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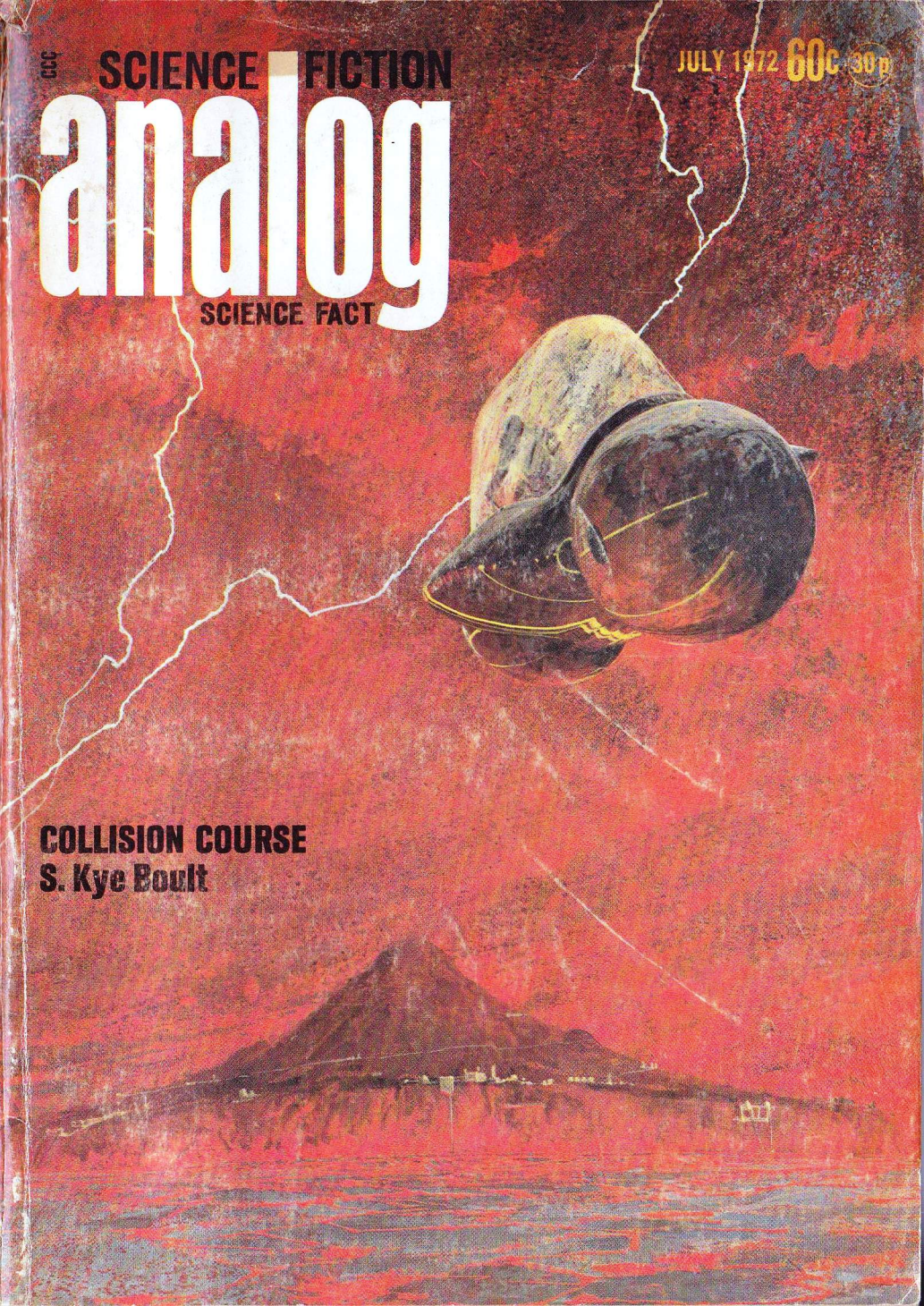

COLLISION COURSE
S. Kye Boult

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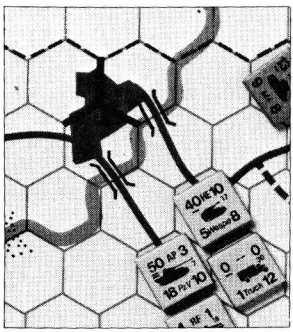

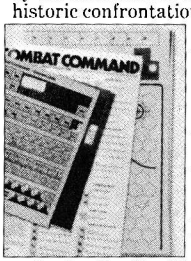

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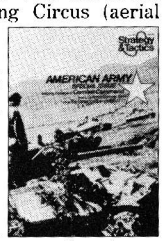

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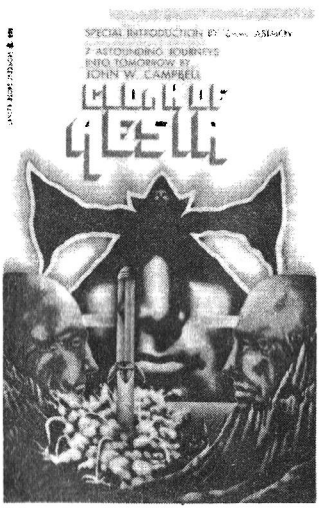

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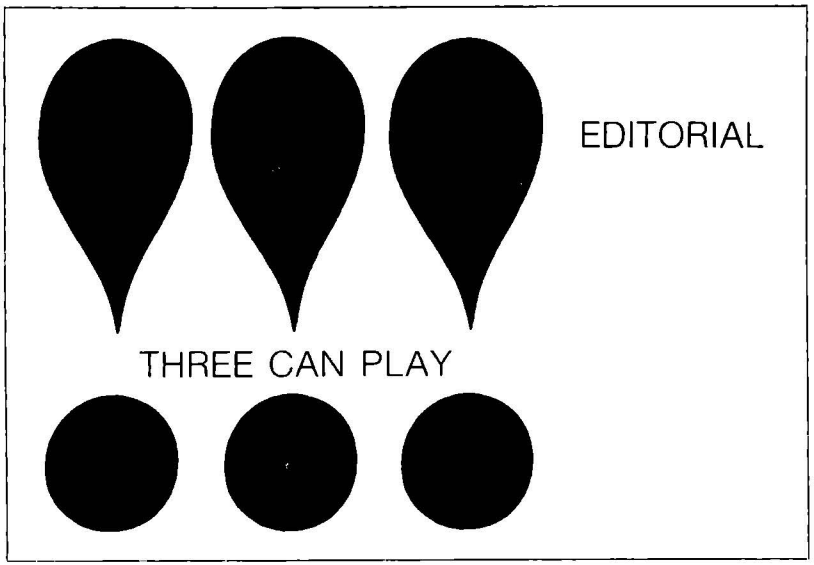


You know that times are changing when *Pravda* and William F. Buckley, Jr. turn up on the same side of an issue.

On the day that President Nixon returned from China, Buckley blasted the visit and the agreement reached between Nixon and Chou En-lai that American forces will eventually leave Formosa. The same day, *Pravda* warned its Russian readers that China and the United States are up to no good.

The world turns!

Back in 1949, when mainland China was falling to Mao's armies, we lived in a bipolar world. There was Them and there was Us. The Communists and the Capitalists. A religious war was on the boil . . . with nuclear weaponry. There were a few people who could see beyond this enmity, but precious few. The United World Federalists dreamed of a sort of super-UN, modeled perhaps on the American system of government. But the real world was very different.

Most science fiction stories of that era were strongly influenced by Cold War emotions, and the chances that it would erupt into World War III at any moment. In addition to a seemingly endless parade of After-the-Bomb stories, there were also the Them-or-Us, Kill-or-be-Killed stories, typified by the late Fredric Brown's "Arena" and Robert Heinlein's "The Puppet Masters."

Beneath the obvious political conflict with Stalin's Russia were powerful emotional factors. Americans

were appalled to realize that our erstwhile ally of World War II greedily gobbled up Eastern Europe and seemed to be taking in China as well. We felt a deep revulsion for Stalin's inhuman tyrannies. We had just finished a desperate battle against another inhuman tyranny: Hitler's Nazism.

World War II, the war against Hitler, shaped America's thinking for many decades after the fighting stopped. It was a Holy War, fought not to impress our political will on another nation, but to eradicate the evil of Nazism. When Stalin's butchery and imperialism became clear to the average American, we immediately transferred our religious anti-Nazi fervor into a crusade against Communism. When China fell to the Communists it caused an enormous emotional impact here. One year later the Korean War started, confirming our fears that Russia and China were out to take over as much of the world as they could.

One result of this was the brief but turbulent career of the late Senator Joseph McCarthy of Wisconsin. He added the word "McCarthyism" to our vocabulary by claiming to find Communist agents or dupes in every office, hallway and rest room in Washington. Regardless of his personal motives, the long-term effects of McCarthyism were disastrous. Although no one accused by McCarthy was ever found legally guilty of espionage, the public uproar and "trial by newspaper" scandals that went with McCarthy's accusations literally paralyzed much of our government and froze our foreign policy into a block of ice. No American politician could speak about Russia or Communist China in terms other than implacable enmity. Not if he wanted to be reelected.

McCarthy was able to use the age-old devices of demagoguery, with the modern technology of television and daily newspapers, to great advantage. Probably without realizing it, he was undermining the one basic liberty on which this nation depends: the freedom to express ideas, to debate openly and decide issues as a result of full, free discussion of *all* sides of the problem.

When McCarthy was riding at his highest, scarcely a word was raised against him anywhere in the nation. But a few science fiction stories cropped up in which the writers examined what the world might look like if a McCarthy type became president of the U.S. It wasn't a pleasant picture.

McCarthy was eventually censured by the Senate. His power and health broken, he died a few years later. But his influence—like Hitler's—remained. Our China policy, in particular, was locked tight. No American politician dared suggest that we try to make some political contact with mainland China. It didn't exist, as far as our official policies were concerned.

Stalin died, and Russia's new rul-

ers appeared willing to blame him for most of the problems of the world. President Eisenhower and Premier Khrushchev began a series of summit meetings. While very little substantive accomplishment came from these meetings, they were crucially important emotionally. They began to remove the religious aspects of the Cold War, the Them-or-Us attitude. It was now possible for Americans and Russians to consider that there were times when they could meet and discuss problems rationally. Maybe it wasn't kill-or-be-killed after all.

Still it was a polarized world. Them and Us. Science fiction stories for years had suggested that what the world really needed was a third power, or the threat of a third power, that would force the two superpowers to work together. In most of these stories, the third power was a Threat From Space. Often, it turned out to be nothing more than a handful of brilliant Earthling scientists who faked the entire Threat just to get the Russians and Americans to work together.

