiction like jazz or the automotive concept of dynamic obsolescence is absolutely and uniquely American) but the illustrations are evocative and the art direction is intelligent. Here is a book which would be perfectly inoffensive if one did not have to read it.

Then there are the Frewin, Sadoul, and Aldiss books on science fiction art which are long overdue but whose evaluation to some degree falls outside of a writer's level of authority. I think that Aldiss is absolutely right in pointing out that the artists in the thirties were consistently succeeding in what the writers were consistently failing: to portray other worlds and times with a decent sense of awe; indeed like pitchers and hitters in spring training the artists were well ahead of the writers and in the main have held their advantage to this day. (The level of paperback if not magazine art strikes me as being on the average far above that of the copy.) Aldiss is also absolutely right in pointing out that the position of artists in this field has historically been even more demeaned than that of the writers; the writers at least had their names on their work and the opportunity to build an audience whereas artists, to this date, are unattributed on many paperback covers and, except for a small audience of appreciators, largely viewed as indistinguishable. In, hence, organizing his book around portfolios of individual artists (unlike Sadoul and Frewin) Aldiss seems to have found the right approach and his copy is, as would only befit one of the major writers in this or any genre, superior to that of the other books and worthwhile of itself.

Of the three books then, Aldiss is probably the one to acquire but I would just as soon acquire them all and someday soon I will. I remember a major science fiction writer saying to me once, "Do you have the same problem I have? I wake up in the middle of the night and I can see the covers of old Astoundings as if they had come out yesterday; they just float on the screen of my head like baseball statistics, remember the broomstick for *Witches of Karres?*" and I said "yes, except with me it's the man in red underwear for *The Players of Null-A*" and with this explosion of autobiography it is probably time to seek a more diffident posture and withdraw.

It was better when the entire field could fit into a hotel room or at least it was easier. It was cheaper too. But into the mindless and electric future we must plunge; ah, Bowker, guide us. ■

Brass tacks

Dear Mr. Bova,

I was extremely disappointed when I read of the death of the Analytical Laboratory in *Locus*. Don't feel that the primary function of AnLab is for the editor alone, but for the readers as well. I've always enjoyed seeing how the stories I read (and didn't read) fared in the minds of others (for instance: "I must have missed something in this story, look at the rating it got in AnLab . . ."; "Gee, I'll have to read this story I've been putting off, look at the rating it got in AnLab . . ."; "I think this story is a pretty safe bet for the Hugo or Nebula next year . . . no, not only because I liked it, but look how every one else rated it in AnLab," etc.).

Now, don't go looking through your files for my submissions to the Analytical Laboratory, there aren't any. I can explain several of the chief reasons why I and many others I'd wager do not submit their ratings to AnLab. First of all, I'm presently in the process of reading many other works; I simply don't have the time to go through my Analog cover to cover the day or even the month I get it. I read some of the stories if they catch my eye, and eventually I will have read all of them, but not in time for Analytical Laboratory.

Second—I prefer to get all the installments to a novel before I begin reading it. I think I would have been perched on the mailbox and foaming at the mouth had I been forced to wait four months for the conclusion to *Children of Dune*, and even longer for the different parts that made up *Dune*. Also, it is difficult to rate a *section* of a novel against short stories (no, impossible would be more fitting).

Finally, another downfall of the Analytical Laboratory is the way that it does rate stories—against each other in a particular issue. Conceivably, a mediocre story could get AnLab's highest rating of the year, had it been in a particular issue. Likewise, the

best story of the year could be behind it.

However, unlike many gripers I do have a solution. First off, save the Analytical Laboratory for once or twice a year. Thus you would still have the space in each issue you have planned for Biolog by just setting aside a single page annually. Second, have the readers *rate* the stories, say, on a scale of ten. This would eliminate the possibility I discussed earlier when the stories are rated against each other, and it would also allow a reader to vote as many or as few times as he wished.

Third, rate novels (whole) against novels, and, if you like, novelettes and short stories in their own catagory like the Hugo and Nebula awards do. With this system you could even rate science article against science article, and editorials and reference libraries also . . .

BILL ALVES

111 Parade Dr.
San Antonio TX 78213

How about it, readers? Are you willing to vote in an annual Analytical Laboratory Roundup?

Sir. . . .

Just got the February issue. No pain on the projected price increase. If that's the tithe I have to pay to the self-styled economists who give Uncle Sam advice on money matters without understanding feedback cycles, then so be it.