There were many political savants who pictured a strong and resurgent Europe as providing the third force needed to balance the two superpowers. But Europe wasn't then, and still isn't today, interested in playing that role. For a while, India under Nehru sought to lead an informal coalition of nonwhite underdeveloped nations into a sort of third-power po-

continued on page 176

John Schoenherr

COLLISION COURSE

If you were captain of a fifty-mile-long chunk of granite sailing on molten magma and had just been rammed by a floating plateau . . . what would you do?

S. KYE BOULT

Tregaron left his control table and went to look out the aft window, down the mountainside to the glittery rooftops of the Tydfil Complex in the foothills. The recreation city danced and wavered as windblown heat waves tricked his vision. The heat was rising from the open magma bubbling in the wake as Tregaron's granite crustal plate floated down toward the equator. He was driving south and east across the magma headed for the terminator and the nightside with its cold winters. The cold season was necessary for *Fohrfende Crustal* to develop and ripen its prime, hard lumber crop. The trees had been too long on the sunside of the planet—*Fohrfende* had stayed until the last with the Trading Flotilla, here in the North. Now, it was time to hurry and Tregaron was driving hard—Course 165—speed sending earthquake strains quivering along the 16K-rod length of the granite crustal. The power room had passed the cruise speed and was working toward maximum.

The watch navigator signaled. Tregaron walked over to the communicator panel.

"The fourshift planning map is coming through on the printer, sir," the navigator reported. "The Planner should be on the screen any moment."

"How much power is he drawing for the sending?" Tregaron asked. Planner transmissions came from the polar continental plate and required considerable noise clipping and amplification, under some conditions.

"Two hundred megafranks," the communicator tech answered. "The static storm is building up again."

"Yes, you can see the cloud flashes very clearly. We will be in the middle of it by end of shift, heh, Tror?" He put a closed fist on the navigator's shoulder to indicate sympathy with his job. The static flashes would blind Tror's search lasers; hinder his navigation.

"Tydfil," he instructed the comm tech, "get that power data down to Transportation, will you? It will help him with his decision to stiffen the sessile boat power beams."

"Can do," the tech said. He motioned to the comm screen. "The Planner, sir," he announced.

Tregaron turned to the screen hanging in front of the forward windows. The head, shoulders and masked face of a Planner formed amid the static snow—sharpened.

"Planner to *Fohrfende*; Tregaron commanding," the deep, artificial voice began the transmission.

Tregaron stepped into the focus of the microphones and lenses before the comm screen and completed the opening formula: "*Fohrfende*, Tregaron commanding, to Planner. Tregaron here: I have the Top shift."

"Good shift, Tregaron," the Planner said. "You should have your ongoing map developed by now. I'm afraid I have plotted a discontinuity for you. You have been on a collision course with *Deserete Crustal* for a tenshift."

Navigator Tror pointed quickly to the track of *Deserete* and the sharp course change in their own plotted track on the new map, as a briefing. Tregaron flicked his eyes down to the plotting table and nodded.

"We have noticed," he said shortly.

"They are not reporting their true position," the Planner went on. "So I must vector you to miss them. It means two 45-degree course changes: then I will fair you back to your original line with a 12-degree drift."

"That's very close to our 15-degree maximum, Planner," Tregaron said. Drifting a 16K-rod-long crustal sideways had its limits, even on the hot, fluid, northern magma.

"I know, but I want to get you across the terminator in the same window. Any other crossing point means a full Planner conference and replotting at least six more continental rafts. We are at the solstice, and terminator movements are heavy. Follow the plan, Tregaron. You can make it."

Follow the plan . . . Tregaron only nodded. He had no intention of doing otherwise. The Planners controlled the period-by-period movement, the planetwide cruising, of all the moving crustal plates. Moving against their orders, maneuvering over a hundred K-squared square rods of granite without planetary guidance was unthinkable.

"What is your maximum speed?" the Planner asked.

"Cruise 19.5: Max. 22, Planner," Tregaron answered.

"Very well. You will have to sustain your maximum. Start managing your power room personnel.

"Good course, Tregaron."

"On course, Planner," Tregaron replied mechanically. The screen cut off.

"Laser watch," he called. "Do you have a report on that crustal? Can we detect it?"

"Negative, Commander," was the reply. "Just bounce from that vector, sir. Here's the display."

The screen showed the laser sweep pattern. Eight sharp points showed on the lower right segment, but only a blurred sweep trace on the indicated vector of *Deserete.* The hard traces were the Trading Flotilla, moving out of range, south for their crossing windows to the nightside. The blur . . . meaningless.

"Discriminator!" he ordered.

The blur switched to a hard signal but the laser tech objected to it.

"That's not good data, sir," he said. "The discriminator program is rejecting everything except flashback from the course position . . . Rejecting ninety-eight percent of the signals now, sir. It's showing us what we want to see, but it could be anything; static flash, instrument error, electric signal failure . . . Anything . . ."

"Hm-m-m. No ranging, of course." Tregaron knew the value of the signal, but he had to try.

"No."

"Back to normal mode then, please," he ordered.

"Here are the maneuvering orders, Treg." The voice was that of Lleyn, his second commander, come into the control room in advance of his shift.

Tregaron glanced at his timer, he hadn't realized the shift end was so near.

"Lleyn," he acknowledged the man's presence, taking the sitrep log from him. "You are going to get to push *Fohrfende* around a little on your shift, man. Welcome to the Top shift."

He read through the sitrep order quickly. Its four-line summary and orders for the next twoshift—power orders to cut thrust and decelerate to a stop for the 45-degree turn—new Course 120—all entries were correct. He picked up the repeater stylus and signed the order. His signature and the order were being displayed in the power room, deep in the crustal's base, and in the permanent log, duplicating his signature. He waited a second, saw the EXECUTE light flash on, then handed the sitrep pad back to Lleyn.

They both glanced at the thrust power dials on the instrument board to check the needle drop.

"Flotilla going off screen, Commander." The tech called his attention back to the laser display. He watched the hard contacts flicker and drop off the screen edge—one at a time—out of range.

The Trading Flotilla had been close, almost within visual sight, all summer. They had orbited a common center trading and selling their goods and manufacture. The sessile boats had flown between the crustals daily taking touring parties and merchants alike in a free and easy exchange that was the joy of the summer meeting. Now, the Flotilla was broken into individual cruising crustals—driving along their own course lines—guided by the Planners from the polar continent.

They would meet again, the Flotilla members, meet deep in the nightside at their winter rendezvous. The six-crustal Flotilla always wintered thus, helping each other survive the night and the growing season, as they helped with the mutual trading each summer in the dayside longitudes.

The day season had been good for the Flotilla. *Fohrfende*'s towns were rich, its timber farms lumbered and sold, its miners counting coin instead of metal, and all were ready for the winter. *Fohrfende* had had its dayside season, but Tregaron regretted seeing those contact points disappear from the screen. He watched the last one go as he waited for the end of his duty shift. Watched the last one slide off out of sight, leaving *Fohrfende* alone on the magma.

Fohrfende was big, self-sustaining and rich in natural resources and power, but alone . . . Sliding across the molten magma, the long, granite crustal with the high towering moun-

tain peak—her distinctive hallmark and Tregaron's Top control room—moved ponderously under his command, his responsibility, and was alone.

He didn't really need the security of the other crustals in the Flotilla, but they had been welcome. Gone, they were missed, and he knew he would feel pleasure when they showed up at the nightside rendezvous, two periods and half-a-world of lonely cruising ahead.

"Set up a laser ranging watch on the line of position between us and the *Deserete Crustal*, Lleyn," he ordered finally, as the timer indicated his shift end. "And notify the mining towns, Hot Fold #12 and Shear Cliff, that they will be on our forward edge. Better do that a few pulses into your shift. They will need time to prepare for the change in fold-over and shock-wave patterns when we turn."

The two commanders were facing each other now, talking in formal tones. Around them the replacement crew, Lleyn's shift, was taking over from the duty men of Tregaron's shift.

"Very well, sir," Lleyn said. "Do you expect the trailing edge heat to be a problem?" When they stopped to turn, the rear of the crustal, a 6K-rod coastline would be exposed in the open rift that was made by their passage across the magma slag—a lake of 2200-degree heat.

"Not with a 45-degree turn." Tregaron answered. "The agrifields will welcome the extra warmth, with this storm blowing. We will be cold long enough on nightside. Let it be."

"Very well. Your shift is over, sir. Any other orders?"

"No, Lleyn. You have the Top, sir. Good course!"

"On course, sir. I relieve you."

Tregaron stretched to relax.

"Order a sessile boat out for me, will you, please?" That was a personal order, not a crustal-handling order. "I want to take one loop around the forward edge and then I'll be back at Level 50 for rations and bed."

"Will do. See you in a fourshift."

Tregaron took the descent tube, four levels down to the hangar and signed out the sessile boat. The Transportation Chief had it on the ramp and drawing power, but he said: "Hold your slide out until you get ninety percent power, Commander. The static storm is very bad. We've been getting twenty to forty percent attenuation. Flying is very spotty."

Tregaron nodded and pulled the canopy shut. The sessile boat's magnetic motors would fly the two-man craft at forty percent power, but if the power broadcast was attenuated . . . forty percent minus forty percent was zero. He would need all the kilofranks he could draw.

The wait wasn't long and Tregaron signaled the door open and slid out into the buffeting air of the storm. He flew with the gyro controls

engaged to help him ride the swirling air masses and headed for the forward coastline and the mining town which would be on the new leading edge when *Fohrfende* made its turn.

He kept his altitude so that he could see a large section of the coast. The trip wasn't long. *Fohrfende* was structured so that the mountain was closer to one edge than the other; Tregaron normally traveled with that as the leading edge.

The coast and the magma beyond became visible. The magma was covered with the thin, floating crust of metal elements that were light enough to float on top of the magma. They cooled into the thin plate-like slag that covered the molten surface. Along the leading edge, as the crustal moved, this metal shield folded up and wrinkled—the normal fold-over of movement. The bent, broken plates were shoved down under the crustal to be remelted or were shoved aside along the front coast to form the wide shock wave that rode with *Fohrfende* as it sailed.

Already, the fold-over was beginning to flatten out as the thrust came off. In time, if he cruised the coast, he would be able to watch the shock-wave curve around and change direction as the power room applied thrust on the new course. However, he didn't intend to stay that long; he was within sight of the mining town, Hot Fold #12.

They were reacting properly, the miners. The mining probes and grabs were being moved back from the coast. Some of the heavier pieces were already on the roads behind the town. They were having trouble with a grab. Its rocket-driven hooks had been thrown out into a plate of floating metal slag and the crew would have to winch it ashore before they could move the grab. They might lose some buildings if the forward thrust piled the fold-over on them, but they had the rest of the shift before . . .

They would make it.

Tregaron swung the sessile boat down the coast and turned back inland. He slid over one of the foothill farms at the base of the control mountain and grinned at the rows of lightning rods with their streamers of static.

"To everybody else the static storm is a nuisance—a danger," he said to himself. "Only the farmers would find a need of drawing the sparks into the ground to renew the soil nitrogen."

A blue-white flash lit up the boat's canopy. The thunder was loud even through the windshear of the flight. Tregaron blinked his eyes.

The power light went out.

He grabbed the controls and swung the boat flat. Banked in a turn, with no power, the boat could knife into the ground. He hit the emergency accumulator switch with one hand. The magnetics had only five kilofranks, just enough for safety, but they stabilized the letdown.

The boat wallowed to the ground and settled on a slanting hill.

Tregaron growled impatiently, counted fifty pulsebeats and tried a restart. Nothing! The electric storm had knocked out the beamed power somewhere in Transportation's transmission center.

He threw open the canopy and stared up the mountain. The lightning flashes were almost continuous and he couldn't see very far against the glare. He pulled the emergency laser kit and clamped it to the pod frame. He pointed it down the mountain; up the mountain, into the glare, it would be useless.

Behind the boat, down on the coastal plain, was the barrack unit of the farm he had just passed. He sighted his laser at the headquarters building and pushed the call button. The thin light beam was almost invisible in the static glare, but it was self-tuning to provide a collimated beam of the right color for maximum distance, so he knew the emergency receiver at the farm would be ringing its alarm. Emergency lasers were crude, but loud and effective.

He saw the crash callout lights come on, a wide garage door open and the dark shape of a truck start out.

He cut off the laser to conserve his storage cells and put on the boat's locator beeper. Then he sat on the back of the seat, opened a ration pack and made himself comfortable.

The air here on the leading edge plain was hot, over two hundred degrees even at this height up the mountainside, but Tregaron didn't notice it. The cells of his skin held a high concentration of the same light metals that covered the magma. His skin insulated him from the outside heat, but his body temperature was rising; a sure sign he was nearing his food and sleep cycle. The crash rations would satisfy his food needs, but not the sleep part. He would be awake when the rescue truck got to him, but unconscious, near hibernation, soon afterward.

A light earthquake rocked the sessile boat. Tregaron noted it; about Force five—normal for the stopping maneuver. The crustal was easing the strains put on it by the change of power. There would be many small shocks during the turn; no one would notice. Earthquakes on the crustal were common, most people didn't even comment on them. Tregaron, knowing about the turning maneuver, was sensitive to the crustal's strains.

He put a hand over his eyes to shield out the glare and looked toward the coast. He couldn't see any change in the fold-over from this distance, nor could he judge a change in the angle of the shock wave. *Fohrfende*'s cruising shear angle was a shallow twenty-two degrees. At this distance the shock wave still ran straight off into the magma; there wasn't the slightest hint of a curve to the broken slag sheets. The crustal hadn't started to turn yet. Lleyn must

be delaying for some reason.

A movement caught his eye and brought his attention back to the mountainside. The truck was coming across the slope, rolling on its six wheels with the humpbacked motion of overland travel.

They had made good time. He must be down near a road. Valley farmers were wild drivers, but even they needed pavement to get here so fast.

The truck pulled up the hill beside him. It was half filled with a squad of girls and they were singing loudly and happily. The squad leader got out of the cab and came running across to the boat.

She was wearing next to nothing: boots, helmet and . . . next to nothing. Either his laser call had gotten her out of somebody's bed or the dress standards of this farm unit were very skimpy.

"Are you hurt, Commander?" She yelled at him.

"No. Just no power." She knew who he was. Well, that figured. Lleyn knew he was out and when the sessile boat power beams failed, Transportation probably put out an advisory saying that he was down.

"Right!" the girl said. "Leader Ayn, here. I have a contact message for you from the Top, sir. Will you come up to the cab? We're using groundplane electronics, and you'll have to talk in there.

"My girls will load your boat."

She turned and began shouting orders. The truck emptied and the swarm of girls, eight or ten of them, marched to the wreck. The leader's standard of clothing seemed to be the uniform of the day.

Tregaron began to be thankful he was so near to his sleep period. Being rescued by all those bare arms, legs and bodies could be strenuous.

He jumped out of the boat and crossed over to the truck cab. Behind him the squad was attaching lifting slings to the flier to get it in the truck. The singing had never stopped.

"Come in, sir," the driver called. "I've got the connection through to Control."

Tregaron slid into the seat, delightfully close to the driver, and took the headset. His ears were filled with the static crackle of the receiver.

"Just talk," the driver said. "Voice actuated switchover, sir."

"Tregaron, here. Tregaron to Control."

"Control here, Commander. Are you all right? Not hurt?" The static was bad. The recent earthquakes, the tensions and strains within the crustal granite, were producing electrostatic interference in the groundplane transmission.

"No. Not hurt. I'm all right." Tregaron made his sentences short. "What is your message?"

"We have an emergency in the power room. The drive is overheating."

"That's what it is supposed to do. Should be expected on a stop turn, like this. Who's on duty? Denbigh's

drive tech? He's experienced, isn't he?"

"Yes, to both. The heat rise was expected . . ." Lleyn's voice broke up. "This is fluctuation . . . higher than curve . . . times lower . . . Suspect instability."

"I don't believe it! Get the Power Chief on duty!"

"Chief Denbigh is in sleep cycle, sir. That's why I called you."

Tregaron looked at his wrist timer. Half the dial face displayed standard time—the crustal-wide convention of hundredpulse cycle time—the second half, reading from its biosensors, displayed his own pulse time cycle. It, the lower dial half, was already showing an arc of red color. His hibernation time was overdue; it would begin any time now.

"I'm long on sleep too, Lleyn," he said. "There's nothing much I can do about it. You are in Control."

"Are we stopped?"

"Yes, sir."

"Then start up slowly. Watch your time. Get legal working on a presentation. If we have to be late at the terminator and need a new window, the Planners will want good reasons."

"Yes, sir. Same course?"

"Yes, of course. Try to build up full speed. I'll pick up Denbigh and bring him in when I wake up."

"Very well, sir."

"Find out what happened, man. Get me a report that I can . . ." He broke off. A wave of dizziness swept over him suddenly. There was no more time, his body cycle was taking over.

"That's all," he said. "Tregaron off."

He turned to the driver. "Tell your Leader . . . Hibernating . . . not hurt . . ."

Blackness filled his eyes. He blinked them open; one thing he'd forgotten . . .

He would be unconscious in moments . . . With all those farm girls . . . His body functions would be slowed down—way down . . . but there were kinky stories . . .

His hibernation reflexes took over; the smile faded from his lips as he sagged against the seat.

Chief Denbigh took his sleep and recreation periods at Tydfil Complex. He was a slipsand driver and one of the best hippodromes was here at Tydfil's main hostel. The lobby was cluttered with displays of the light, two-runnered slipsleds and pictures of drivers in the horizontal racing position on the walls of the vertically banked hippodrome.

Tregaron pulled Denbigh out of his room in the middle of his rations and canceled his drivers' conference and competition schedule. Using his authority as *Fohrfende*'s Commander, Tregaron roughed over the protests and ignored the paper work. Denbigh, of course, was outraged until he heard about the hot drivers in his power room. That stopped his tirade and he said: "I need a tube station. Are you coming inside with

me?" and walked off, not waiting for an answer.

Tregaron followed him to the reserved tube car he had ordered held for them. Lleyn still had half his fourshift on duty at the Top, so Tregaron had time to visit the power room.

He crowded into the tube car behind Denbigh and sent it speeding deep into the mountain, the rails vibrating under its wheels.

A hundredpulse in, the tube car hit a series of warning lights and came to a stop in a small substation. Tregaron lifted the canopy and stared at the yellow and black barrier blocking the track ahead.

Two guards came over.

"The line's closed," one of them announced. "Set your program back to the main junction . . .

"Oh, pardon me, Commander. You're checking, of course. Shunt your car in the yard, sir. There's no power in the tracks beyond here."

Tregaron got out; Denbigh followed him.

"No, I'm not checking," he said. "I am trying to get the Power Chief, here, to his tubes. We didn't know the track was blocked. What's the trouble ahead?"

"The power tubes, sir. They're overheated. The temperature is too high. We've had to close off the whole level and about two levels above here."

"Too high?" Denbigh jumped on the phrase. "Nonsense, we are on the return side of the system. The working fluid is cooling. Too hot? Who said? Who? Who?"

"The sensor alarms, sir." The guard backed up a step. "They are fifty percent over life tolerance, now."

"On the return side!" Denbigh's voice was shocked. "Treg, I've got to get down. Where's the next drop tube? You know this mountain. Away from my tubes I'm lost.

"Get me down, Treg: before they blow a hole in the magma side."

"There's a cargo lift." The guard pointed. "We came up it when the Warden brought us on duty . . ."

Denbigh started off at a run. The down lift was above them, Denbigh pounded the call button. When the cage reached his level, he tore open the gate and jumped aboard.

"Get me a report!" Tregaron called. "As soon as you know the damage."

"As soon as I fix it!" He fell out of sight, the lift dropping on its express setting.

Tregaron punched up the cage on the up side. He waved at the guards and headed up toward Control.

The lift took him up to within five levels of the Top and he had to hunt for another vertical shaft to get him higher. His knowledge of the mountain wasn't as detailed as Denbigh had assumed.

The inside of the Top control room was all out of balance. No one showed panic—they were well trained, but the groupings were

wrong. People weren't at their customary stations.

The map on the planning board had four navigators working on it. The laser scanner was on sweep and unmanned. A team of five engineers and a girl from the observatory section were leveling a telescope mount at the window—and Lleyn . . .

The command chair was vacant.

Lleyn, his back to the organized chaos, was standing at the window looking out.

Tregaron looked at the power situation repeater and gasped at the red lights. The whole board was on WARN ALARM and a full quarter of it was showing violet indicators—danger levels.

He shut the control room door and fought down the impulse to yell and growl out his anger. The sitrep board was beyond that.

"Commander Lleyn," he said, holding his voice low, but pitching it to carry. "Report the emergency, sir!"

Lleyn turned. "Tregaron! Commander, you are back."

"Yes. And Chief Denbigh is in the power room. He should begin clearing up your board for you. What are you doing? No. First: What happened?"

"A drive unit ran unstable while we were decelerating, sir. It heated up. I reported to you."

"And I told you to handle it. That was a twoshift ago, Lleyn. You don't want to tell me this mess . . ."

"No, sir. With only one unit unstable, Power just shut it off. They were shifting drive units for the course change anyway.

"The trouble started when I ordered full power on the new course. Three drive units went unstable, and the excess heat blew the safeties. Drive heat was radiated directly into the internal power tubes. The working fluid on the riser side is twenty-five percent of magma temperature. Twenty-five percent of 2200 degrees is . . ."