Was tickled pink, blue, and orange to read about the pay-scale increase for your writers. Now if I can just contrive to produce some decent material . . .

ANLAB votes (or whatever you call them now . . .) 1. Portions of This Program, Ing; 2. Nuclear Run, Cochrane; 3. Particle Theory, Bryant; 4. Crown of Thorns, Brennert; 5. E-Dep, Vinicoff. The two articles on the Sun were most interesting . . .

Your special feature, Jeff Rovin's attempt to get some hard data from the Ford administration, scared the crap out of me. As a consequence, I have written a few letters myself. One, a near carbon of Rovin's, went to the capital here in Sacramento. If anything interesting is produced, I'll ship you a copy.

Last, I wanted to mention Lester del Rey's book column. I find it sensible, straightforward, and reasonably objective; and his long expertise in the field is a most welcome leavening in these days when I can't pick up a college English text without finding some PhD litterateur bad-mouthing my heroes. I think sane, rational perspectives like del Rey's (and perhaps insane, rational perspectives, like Spider Robinson's, in your Competitor That We Don't Mention) will help keep us on the track while the latest academic fad wanes and dies.

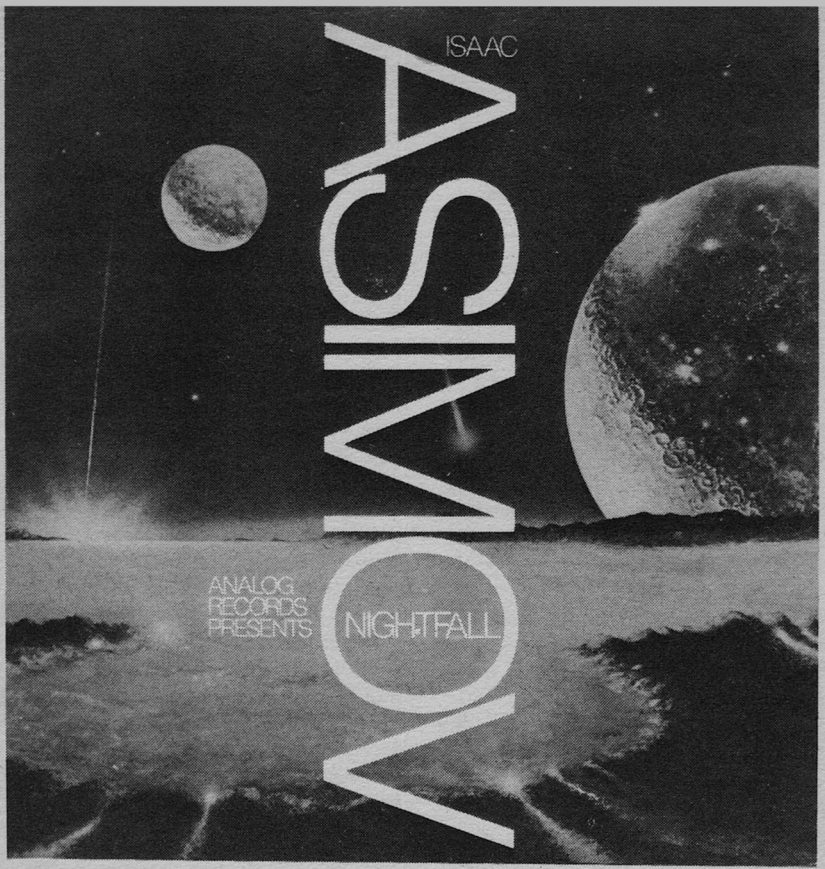
In short, I appreciate Mr. del Rey's columns.

. . . may your slushpile grow roses.

DAVID G. POTTER

5700 Franklin Blvd.
Sacto, CA. 95824

Thanks for the kind words. The readers' preferences for the February issue were quite scattered, with Bryant's lead story narrowly maintaining a lead over the others. We're glad you enjoy del Rey's column, and Spider Robinson (a rose from our



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slushpile, by the way) writes book reviews for Galaxy. See, we do mention our competition. Sometimes.

Dear Ben,

I was intrigued by the Feb. 1977 articles (Margaret Silbar and John Gribbin), about the Sun's puzzling lack of neutrino emission, or our inability to detect it.