"Five hundred plus. I can work it out. Any deaths?"

"Probably. No reports. The whole ten levels around the riser and the return tube system are hot."

"I met the sentries." Tregaron nodded. "Well, Denbigh will come up with something. He will have to. Do we still have thrust?"

"Yes. The power room is in solid granite down there. Good insulation. We've cut to fifty percent drive, but we're on course."

"Good. Put a man on that power board and make sure the readouts are good, not just overloaded circuits."

"That's not all, sir." Lleyn pointed out the window. "We have something out there in the cloud.

"We got a laser return just a hundredpulse ago, then the screen fuzzed out. We can't penetrate the cloud with any color beam."

"Just one pulse? You could have gotten a sharp cloud return."

"The engineers don't think so. We have a stationary storm cycle out

there; mostly carbonics and chlorines; traces of sodium, but almost no light metals."

"Hm-m-m!" Tregaron said, "And the telescope?"

"They are photographing, sir. A heat plate with a feedback strobe to filter the lightning."

"Good idea; if they get anything . . . Very well, Lleyn, I'll take command now. How much more of your fourshift is left? Do you want to stay on duty?"

"Yes, sir, I'm in good condition. I've ordered rations sent up. You can hold this crew overshift. If you need to."

"I may."

"I have the Top, sir," Tregaron said, formally assuming control of *Fohrfende* again. "Good course, sir."

"On course, sir," Lleyn replied, completing the ritual.

The crowd broke up around the telescope and the girl hurried over with the plate.

"The first plate is finished, Commander," she reported.

"Subobserver, Rhyl," Lleyn said as introduction.

The girl peeled the print off the back of the plate and clipped it into the viewer. The viewer projected onto the hanging vision screen.

"Ah, the laser was right," Tregaron said. The plate showed the flat reds and blues characteristic of heat pictures. Near the upper edge was a double winged pattern of deep blue. Very hot, and significant in its shape.

The caller rang on the power board. The tech said: "Power room!"

"Switch it on!" Tregaron waved the slide off the screen.

"Tregaron!" Denbigh's face came on the screen. He was dirty and wide-eyed, but his eyes gleamed in triumph. He wiped his face and said: "I've cut out the two drive units and stacked radiators into the riser lines. The temperature's going down."

"What caused the heat-up?"

"How do I know. A magnetic instability. The drive units were unsynchronized, then heterodyned. The storm? A magnetic cell in the magma? A mistake in switching when we started to maneuver? Who knows? The men who could tell me are in the drive cells. I can't get at their bodies until the temperature drops to two hundred plus . . . two fourshifts.

"Tapes may tell me something if the magnetics didn't . . ." He shook his head. "I'll clean up down here and start checking. Power tubes should be down to safety levels in a twoshift. Do what I can there."

"You said, 'something in the magma'?" Tregaron glanced at the photoplate. "Could the drives have been damaged from outside?"

"Magnetic cell?" Denbigh considered. "That was a guess . . . Never heard of one big enough . . ."

"How about another crustal drive system?"

"Shouldn't bother ... . Unless the other was deliberately out of sync or

cycling through our drive frequencies.

"Which crustal? I'll check the specs and get some instruments looking."

"*Deserete*, for a guess."

Denbigh nodded and broke the connection.

"Here is the second picture, sir," Rhyl put in.

Tregaron looked at the screen. The same blue pattern was repeated in this plate.

"Can you tell range with that?" he snapped. "The blue pattern, upper right."

"Yes, I think so," Rhyl said. She put both prints on the screen, flicked from one to the other to check the overlap and made a measurement. "Six thousand meters plus," she announced.

"A twoshift at our reduced speed," Lleyn said.

"Less than that, I suspect," Tregaron said. "Observer Rhyl, what was the bearing change on those two plates?"

"Why, no change. The telescope is clamped down. Bearing 120, Magnetic."

"Navigator!" Tregaron raised his voice. "Line of position, 120? What is on it?"

One of the navigators slapped a straightedge on the board. "Our laser contact, sir," he reported. ". . . And . . . the last Planner position for *Deserete Crustal* . . . Way out."

"*Deserete!*" Tregaron said. "It's got to be! *Deserete*—and headed right at us."

"Impossible. They'd have to be sixty degrees off course." Lleyn shook his head.

Tregaron pointed at the communication panel. "You haven't heard from a Planner since that went," he said. "Put a crew on it and get some auxiliary power in here. I want a beam punched through to the Planner!"

"What *internal* comm is working?"

"Main trunks, sir," the board tech answered the question. "All open. Traffic monitored to essential messages and routings. The sealed levels around the power pipes are cut out . . . Admin Two is handling routing to leave us unloaded up here, sir." He cut himself short; the details weren't called for.

"Of course . . ." Tregaron mused. "Punch up Transportation and Communications in Admin Two, will you? Both chiefs on a conference screen."

"Commander," Observer Rhyl had been studying the photos, "that color frequency is about magma temperature. Do you think it is an open rift in the slag sheet?"

"What?" Tregaron had been planning other things in his head. "Oh. Sort of. Look at the shape. That's a shock wave from a moving crustal, Observer. *Deserete.*"

"But . . . 120, Magnetic is Zero, Relative. We're not drifting sideways, on this course: Course 120 . . ."

"I know it, Observer. Zero degrees relative to our course is always our leading edge.

"Whatever is out there, is dead ahead and closing. What is more important; two repeat bearings means a collision course.

"Now, get one more plate, bearing and distance, then convert that scope of yours to vision. We'll be able to see whatever it is, shortly."

The conference screen lit up and he turned his attention to the two chiefs.

"Good shift, gentlemen," he opened. "Emergency orders: clear your desks please.

"Communications: Contact both mining towns on the leading edge," he ordered. "Order immediate evacuation inland to the mountain. We are going to collide with another crustal. This is an unplanned collision, obviously, and the fold-over will be extreme: also the shock. Use your groundplane transmitters, Chief, and keep at it until you get them.

"Transportation: Send out two-man ground cars to both towns: same message. Your men will be back up to Comm, Wheels, but tell them to hurry."

"You want vehicles sent to the towns for evac?" the Transport Chief asked.

"No. No time. They will have to use their own or walk out. Move! Command out!" He cut the channel with a wave of his hand.

"Get the Power Chief back on, please," he ordered.

A navigator spoke up: "The specs on *Deserete* are ready for display, Commander."

"Show me, but cut in the Power Chief when he comes on the line. Don't wait."

A plan and cross section came on the screen. *Deserete* was a flat, low-profile crustal, without a central mountain spline or keel, like *Fohrfende.* Its area was slightly larger, mass about .73 . . . No agriculture. Meat herd economy . . . small omnivores. A hot, disagreeable place. With that low profile, the magma heat would be high, even while it traveled.

Denbigh's face cross-faded onto the screen. Tregaron switched his thoughts.

"Chief, I want all drive cut–zero thrust! Begin deceleration thrust in sector bearing 330 to 35, Relative. Begin now!"

"Zero thrust; can do." Denbigh said. "Cut all drives," he ordered off screen. "Cut 'em!

"Deceleration, negative, sir." Denbigh was still acknowledging his orders formally. "Be advised that zero degrees is the sector where we have three disabled drive units."

"Chief, I'll say it once: We are on a collision course with another crustal. I want our forward motion canceled! As fast as possible. Full drive, if you can do it. But do it! Collision, do you hear!"

"Why didn't you say you were in a

hurry? I'll sychronize them," Denbigh turned away from the screen. "Give me 33, 34, 2 and 5; and tie open the dials . . ."

"Cut him!" Tregaron ordered. "Do you have a Planner for me yet?"

"Commander! I've got visual," Rhyl called.

"Visual? Oh, the telescope. I asked you for a print and range."

"We are plotting it, Commander," the navigator said. "The three plots show *Deserete*'s speed at twenty."

"Time to impact?" Tregaron asked, knowing from the sightings that it would be too soon for him to maneuver *Fohrfende* out of the way.

"Computing . . . three hundred pulses."

"So fast?" Lleyn said. "But a speed of twenty . . ."

"Closing speed, Lleyn: We're moving too," Tregaron said absently.

"Full deceleration, sir," a navigator reported. "Inertial instruments show we are beginning to slow."

"Tell me when we are stopped!" he said and stood waiting, ignoring the time, for Denbigh's drive units to stop the massive crustal; give them some advantage in the coming collision.

"Stopped, sir," came the call.

"Power Chief, cut all motors!" Tregaron ordered. "Communications. Message to all city managers, farm leaders and the mining mayors: *Emergency collision. Sound your earthquake alarm. Operation Class II.*

"That will give them some warning. How about the evacuation?" he asked Lleyn.

"They won't make it. They are moving, but . . . Look!" Lleyn pointed to the screen.

A projected view from the telescope showed the low cliffs of the oncoming crustal. Slabs and pieces of broken slag folded up over its forward edge, broke off and slid to one side or down into the magma under the advancing crustal. The black-spotted, red and orange magma glowed in a flickering, broken line, pierced by spurts and gouts of splashed molten metals—glowed along the front cliffs of the *Deserete Crustal.*

Tregaron stared at the screen, held by the sight. He had never seen the leading edge of a moving crustal block before. It was brutal; magnificent; primitive.

"There it is!" a crewman at one of the windows shouted. "You can see it, between flashes."

Tregaron kept his seat, didn't join the rush to the window. He could see more on the screen. He glanced quickly around the control chamber—the duty sections were still at their stations. Who were all these other . . .?

Oh, yes. They were the oncoming shift. His own shift. Lleyn's crew were overshifting—still on duty until their hibernation cycle caught up with them—the others were faces he knew and welcomed: his own shift crew, coming back on duty.

His eyes went back to the screen and his hand darted to the alarm button. Flashing lights here in the Top, sound sirens all through the mountains and the power center, sent his warning to men who couldn't see the onrushing crustal. He jammed the button down.

The line of glowing magma had doubled in width and the screen was now showing the fold-over of *Fohrfende.* Both crustals were visible in the same scope—on the same screen. They were less than fifty meters apart.

As he watched, waves formed in the magma. A violent splash sent orange fingers exploding into the sky, tore away massive sheets of the slag fold-over. The magma wave action was reflecting back and forth between the crustal edges.

"Attention everyone! Back to your stations!" Tregaron ordered. "Double-man all positions." He magnified his voice with the chair speaker to cut through the excitement and brought everybody hurrying back. Their training was good.

On the screen, the glowing magma was a narrow strip now—turbulent with splashes.

Tregaron tightened his hands on the chair arms and issued an order he'd never expected to give: "Stand by for collision!"

Then, because there was no precedent for what was going to happen: "This may sound silly, gentlemen, but . . . *Hang on!*"

The control chamber became absolutely silent. On the screen, and an equally silent picture, the two crustal edges came together. The fold-over split and shattered at the impact.

Deserete had collided.

The control Top remained silent. There was no movement. Automatically, Tregaron noted that the point of collision was near Bearing 10, Relative—not quite head on. Although he had no idea what it would be like, unconsciously he was expecting a jolt or impact, as in a ground truck crash. He was disappointed in the effect of the collision.

Suddenly he realized that both he and Lleyn were counting in a low singsong rhythm.

Oh, Gods, yes! The shock wave . . . *Fohrfende* was big . . . the leading edge was 2K rods away. The impact would take 10 to 15 pulses to get here through the rock . . .

The floor rose up and down. Dust drifted out of the ceiling and things began to rattle.

Tregaron kept on counting . . . That was the leading shock wave. Behind it the granite of *Fohrfende* would be compressing and stressing to absorb or transmit the energy of impact . . . *Deserete*'s mass . . . the multiple, multiple of its speed . . . the time correction factor . . . He wouldn't have time to work the equation, but the energy would be very large . . . very large.

The shock struck!

The floor slid forward and back, tumbling Tregaron's command chair off its mounts.

The wall-mounted instruments twisted and strained. Two cabinets fell over, sparking power shorts.

The floor rose, fell and jerked again under Tregaron.

The rock ceiling screamed and a roaring, grinding sound tore at his ears.

He rolled sideways to get to his feet and saw the windows, all of them, shatter and break out of their frames.

Then dust and smoke rolled in to hide everything, and the floor smashed him off balance again.

A wind began; blew unchecked through the vacant frames and cleared the dust. It also brought a blast of heat—the open magma channel had raised the coast temperature— forty or fifty degrees by the feel of it.

Tregaron pushed himself to his knees and waited to see if the floor would let him stay there. The hot wind cleared his head a little, too, as it was clearing the control chamber.

The floor was still shaking, but only aftershocks . . . small ones, Force three, or so. The rock of *Fohrfende* was adjusting to the stresses:

Nothing serious. The big one, though . . .

Tregaron pulled himself to his feet, using the overturned command chair. He hauled the chair upright and found Lleyn under it.

He reached for a pulse. Dead? No, strong and slow. Hurt? Hm-m-m, no blood. Ahh, the shock had put him into his hibernation cycle.

"Medic, sir," A voice said. "I'll take him."

"Hibernation," Tregaron reported. "Watch for it. Half the crew in here was overshifting."

"Right!" The medic rolled Lleyn onto a stretcher.

"You got here quick," Tregaron commented.

"On duty on this level, sir," was the reply. "Team of ten. We can't go anywhere else. The corridor's down and the lift is gone.

"Watch your step over that way, sir. There's a big crack."

Tregaron stood up and looked.

Crack? The control room had split open. The medic's 'big crack' was an open fissure in the forward wall, the floor and the roof. About ten meters to his left, the crack dug into half the back wall and probably cut the corridor behind him. The sky was visible through the roof and front wall. The whole mountaintop had split along a fault.

No vital equipment had been hit by the split. Tregaron suspected the designers had known the fault was there, although he hadn't. No equipment was damaged by the fault, but it isolated the telescope crew from the rest of the room. They were moving around their scope; the girl, Rhyl, was looking through an eyepiece. No casualties there: check.

He pulled his log recorder out of the chair pocket and began dictating. The automatic sight-sound secretary would certainly be a casualty.

"The windows, gone, of course. Minor except for the shattered glass hazard. The screen, for comm: Out. Smoking. A wonder it didn't fall out of the ceiling. Power panel: Crew working . . . some lights still showing on the panel. Emergency lights on. Accumulator power, O.K. Navigation: Dust, dirt. Full crew? No, Tror is down. Head wound visible. The rest of his crew looks able, though. No equipment damage, for what it's worth. Those bodies are hibernating, from the way the medics have laid them out. Check casualties, none reported yet. We may be lucky.

"Communications: Worst hit. Two panels down. Either more casualties, or the medics just got to them last. No power.

"What else? Lift and corridors: Reported out. No problem, we aren't going anywhere. Damage control will come to us.

"Power room: First priority, there. I need to back away—break contact with *Deserete.* Need power for that: for everything.

"Observatory crew: They're isolated. Rations and rescue may be . . .

"What the . . .!"

The girl was waving, trying to attract his attention. She was pointing at the scope and out, forward, toward the collision zone.

Tregaron fumbled an amplifier out of the chair and thumbed its switch.

"What do you want, Rhyl?" His magnified voice turned heads all over the room. The sound coincided with another small aftershock and a few of the heads twitched in fear.

"There is an amplifier in the emergency pack, there under the window," he went on. "Get it and we can talk." She could yell, but the wind noise in the open windows made the amplifier a good idea.

Out of the corner of his eye, Tregaron saw the Communications Chief push two men off to collect the rest of the amplifiers. He'd distribute them . . . twelve packs would give him a working intercom, at least.

"Commander," Observer Rhyl had found her amplifier. "I can see vehicles on . . . the other crustal. They are big and they are headed straight towards us.

"I think . . . I think they are going to cross over, sir."

Tregaron found the statement didn't excite him. No one could imagine why a crustal like *Deserete* would collide . . . deliberately crash into another. But given the fact of such a collision, an attempt to cross from one shore to the other . . . for whatever purpose . . . was logical.

He walked down to the window and looked down the mountain. The flat surface of *Deserete* was visible and the dark wrinkled mass of the fold-over line. . . .

Someone put a pair of glasses in his hand. He used them. The long-focus lenses showed the moving vehicles clearly.

They were big. At this distance, any appearance of size at all meant they were as big as a farm barracks. They were all closed up, too; no open cab or truck body; no holes or window that he could see.

There! One of them was crossing the fold-over. The coverup must shield against heat, too. New fold-over was hot, up around eight hundred degrees.

And another coming across. . . .

They were on *Fohrfende* and moving inland.

He saw the tiny red explosions . . . and smoke.

"They are throwing explosives!" Rhyl yelled. "At the mining town buildings."

A whirlwind of voices rose behind

him. Everybody tried to talk at once.

Tregaron grabbed the two men next to him. He handed the glasses to one.

"Watch!" he ordered. "Dictate a running report. You, log it!" he said to the other, thrusting his recorder at him.

Then, using his amplifier: "Hold it! Settle down!" he commanded the rest of the room.

"We can't get out of here. We can't get down there to help. So, let's do what we can do. Run the Top! POSTS!

"Communications, I want two lines opened right now. Any way you can. One: to the power room. Two: to the mayor of the mining town down there. Find him!

"Everybody else. Clean up your section. Quietly. Don't bother the

working brains, troops. I want to hear their gears whine."

The general laughter was close to hysteria, but it relieved some tensions. The crew went to work.

Tregaron kept himself near the communications panel and fought the impulse to go look out the window. Just seeing the invading vehicles wouldn't help. He needed a close-up report on what they were doing.

And his comm lines were dead.

"Commander," the comm tech shouted. "I got the mining town. Groundplane electronics."

An aftershock jarred through the room, causing the comm tech to tear the earphones from his head.

"Static," he said, rubbing his ears. "Aiiee, that hurt! The rock is squeaking and talking, but you can hear him, sir." He handed the headset across and braced the portable comm units he had jury-rigged, so they wouldn't fall off his board.

Tregaron listened gingerly. The noise level was high, but the voice was there, saying: "Forfar to Control," three times in a calling pattern, holding, and repeating the call. Forfar was the mayor of Hot Fold #12.

"Control to Forfar," Tregaron cut into a break. "Report. Report. Report."

"Town overrun by invading . . . vehicles . . . crossing the fold-over. Six on plain inland of town . . . headed for mountain. One destroyed by our action . . . We are engaging with mining gear . . . unsuccessful . . . invader throwing explosive projectiles . . ."

"Acknowledge invasion and your holding action," Tregaron cut in. "Understand you said, one destroyed. Report the method you used. Report method."

"Four men in a mobile slag grab . . . load of liquid explosive. Crashed and detonated against . . . side of crawler. Out of action . . . No prisoners."

"Can you repeat this attack?"

"No. The four men are dead. Explosives storage bunker . . . destroyed on collision . . ."

Tregaron was silent. There wasn't any order or advice he could give. His skill and training was in administering and piloting the crustal on her course, not fighting. Forfar, on the scene, and his miners were already fighting. They didn't need orders from a commander who couldn't see the battle without a telescope.

"Crawler approaching . . . road WA-5 . . . I must pull back . . . Call in at new base . . . Forfar, out!" The weak sputtering voice broke off.

Tregaron handed the headset back and turned to the room. The crew was silent, they had heard only one side of his conversation.

"Observer Rhyl," he called. He kept his voice calm, but used the hand amplifier again, so he could be heard by the whole room. "We have been invaded by those vehicles you saw. The miners of Hot Fold #12 are fighting them. Will you get a vi-

sual sighting on them, with your scope, and plot their position and course? Toss the results across to the navigators, please. I want to see them on the plotting board."

"Commander," the power board operator spoke up, "Chief Denbigh is on the board test circuit, sir."

"Cut in the speaker," Tregaron said. "Let's all hear. We can't do anything without power.

"Chief. Tregaron, here. What is your damage?"

"Whatever could break, broke," the chief's voice rattled the panel's small speaker. "What did you expect? I cut all circuits for safety. Everybody is on local accumulators all over the crustal. Won't hurt them."

"Can you give me a power buss up here?" Tregaron asked. "I need communications."

"As soon as we check the circuit continuity, you are being switched back in. You should have lights and Buss 12A. Tell your comm techs to tap that one."

Tregaron looked at the tech, who was already throwing switches. The man nodded.

"Planner frequency!" Tregaron ordered him. The faraway Planners had to know what was happening here. "Listen first, then contact a Planner with our sitrep.

"Chief," he turned back to the Power Chief's speaker. "How about drive power?"

"Drive? Hah! We are detecting drive units at full power, not fifty meters out. I am plotting their frequency for synchronization with ours right now. We have too many drive units at present. All working the wrong way."

"I want to pull away from them, Chief. Did the earthquake damage you physically down there?"

"No. The magma distributed the shocks. We are designed for severe quaking down here.

"But no drive, Commander. I can't use *Fohrfende*'s drive."

"What? Why?"

"To back away. Not possible. The magnetic disturbance of the other drive units out there. I can't use any unit on our leading edge . . . Units 32 through zero, to 5 . . . Impossible. Not with those other drives working. Our units would heat to explosion in a tenpulse . . . Hole us into the magma."

"Very well. Get back to me when you know what thrust units I *can* use," Tregaron was unnaturally calm. If he couldn't back away from *Deserete,* he didn't know what to do. "Check them carefully, Chief. I've got to have some mobility. I've got another great crustal stuck on our nose up here."