Fluctuations in thermonuclear activity over the eleven-year sunspot cycle seem the most logical explanation. There was a recent article in Scientific American (June 1975, Pulsating Stars, by John R. Percy) on variable stars, which fluctuate a lot more noticeably.

The stages would be:

1. 'Turned-off', the Sun's core gradually contracts, becoming hotter and denser.

2. When the core becomes hot enough, a chain reaction starts up, since the nuclear fusion reactions go a lot more vigorously as the temperature goes up.

3. This chain reaction is exaggerated by the fact that the most vigorous reaction, between the two helium-3 nuclei, depends on the *square* of the concentration of He-3.

4. The innermost core expands vigorously outward, becoming less dense and less hot and thus slowing down the reactions. The explosion however is damped by the outer core, so that there is only a modest impact on the turbulent convective mantle, which then varies a little in its radiation emission, sunspots and solar flares.

I don't know whether the math for this will work in the computer models; but it's undeniably true that many stars oscillate considerably, with a wide variety of cycle times and brightness variability. Whatever explains them will explain the much more modest fluctuations in normal stars like the Sun.

If this oscillation occurs in an eleven-year cycle, the neutrinos detected should vary as observed so far, with a low emission over much of the cycle and a big peak when the damped explosion occurs, which would be at or somewhat before the peak of the sunspot cycle.

The second article's theory on the passage of the Sun through dust clouds in the galaxy also seems quite a plausible explanation for irregular long-run climatic fluctuations like the Ice Ages.

If the Sun's radiation varies only moderately, then the Earth's clouds should act as a *stabilizing* factor.

More heat, more clouds, more reflection or radiation. Less heat from the Sun, fewer clouds, less reflection. But this only works *within limits*. The cloud cover can't get more than 100% or less than 0%. If the radiation gets too high then the Earth, in spite of being almost totally covered by reflective clouds, will heat up underneath (like Venus). If the radiation gets too low, there will be few clouds but the Earth will cool down in spite of this.

GLENN T. WILSON
722 Montclaire
Edwardsville, IL 62025

Part of the "problem" with the Sun is that we have, until very recently, considered the Sun to be a completely stable, utterly reliable "mighty machine." But, as Galileo said in 1613 in his Letters on Sunspots, *"Names and attributes must be accommodated to the essence of things, and not the*

essences to the names, since things come first and names afterward." We have told ourselves that the Sun is a stable star for so many generations that its new-found instabilities have shaken our confidence in the Sun's internal workings.

Dear Mr. Bova:

Just in case you missed it, the passage below appeared on page 2 of the January 18, 1977 issue of the Commerce Business Daily. Knowing of your continuing interest in such matters, I thought you, of all people, might know who would like to put their two cents worth in on this. I know you are very busy, so no acknowledgement of this letter is necessary. Thanks.

"SEARCH FOR IDEAS IN SOLAR ENERGY. NASA sees a need to investigate novel, improved means to convert sunlight into other forms of energy and is in the process of determining what types of research should be supported. Current concepts for doing this are based on photovoltaic devices and thermal engines. We are concerned that approaches other than these may be more effective and make better use of the environment in space. If you have any ideas, concepts, or suggestions which could aid NASA in formulating research objectives in solar energy conversion in space, you are invited to mail them to NASA Headquarters at Code RR, Washington, D.C. 20546. Concepts should center on systems which are located in space (near Earth) and which, in principle are capable of highly efficient energy conversion. Systems scalable to megawatt and gigawatt power levels are needed for potential applications in space and/or for transmission of energy to Earth. Only sufficient information to permit consideration of the idea or concept as a portion of an overall planning effort is desired since it will be used only as the basis for determining research objectives. NASA may, if further effort is justified, issue a separate Annnouncement of Opportunity and/or Requests for Proposals to pursue those research objectives developed in this planning phase. The submission of detailed concepts or ideas which would disclose proprietary information should not be submitted since the information submitted may serve as the basis for a solicitation of proposals or otherwise be disclosed. Ideas submitted in response to this announcement should be forwarded to NASA by 31 Mar 77 to be considered for this planning phase. Att: D. A. Douvarjo (PO14)."

JAY LOUNSBURY
2508 Lakehurst Avenue
Forestville, MD 20028

It's good to see NASA showing some interest in this area, although I feel that: (a) NASA's interest is motivated by a desire to show that there are practical missions for the Shuttle; and (b) there are simpler, cheaper, and better ways to provide all the energy we will ever need without solar power satellites beaming microwaves through the atmosphere.