"Understand. I will do so," the Chief replied. "The other crustal *can* back away by itself, if we don't use our driving units. Consider letting them start the action."

"I think they already have. We've been invaded by big, crawling trucks, throwing explosives.

"Give me power, Chief. We're going to need it."

Chief Denbigh cut the circuit without replying. Characteristically, he preferred action with his switches rather than words.

The control room lights came on. The instrument boards lit up—mostly red and violet, but lights that told a story to the technicians and gave them something to do. The overhead lights were missing panels, broken units or shorted circuits, but they were brighter than the emergency lamps. Denbigh was contributing to the shift morale at least.

"Admin Two has a call in, Commander," the girl comm tech reported.

"Tell them what you've heard, Ayn," Tregaron ordered with a wave. Admin Two was the second control center on *Fohrfende,* further down the mountain. "They are to handle all emergency repair and rescue, and administration. I will handle power and conn only from here . . . for a fourshift at least. If we can't do it by then, we may never get out of trouble."

"Go on, Ayn. You know as much about our situation as anybody."

The girl nodded and began talking.

Tregaron walked over to the plotting board. Somebody had torn two map pages out of a bundle and cut out the outlines of the two crustals to tape down on the board—over the course lines.

A navigator—also a girl, Canna—was inking blue circles on the forward plain of *Fohrfende,* blue circles with course lines slashed through them. She was plotting the crawlers from a message paper thrown across the crack by the telescope crew. As Tregaron came up, another message was brought up across the room and the course arrows were extended.

The blue arrows focused on the mountain; on the Top location; here. The crawlers were headed this way.

Well, there wasn't a thing he could do about them. The only thing he commanded was the crustal, *Fohrfende,* itself. Maybe he could turn and scrape down one side of *Deserete* and slide by . . .

"Comm. Order Admin Two to evac all mining towns. I'm going to try and slide down *Deserete*'s side. The fold-over and magma damage to the towns will be . . . Wait! Magma . . . Magma?" He changed his mind, canceled the instructions with a wave of his hand.

"Navigation, let me see a cross section of *Fohrfende!"* he ordered. He had a wild idea. The mountain and the granite crustal he rode was solid, firm; the magma it floated on was not. The magma was liquid, unstable . . .

The cross section was spread on the table.

"*Deserete,* too, sir?" Canna asked. She put the other sheet down.

Tregaron studied *Fohrfende.* Below the surface, below the magma, *Fohrfende* had a great bulbous underbody extending down into the magma, with a mass and depth suf-

ficient to balance the tall mountain spine that held the Top, and the recreation cities. *Deserete,* on the other hand, was a flat, floating slab, almost equally distributed above and below the magma throughout its entire area.

The facts that made Tregaron's glimmering plan suddenly seem practical were the location of the mountain and the under-magma bulge. They were well forward on the crustal as it now lay against the low shoreline of *Deserete.* Above the magma, on the surface, *Fohrfende* presented a short plain, then the rise of the mountain. Below, the granite was shaped like a blunt spearhead pointing at *Deserete* and with a great stabilizing blade deep in the magma. The farming fields and flatlands of *Fohrfende* spread out behind the mountain, as it was now oriented. They would be protected in what Tregaron intended to try. The great mass of the crustal, the mass he was going to use to its fullest, was here, under the Top, forward and close to *Deserete.*

He ran his finger down the sloping ramp of the under-magma leading edge as it was shown on the cross section. The shape was right; his idea would work. If . . . If there was power enough.

"Open the circuit to the Power Chief!" he ordered, then walked over to the panel. "I'm going to smash up some of their coastline.

"Chief," he said into the comm grill. "Give me full power on all aft drive units. Unit 18 and as many on each side as you can. Course Zero, Relative. I'm going to ram *Deserete* out of our way!"

"Huh! If we start up, they won't be able to back away, Treg. We will heterodyne their forward drive units just as they are doing to ours now."

"Full drive, Chief!" Tregaron ordered. "Can do?"

"Hm-m-m. We *have* analyzed their field and I can synchronize anything aft of our center . . . Yes. Can do!

"Full drive on all aft units. Course Zero, Relative." Denbigh repeated the order and began yelling at his crew.

The power tech switched off the speaker and began working with his panel. A row of lights came on . . . and three dials lit.

"Well, I'll be . . .! The circuits work." He was amazed. "That's power. That's forward speed." He was pointing to his dials. "Do the repeaters work on the navigation table?"

"No." came the short reply. "I can see those, though. No need."

Tregaron walked back to the center. His chair was broken, so he stood, but this was where the crew was used to seeing him.

A technician took station beside him with the amplifier. A three-man message relay team was in position by the cracked floor to get things from the telescope crew. A busy group was snaking an electronic cable across the gap to jury-rig a por-

table vision unit. Men and girls all through the room began to hold at their work stations rather than drifting aimlessly. Tregaron's fourshift crew tightened around him, waiting.

The power lights flickered and began to go green. Unit 18 . . . 21 . . . 15 . . . 24 . . . 12 . . . Then the small ones in between. The power scale ran quickly up to fifty percent, then more slowly, into the full power sector.

The control room floor lifted, rose and fell, then jerked forward and back—a quake.

The jerking motion of the ceiling tore the rest of the overhead screen loose; ripped wiring cables and sent it crashing noisily to the floor. Tregaron braced himself against the motion. The granite was taking up strains relaxed during the collision. The drive power was restressing the crustal against the pressure of *Deserete* on the forward edge.

The power crept up toward the red line. The motion indicator showed nothing.

The power built up. Something would give soon. *Fohrfende* was more massive . . . even from a standing start she should be able to push *Deserete* on the unresisting magma. It might take time, though.

The technician at his side tapped his arm, indicating the vision screen. The jury-rig was complete; the portable screen was alight.

Rhyl's telescope picked up the crawlers at the base of the mountain first, focused on them so that the bursts of gas when they launched their explosive projectiles were visible, then began to lift the angle of sight to look at the coast.

"The crawlers aren't moving," one of the navigators commented. "Maybe they've found out *we* are moving."

"More likely they are tossing explosives at the Tydfil recreation complex," Tregaron said. "We haven't moved. And we are near max power."

The picture now on the screen showed the fold-over and a wide strip of glowing magma.

"They've backed off! Aiiyee!" A cheer went up at the sight.

"Hold it!" Tregaron used the amplifier. "Don't get happy. We are driving against them. If they back away, *Fohrfende* should move to follow.

"Power board. Check that motion dial, Yeovil. Is it working?

"Rhyl, can your instruments tell whether that is a gap in the magma . . . or what?"

"I'm putting a pyrometer on it now," came her amplified reply. "OH, LOOK! Waves. And more crawlers. The magma!"

The telescope had picked up six more crawlers, moving on the plain of *Deserete.* They were in line along the magma, as if looking for a way across, when a sudden wave—a heaving surge in the magma—lifted toward them, engulfing all six and spreading the strip of magma into a wide lake, three times its former size.

As Tregaron watched, another surge swept outward and the lake became wider. He was stunned for a tenpulse. Those crawlers—they had had men in them—were gone in a heartpulse.

Then he shook himself and began a wide grin of triumph. *Fohrfende* was pushing up the magma to make those waves; squeezing it out by driving against the coast of *Deserete.* He was winning. *Fohrfende*'s thrust was pushing the other crustal.

Another series of quakes rattled the room. The floor crack groaned loudly, but there was no movement of its edges.

"Commander," Navigator Canna called, "look, sir. We think that *Fohrfende* is driving up on top of *Deserete.*" She had plotted the two cross sections on the board and moved them together to animate her theory. The leading edge of *Deserete* was plotted as being driven deep into the magma by the mass of *Fohrfende* and the shape of her leading edge.

"This would be magma in here, sir. The lake we see." She ran her finger along the diagram.

"I believe you are right," Tregaron said. "That's about what I had in mind. I didn't think they'd tip so easily, though."

He looked at the screen, with its glowing magma lake, and again at the power dials. The dials showed levels near the red danger line.

He reached out for the amplifier.

"Yeovil, get me Chief Denbigh!" he ordered the panel tech.

"Communications, put out a notice on the Planner frequency: *Fohrfende* to . . . No. No need to sign it. Just say: Cut your power or we'll tip you over. And repeat it."

"Can we do that, sir?" the tech with the amplifier asked in a low voice.

"I don't think so, but they don't know it, and I'm damn well going to *try* to drive right over them if they don't get out of the way.

"Chief," He strode over to the power panel to use its comm speaker directly. "We are close to red-line, but I need more power. I am driving them under the magma with our leading edge. That's my plan and it's working." That was enough briefing, Denbigh knew the under-magma shape of the crustal as well as anyone.

"More power, Chief! What are your reserves?"

"Forget your stupid gauges!" Denbigh snapped back. "I'll tell you when my drives are at maximum."

Tregaron smiled. "Good. Now, Denbigh, let's rock them a little, besides. Can you vector us fifteen to twenty degrees, Relative . . . from one side to the other? Hit them left and right?"

"Easily. Cut down on one side; more boost for the other. You'll wag our tail, though, Treg. You aren't flying a sessile boat up there, you know."

"I know.

"Do it left, Relative, first. Keep this line open and I'll order the

switchover when I see the movement."

"Begin left vector. Power to half on left rear quadrant. Power to boost on right rear quadrant. Standing by to reverse sequence." The Chief repeated the order and left the line abruptly.

Tregaron went back to looking at the screen. He saw the power lights on the panel change, out of the corner of his eye, but his attention was on the viewscreen.

A wind began to blow in through the broken windows and people scattered to hold down papers. Dust filled the air for a moment until the wind sucked it out the window openings again.

The wind was blowing stronger than before. Why? Ah, an air mass, caused by the open magma lake, moving up the mountain as it passed. Of course wind, but the lightning storm seemed to have died away.

Tregaron saw the movement he was looking for; the fold-over started slanting, slipping and breaking away. Then the surface of the magma began to vibrate—ring ripples, crossing and intersecting, shivered out from *Fohrfende*'s leading edge. The surface of the molten lake began to jump and spread across the *Deserete* plain.

The sound began, too. A grinding in the air, that grew to a roar and started loose metal shaking, to add to the noise.

Denbigh, shifting the crustal's drive vector, was turning *Fohrfende;* rolling the right corner of the great, square front up onto the flat cliff of *Deserete;* tilting it deeper into the magma.

Tregaron, relying on his visual instinct for *Fohrfende*'s inertia, ordered: "Chief, reverse your vector! Right vector! Same setting."

"Right vector. Phasing, now!" Denbigh's voice repeated.