Dear Mr. Bova:

This is a followup to your article on the Dumbo Reactor by Donald Kingsbury.

Since publication of Don Kingsbury's article in Analog, classified reports from Los Alamos have been "declassified" and are now available

to the public. The inventors of the Dumbo concept have applied for a US patent and are negotiating with the government for a waiver of US patent rights. The patent application was for a "Lifter" (Laminar Impeded Flow Tubular Exchange Reactor).

Further, it appears the heat exchange structure taught by this invention can be operated electrically to produce monatomic hydrogen. If "single H" thus produced can be quenched and stored, it could be a very high specific impulse fuel.

Analog and its readership deserves a lion's share of the credit for stimulating interest in this exciting technology.

ARTHUR M. DULA
Butler, Binion, Rice, Cook & Knapp
Attorneys at Law
Esperson Buildings
Houston, TX 77002

Science fiction stories examine the future. Science fiction people *help shape the future!*

Dear Mr. Bova:

Although I have been reading Analog for many years, this is the first time I've been impelled to write . . .

It was with relish that I turned to the March science "fact" article, "Space Cooking." But instead of meaty facts, you have the gall to serve me up a platter of tripe! I never sausage poor taste! Mr. Bester is a well-seasoned writer of fiction, but his ability to write fact is at steak here and your editorial policy has an off-flavor.

Science fact? Baloney!

J. GLAZER
P.O. Box 31
Horse Creek, CA 96045

Thanks for your peppery letter. Most of our readers devoured Bester's serving hungrily. After all, where did you previously see a zero-gravity galley described, or a whole haut cuisine *dinner prepared before your very eyes? One is apt to wonder if a reader who cannot digest Bester's fine* entre *isn't something of a* crepe.

Dear Ben,

Diana King goes only halfway toward rethinking our educational system when she advocates: "Tear the Institution down and start over again." If we are to have zero-based education, we need to do more than just ask King's fundamental question: "What are we educating people *for?*" We need to get some working answers.

Jefferson County's District R-1 (student pop. 80,000) did ask parents, teachers, and students King's question. Their answers defined 5 educational goals (i.e. *raison d'etre*) for our schools. The goals are that each R-1 student:

1) Master the basic skills for continued learning.

2) Develop a sense of responsibility & act with understanding and respect toward others as individuals.

3) Develop his unique talents and his sense of worth, well-being, and happiness to the fullest.

4) Become actively prepared to cope with change.

5) Develop the skills and attitudes necessary to earn a living and function as a contributing member of society.

We returned to the R-1 community and asked: If we look at a graduating senior, how can we tell if our 5 goals

have been achieved? The answers identified 88 student outcomes.

These student outcomes revealed that basic learning skills include not only the 3-Rs but also listening and speaking and observing. They revealed that coping with change includes seeking new ideas, understanding how the electoral process can create change, and planning ahead and being able to modify these plans.

King decries such modern goals as "self concept development and value clarification." Eric Frank Russell's "I Am Nothing," (ASF, July 1952) describes far better than I the need for a positive self concept. If value clarification is predicated on not only sight reading but also comprehension, application, synthesis, and evaluation then true value clarification is predicated on ability *to think,* King's prime goal. I suspect that King's complaint is not so much against modern goals as it is with academia's misunderstanding of them, the same misunderstanding that transmogrified "every child has the right to succeed" into "no child may be permitted to fail."

I can see in the year 2000—

A bright student replies to the holistic computer simulation of Socrates: "If you would cry 'fire!' in a crowded theater, should not you then be restrained?"

JOHN R. ISAAC
6344 W. Rowland Ave.
Littleton, CO 80123

Goals for education? Let's stop talking nonsense and get down to realities. Students should learn how to read and write. They should face comprehensive essay tests *at the end of each year, administered by an organization that is separate from the school system. A teacher's salary should be based on the percentage of the teacher's students who pass the test. The ultimate social test of the teacher's "success," of course, is the amount of tax money that the teacher's students pay to their various governments. Students who pay no taxes should endanger the teacher's job.*

Dear Mr. Bova:

I am sorry, but I feel I can no longer support your magazine with my subscription.

Some years ago, when I first subscribed to Analog, it was for the high quality stories, articles and editorials it contained. Today, the material has declined to a style more suited for Hustler, Playboy, or Penthouse. The styles in general seem to come from practicing on bathroom walls. Most of the writers seem more interested in being anti-everything and Avant Garde than in writing imaginative and quality material. Maybe, today's readers can support that kind of thinking and writing, but I can not!

GARY BRANIGAN
2321 Harvard Dr.
Arlington, TX 76015

Gee, I didn't know that anybody read *Penthouse or Hustler! Moreover, if the occasional references to sex in Analog bother you, stay away from the Bible: it's much "sexier" than anything we've ever published.*

Dear Ben:

Read your opening statement on the February Issue—according to your demographics printed some time ago, I am your archetypal reader: Student in a tech school, 27, 135 I.Q.,

and a parabarbarian by your classification. And (the litany) I believe Science Fiction Is The Medium of Ideas. No more, no less. Ours run in several inter-reacting schools; from Veliskovskites to people who *liked* Dhalgren to Trekkies and Film Buffs. But the old hard core is the Techies, the Ingeneur Archetypical. A literary person who can comprehend Reality can write science fiction, but you need Tech somewhere to write Science Fiction. I would like the use of that Tech.

I am considering doing an Independent Study: To design, build and test an air-fluid heat-pump with a solar collector and I'm considering pumping it on a windmill. This kind of work is being done somewhere in this US of A, who has some information? If you know of some work being done, please write. *Who* acts as a clearing-house on this stuff? *Anyone* with personal experience in low-energy systems, contact:

ERNEST BLAKE
112 N. Broad St.
Johnson City, NY 13901

Typical indeed! Science fiction people are activists, and problem solvers. If there is no clearinghouse on "alternative" energy systems, let's make one.

Dear Ben,

Eric Vinicoff's story, "E-Dep", in the February issue is a good example of how relevant science fiction can be to the problems of the "real world", and how quickly science fiction authors react to those same problems.

Would that the real world reacted as quickly to the ideas presented in science fiction . . . As I write this, most of the Midwest is in a state of emergency, brought on by abnormal snowfall and unusually low temperatures. Locally, many industries and businesses have curtailed operations or shut down entirely because of natural gas shortages, and some residents in rural areas are the objects of National Guard rescue missions because they're snowed in and can't get out to buy heating oil and food. Land and air traffic is at a minimum. The Ohio River, which is *the* major route for most of the oil, coal, and gasoline for the area, is strictly impassable due to freezing and ice floes. The local power company has a thirty-day supply of coal . . . If this goes on, things could get worse.

Now, I'm not griping about the weather itself; there's nothing we can do about that—yet. What bothers me is the official reaction to the situation. To be sure, the governors of Ohio and other states similarly afflicted have, thus far, handled the situation admirably, but that's not the reaction I'm referring to. The reaction I'm referring to is that of Energy Secretary James Schlessinger's statement that it's time we ". . . get serious as a nation with regard to conservation."

Fine. We'd better get serious about conservation, or suffer the consequences (and we already are, to an extent). But if we had been serious "as a nation" about developing a technology that is not dependent on fossil fuels back in the fifties and sixties—instead of bowing to conservationists' nuclear fears and ignoring other alternate energy sources as crackpot—we would have a society that doesn't have to worry about conserving energy. Of course, our biggest problem is, to

quote a remark you once made, "Stone Age attitudes in a Nuclear Age."

MICHAEL A. BANKS
P.O. Box 312
Milford, OH 45150

It wasn't the conservationists, but the power companies, who have ignored new technology for more than a generation. And they will continue to ignore it as long as they can simply raise their prices—and profits—and mortgage everyone's future. The "Stone Age" concept comes not from me, but from Carlton S. Coon, the Harvard anthropologist.

To the editors:

I would like to commend Mr. Cochrane on his story "Nuclear Run." I thought it was a good, exciting story that was very plausibly done. I do wonder at his premise.

Why does Mr. Cochrane think future power plants will be solely nuclear? We have the technology for solar power; it's long been known we can get alcohol and methane from garbage, excrement, wood pulp, etc.; new designs of windmill props make wind power feasible; other alternate power sources often discussed include geothermal power, tidal traps, heat induction engines, thermonuclear power, etc. So if nuclear plants are shut down, there *are* other methods to produce electricity.