The noise increased. Tregaron saw the fold-over come alive. Sections broke off, buckled, snapped into the air, and slid into the magma. *Fohrfende* rolled massively to the right, now slid its left corner over *Deserete* and rocked the half-submerged crustal in the opposite direction.

A wave pattern developed in the magma; a combined surge and chop that flowed across the glowing surface, kept it agitated, in turmoil.

All he could see now in the scope field was magma. None of *Deserete*'s land was visible. He signaled to Rhyl to lift her line of sight. His amplifier couldn't make headway against the noise. And the grinding, scraping noise level was rising, flooding in through the broken windows.

Instead of lifting, the scope slid swiftly to a view of the invading crawlers, the ones on *Fohrfende*'s foothills. They were still. No projector smoke. No motion.

Tregaron read Rhyl's swift note, handed up the relay to him: "WE THINK THEIR POWER HAS BEEN CUT."

He went to the power board and

reached for a headset. He couldn't give orders in this noise.

"Cut all power, Denbigh. As fast as you can," he shouted into the set. "As fast as you can without breaking anything. Check your detectors. I think *Deserete* is out of power."

"They are," came the dimly heard reply. "Their drive magnetics disappeared a tenpulse ago."

"Very well! Then increase power at Bearing Zero, Relative, Denbigh. As you cut down. Back us off!"

Tregaron stayed by the panel, watching the Chief's switching and power control as displayed in the indicator lights. He balanced himself, swaying with a sequence of small quakes. Two . . . three . . . four . . . each a tenpulse apart and short, the quakes rolled through the control room as the crustal redistributed its strains again.

The noise grated a final wave up from the coast and stopped, leaving aching ears.

"The screen!" The cry was a scream.

Tregaron whirled.

Observer Rhyl had brought the coastline back into her telescope's focus in time to catch the broken leading edge of *Deserete.* The sight had brought a scream of alarm from the watchers.

Deserete was rising out of the magma lake, rising higher and higher. *Fohrfende* had been driven up over the leading edge of the desert crustal, forcing it down into the magma. Now, as the reverse power backed the two crustals apart, *Deserete* was rising: flung buoyantly up out of the molten depths.

The telescope was on high magnification, and the portable viewer was a small window, but the sense of great catastrophe wasn't lessened by the limited view.

The edge of *Deserete* was a high cliff now, all along the forward edge of *Fohrfende.* Runnels and rivers of yellow-red, glowing magma streamed off the plain and spattered down the cliff side.

And still it rose. The energy *Fohrfende* had transmitted to the *Deserete* crustal mass was all released in one buoyant leap upward.

Then it started down—*Deserete*'s leading edge—and Tregaron could see an increase in the glow of magma activity on the surface of the crustal. A wave—a splash—of molten matter rushed at him, magnified by the telescope.

The leading edge came down, sank a little, rose and hunted its equilibrium in a long oscillation. *Deserete* was floating level again.

But it was not the same. The desert was gone. In its place was a magma lake that had been dipped up by *Deserete*'s diving action. A glowing, liquid cover, already beginning to scum over with purples and grays, as the light metals floated and blended to form the insulating slag.

"That's a dead crustal, Commander," Observer Rhyl's amplified

voice broke the silence. "My pyrometer is off the scale."

"Dead or not, it's lost," Tregaron said. "The magma covers the flat desert as far as I can see in the scope field and it's slagging over. That will keep it hot underneath the scum.

"Any rescue of survivors will have to be a Planner problem from now on. We can't do anything.

"We might be able to put up a sessile boat in two fourshifts and come back to look at it. But not now . . . Any communications?" he asked.

Deserete had made no attempt to contact them before the collision, but they might be putting out a distress beacon now.

"Nothing yet, sir," was the reply.

"I wouldn't think so.

"Ahh . . . Log the position. Beam a report to the Planners as soon as you can get a line to the poles.

"Meanwhile, let's get away from here and back on course. If we can find out where we are."

"I have the running plot, Commander." That was Canna, the navigator who ripped up map books. If she had kept up her dead reckoning in this shaking and howling . . . a promotion was due her.

"Course, Navigator?" Tregaron asked. His control Top was a shambles and there was a dead crustal off his bows, but he put his hands behind his back and asked the question as if he had just come on shift.

"Turn right three hundred degrees to Course 60. Our turning radius will clear *Deserete,* then we can begin a ten-degree-per-fourshift drift. That will take us back to our terminator window."

"Do you still estimate we can cross the terminator in the same window?"

"Easily, sir. Actually we are committed to that window until we can get an ongoing update from the Planner, so I had to plot it. It won't be hard, sir. We don't have to make our second course change to avoid that . . ." She pointed at the viewscreen and *Deserete*'s cooling hulk. "We can make the crossing window using cruise power. ETA at the Flotilla rendezvous will be unchanged."

"Hm-m-m. Cruise power, heh? Chief Denbigh will like that, at least.

"Very well. In the absence of Planner contact we can plot our own course . . . I don't like it, but we can't afford to miss our plotted window.

"Make it so, then!

"Power Chief, please," he instructed the board tech. "Denbigh: Right standard 300-degree turn to Course 60, Magnetic. Set cruise power; ten-degree drift; right, Relative."

The chief's voice, repeating his orders, rasped from the board speaker. Then; "Did we win or are we running away?" he asked.

"We won," Tregaron said briefly.

His mind filled with a mixed picture of the damage to *Fohrfende*; the earthquake faulting, collapsed tunneling, torn and destroyed mining towns, explosive damage in Tydfil Complex, the broken windows, un-

workable circuits, smashed equipment: damage he knew about. Soon he would have to contact Admin Two and find out about the rest of the crustal; problems he hadn't even heard about yet.

"We won," he muttered. Even thinking about the full damage report and the problems ahead staggered him.

"Planner circuit open, Commander," the comm tech called. "Planner coming on. No vision: just voice. Focus mikes are working, sir."

Tregaron nodded and stepped in front of the microphone and vision pickups out of habit. He was standing with his feet in the wreckage of the overhead vision screen, scattered on the floor. The broken lenses of the pickups followed him.

"Here he is, sir," the comm tech said.

"Planner to *Fohrfende*: Tregaron commanding." The faraway voice of the polar Planner was calm and unhurried. "Tregaron, I am afraid we must give you a course change to your terminator window. Your new course is Course 60. Then set up a 10.5-degree-per-fourshift drift . . ."

Tregaron glanced at the girl navigator and grinned.

"Our instruments indicate you are not receiving your ongoing map printout. You will have to utilize dead reckoning procedures until equipment repairs can be accomplished." The Planner paused.

"Understand. Repairs in progress," Tregaron said into the pause.

"What is your speed?" the Planner asked.

"My speed is 19.5, cruising; 22.5, maximum," Tregaron replied.

"Very well. You may maintain cruise speed on this new course. You can relax your power room personnel requirements.

"Good course, Tregaron."

"On course, Planner." Tregaron put a little pride in his voice. Pride for the shift crew around him and Denbigh, deep below. The Planner hadn't asked about the collision; reports would be compiled and sent, the incident investigated, but the Planner was concerned about the long view: the planetwide movement of the crustals and *Fohrfende*'s course and speed were more important than the other details. That was the reason for the pride.

Wrecked and damaged, with invading crawlers still to be handled, *Fohrfende* was still under control and moving to Flotilla rendezvous. Tregaron's pride was in the report: *"On course."*

He walked back to look at the plotting table. All of the map bits and scrap papers were off the map grid and the girl, Canna, was taping in the new course.

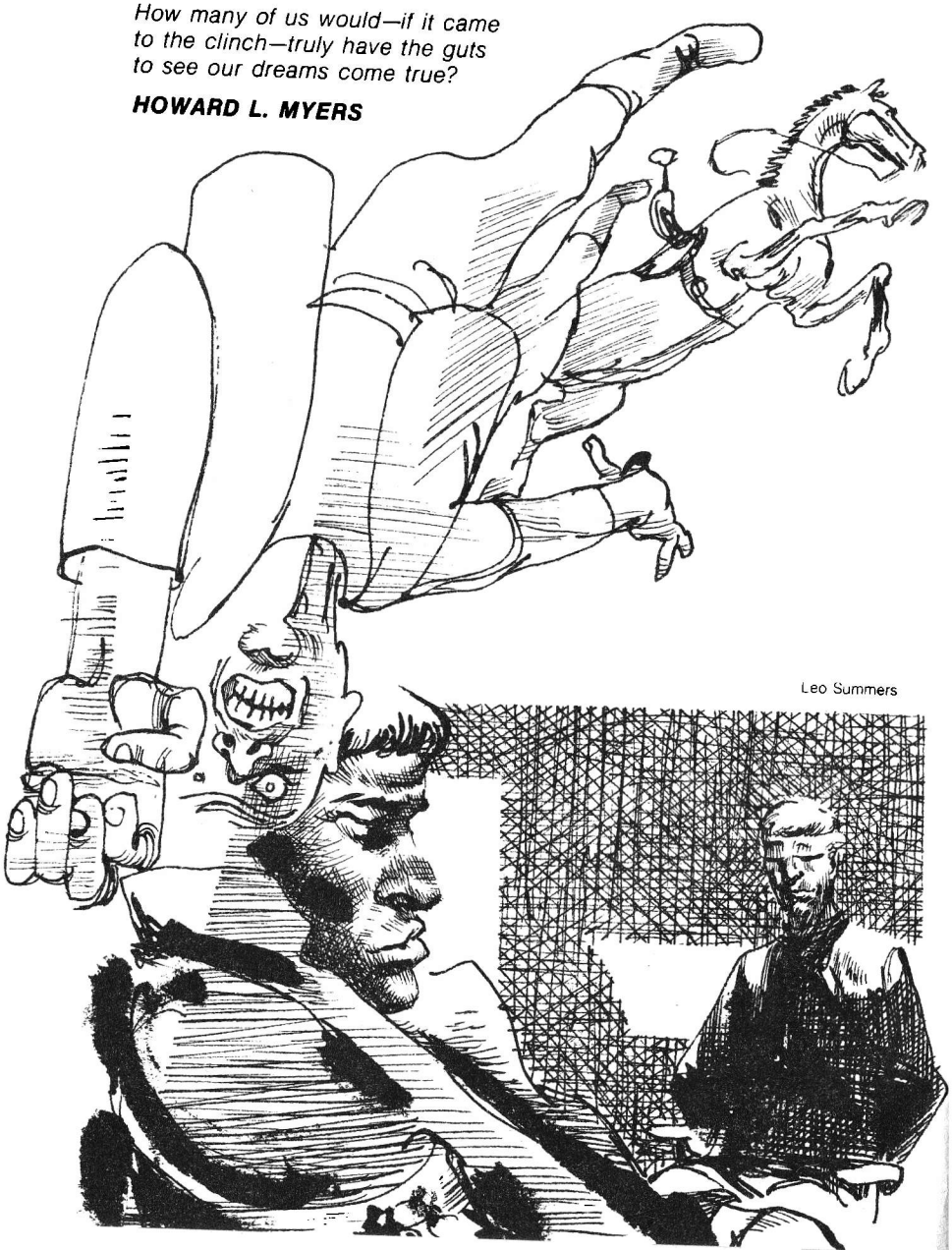
Business as usual.