This singlemindedness is, to me, the worse thing about the power industry. Before the oil embargo, most plants were run on fossil fuels; now the power companies want to depend on nuclear fuel. Most uranium is mined in foreign countries, and this fact leaves open the possibility of America being blackmailed. What's the sense in this?

I think if our power needs were supplied by different interlocking power systems, our economy would be the better for it. Then, if one system is found to have more debits than credits, it would be easier to replace it with a better one. There would be no need to put up with a "necessary evil."

But apparently Mr. Cochrane didn't think of this.

F.H. POTTHOFF III
1814 Pine Village
Houston, TX 77080

Could it be that this "singlemindedness" of the power industry is one of the things that Cochrane was trying to point out in his story? And don't expect the power companies to look kindly on solar, wind, or any other power system that can be purchased and used by individual citizens—who will then be "energy independent" of the power companies!

Dear Ben:

This is to inform Analog's readers of the formation of the Science Fiction Oral History Association. Ever since the advent of wire and tape recording—and perhaps even before that—science fiction events, personalities, interviews, discussions were being recorded. Most of these recordings have disappeared into private collections or simply vanished. Many that survive were made on poor equipment and are so unintelligible as to be useless.

The Science Fiction Oral History Association will attempt to arrange recording of important events at *all*

science fiction conventions. It will sponsor special panels and interviews to preserve information of importance to science fiction history and criticism. And it will attempt to locate and salvage as much as possible from recordings made in the past. Further, it will make every effort to assure that the recordings it sponsors are properly engineered and made with effective equipment.

The recordings the Association controls will be placed in official depositories at major universities where they will be available to fans, students, and scholars, and the Association will sponsor convention projects such as those that recently took place at Con-Fusion: A Science Fiction Oral History Conference; and an Oral History Hospitality Room, where fans had an opportunity to hear speeches, panels, and interviews from conventions they had missed, as well as old-time science fiction radio programs.

The members of the Science Fiction Oral History Committee reflect the broad base of interest in this project: Howard DeVore, representing Science Fiction Fandom; Thomas D. Clareson, representing SFRA and the Academic Community; and Frederik Pohl, representing SFWA and the professional writers. The support of all readers and fans of science fiction is earnestly invited.

To become a charter member in the Science Fiction Oral History Association, please send check or money order for $3.00 to Mary Anne Nueller, 13976 Mansfield, Detroit, MI 48227. Checks should be made out to Mary Anne Mueller.

LLOYD BIGGLE, JR.,
CHAIRMAN

Sounds fine and exciting. But what provisions will be made to prevent "scholars" from making copies of the tapes and then selling them, or broadcasting them on non-profit or commercial radio stations?

Dear Mr. Bova:

While a long time reader of Astounding/Analog this is my first letter in over 10 years. It has been a long time since the late John Campbell and I had some lengthy correspondence over an article of ours on snakebite he published in '66.

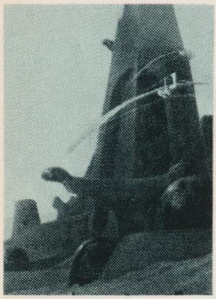
I'd like to complement you and the authors on the lead story in the March Analog: *Stardance*. The authors Robinson are to be commended on their command of both the idiom and the technical language of music and show business in writing an excellent and moving SF story.

While Analog has had some excellent stories occasionally, I would rate most of the rest only good thus leaving a large minority of the balance not up to the standards of the 30's and 40's . . . stories that would be on any reader's all-time great SF list. I'd like to add the Robinsons name to that list and in so doing pay them the highest complement—believe you have a Hugo, Nebula, or other SF award winner in *Stardance*.

A. W. HULETT, M.D.
P.O. Box 338
Charleston, MS 38921

The "standards" of the 30's and 40's are based on the fond memories of the very best stories of that era. If one goes back and reads the magazines, one finds the usual number of clinkers among the gems. But "Stardance" is a gem, by any standard.

JANUARY 1976



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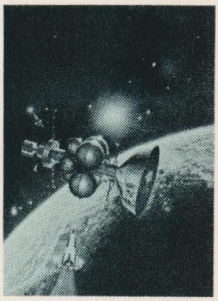

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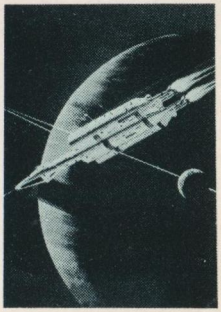

OCTOBER 1976

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