He looked at his wrist timer. It was still working and showed a little less than half of his fourshift still to go: time to get in a few rations and start on his problems. ■

MAN OFF A WHITE HORSE

How many of us would—if it came to the clinch—truly have the guts to see our dreams come true?

HOWARD L. MYERS



Leo Summers

This was the real thing. Barfield was gloriously sure of that. Not just a dream, like it had been a thousand times before. This time he was really astride a powerful white stallion, drawing looks of admiration, fear, and respect from hundreds of upturned faces as he rode through Central Park.

It couldn't be a dream, because he never thought to wonder about that when he was dreaming. And a dream wasn't this real.

Just to make sure, he studied the reins gripped lightly in his right hand. Genuine leather, all right, with blood-red rubies attached in little square silver mountings that were pointy at the corners. Certainly no dream contained detailed stuff like that.

Was he going to fall off? Not in a hundred years! The dream intensifier had finally worked, and simply by dreaming of riding, he had learned to ride.

A family of picnickers scattered in all directions as he galloped his horse over their spread cloth. He roared with laughter to see them jump, their faces pale with terror. He towered over them for a moment, then rode on . . .

. . Into a swarm of high-society chicks having a lawn party. He picked a choice one and swept her up in front of him.

"Barfield!" she exclaimed, recognizing him.

"Yeah." He knew who she was, too—Jacqueline Onassis' granddaughter—but he wasn't going to give her the pleasure of letting her know he knew.

He stood in the stirrups and quickly had his satisfaction with her. Then he let her slide from the horse to sprawl panting and indecent on the grass.

His horse was now climbing a hill, going up fast in powerful lunges. All the world lay below him, below the magnificent Barfield.

They topped the hill crest. The down slope on the other side was dizzyingly steep. Barfield gasped and cringed back. His left foot lost the stirrup and . . .

. . . He was falling!

"Ugh!" he grunted as his body gave a jerk. He opened his eyes and gazed dully at the captive across the room for a moment.

"Something wrong?" the man asked in that annoyingly confident voice of his.

"I must've dozed off," said Barfield.

He stood up, feeling as short, dumpy, and ineffectual as he knew he looked, and walked over to check the captive's cuffs and blindfold.

"We haven't been properly introduced," the man said pleasantly. "My name's Paxton . . . G. Donald Paxton."

"Never mind the chitchat, Body," Barfield growled. Usually a captive would show fear when addressed as "Body," but this guy didn't turn a hair.

He saw the cuffs were still tight on wrists and ankles, and returned to his chair, his mind returning to his drea . Funny how real it had seemed, and hov sure he had been of it. Looks like that high-society party would have been a dead give-away. Everybody knew upper-crust chicks didn't fool around in places like Central Park. Besides, there'd been something on the tube about that girl dreaming herself up a judo black belt. Nobody was going to grab *her* up on a horse and get away with it.

But it had been a good dream—all but the last part.

"I hate to be a nuisance," said Paxton, "but I need to go to the bathroom."

Barfield got up. "No sweat, Body." He got out his keys and removed the cuffs from Paxton's ankles. "Stand up." Paxton stood, and Barfield guided him into the bathroom, where he refastened his ankles and freed his wrists.

"I'm gonna close the door, and then you can take off the blindfold," he instructed. "When you're through, put the blindfold back on and call me. Try something funny, and there ain't enough ransom in the bank to keep you alive. Got it?"

"Yes. Thanks very much, Friend," said Paxton.

Barfield thought a few cuss words. What kind of nut was this guy, Paxton? Acting like he didn't have a care in the world, which was no way for a kidnap victim to act.

Presently Paxton called him, and Barfield opened the door and returned the man to his seat.

When they were settled down Barfield said, "You don't catch on, do you, Body? You stand a good chance of getting conked. You dig that?"

"Of course," Paxton nodded, cheerful as ever. "As an attorney, I'm quite familiar with the kidnap racket and its practices. I believe the general rule is to kill one out of four victims, to keep the public aware you mean business."

"One out of three," Barfield corrected, grimly. If Paxton had said one out of three, he would have replied one out of two. But again the victim showed no sign of intimidation. "You figure the odds are in your favor, huh, Body?"

Paxton shrugged. "If not, everybody's got to die some time, Friend," he replied with a mild chuckle.

"Well, if I don't hear soon that the payoff's bein' made, your time's comin' pretty damn soon," Barfield glowered. He looked at his watch and blinked. Five hours had passed since Stony Stan and the other guys had brought Paxton in. He ought to have heard from Stony long before now.

Paxton seemed to realize that. "I'm afraid I have enemies as well as friends," he said. "That could delay the payoff."

"Friends?" grunted Barfield. "What about your family?"

"No family. The ransom will be collected from my friends, or business associates might be more accurate."

Barfield frowned. Stony Stan never told him more than he had to know about a job, which was damn near nothing. Barfield's job was to baby-sit the victims, and then drive them to the release or conk-out point. So maybe this wasn't an unusual job, so far as he knew. But it seemed risky to expect a payoff from a guy's buddies instead of his relatives.

"What kind of line you in?" he asked.

"I'm an attorney, as I think I mentioned. Actually, my position is general secretary of a union."

"Big operator, huh?" glowered Barfield. "I got a hunch you're goin' to be the one out of three, Body." He stared at the blindfolded man in resentful silence for a while. A damned union boss, and Barfield couldn't even get into a union as a member!

"Which union?" he finally asked.

"American Bar Association."

That didn't win any sympathy from Barfield. He knew several barkeeps, and thought most of them were jerks.

"Your friends better come through pretty damn quick," he said.

After a silence Paxton asked, "Do you know you talk in your sleep?"

"Huh?" Barfield sat up. "What did I say?"

"It sounded as if you were talking to a horse. Were you having a dream about riding?"

"Yeah." Barfield's thoughts returned to the dream.

"It sounded like a good one, except perhaps at the end," Paxton said.

"I fell off the damn gluepot," Barfield said in injured tones. "I always do."

"I do a little riding," Paxton said modestly. "It's very pleasant exercise, don't you agree?"

"Me, I couldn't say, Body," Barfield retorted. "I can't stay on top of a damn pony."

"Oh? That's too bad. Why don't you get an intensifier and let your dreams teach you how to ride?"

"Look, I already told you," Barfield snapped, "I keep fallin' off at the end of the dream!"

"Oh, yes. That would invalidate the dream-learning procedure, wouldn't it?" Paxton said.

Barfield grunted.

"That's said to be why there are so few levitators," Paxton went on thoughtfully. "Many people have dreams of floating through the air, but the overwhelming majority of those dreams end in crash landings." He chuckled. "Of course when someone has that dream under an intensifier, the technique of levitation becomes clear to them, but the crash at the end becomes equally realistic, and traumatic. As a result,

they actually have the waking skill of levitation, but the trauma is a total block that keeps them from ever using the skill. It never occurred to me that the same condition would apply to dream-learning how to ride a horse, but I can see now why it might. Effortless motion is involved in both—suddenly becoming very effortful."

"How come a mouthpiece knows so much about dream-learnin'?" Barfield demanded.

"An attorney has to know a little about a lot of things," replied Paxton. "I've never used dream-learning myself—never felt the need for it, really—but I have several acquaintances in the dream-psychology field, and have discussed the subject with them frequently. Just a couple of weeks ago—"

Paxton's voice trailed off. Barfield was thinking of Stony Stan, who could levitate. That ability of the gang's chief was very useful in pulling kidnappings. In fact, it was their secret of success. But just the same, Barfield cherished the hope that some day Stan would lose control and fall to the ground and burst open like a rotten apple. That would be fun to see happen. If what this guy Paxton was saying was right, Stan had never dreamed of falling, didn't know the helpless terror of it, and the damn bossy bastard had it coming to him.

Barfield blinked suspiciously. "Yeah? What about two weeks ago?"

"I beg your pardon?" Paxton smiled brightly.

"You said something about two weeks ago, and then shut up. What is it?"

"Oh, nothing. I merely decided I was boring you with all my chatter about dream-psychology."

"The hell you say," growled Barfield. "You're tryin' to hold somethin' out on me! Start talkin', Body, or I'll conk you right now!"

"Well . . . it was just something this acquaintance was telling me about recent research on the fall-syndrome. Really, Friend, I don't think you want to hear this."

"Keep talkin'," Barfield commanded. He wasn't sure he wanted to hear any more about falling, either, but making victims obey him was one of the pleasant things being in this racket.

"If you insist," Paxton shrugged. "He said they've discovered the cause of the fall-syndrome."

Barfield started. "Is that the straight stuff?" he demanded.

"Oh, yes. The man I'm speaking about is one of the top experts in the field. I'm sure he was right."

"I mean are you *givin'* it to me straight?" yelped Barfield in exasperation.

"I have a precise memory of the conversation," replied Paxton. "An attorney has to have a—"

"I mean, are you tellin' me the truth?" hissed Barfield.

"Oh. Yes, of course. Sorry I didn't catch your meaning sooner, Friend."

Barfield sat back in his chair. He was inclined to believe this guy. "What does cause it?

"The fall-syndrome? Fear . . . but oddly enough, not usually fear of falling. That's why it stumped the dream-learning specialists for so long. It can be fear of almost anything, but is usually a realistic fear, based on feelings of guilt."

"Hah! I ain't afraid of anything! Except fallin'."

"Well, it can be fear of falling, of course," said Paxton, "but is usually something else. I suppose, then, you have a fear of high places—acrophobia, it's called."

"Hell, no," grunted Barfield.

Paxton paused, looking surprised. "You're sure of that?"

"Sure I'm sure!"

"Well . . . that doesn't jibe with a fear of falling," Paxton murmured, as if to himself. "So it must be . . . well . . . never mind."

"Must be what, Body?" Barfield yelled, rising and walking forward to stand menacingly over the captive.

"It must be a fear you can't let yourself know about," said Paxton rapidly, cowering.

"Yeah? And what's that?"

"I have no way of knowing, Friend," Paxton babbled. "Possibly a man in your . . . your profession would have a fear of getting caught. Other than that, I honestly don't know."

"Me afraid of the cops! Haw!"

Barfield strode away to stand close to the phone. He wished it would ring and Stan would tell him the job was going according to schedule. Had something happened?

He decided he needed a drink. When he picked up the bottle he noticed his hand was shaking. He stared at it.

Hell. Paxton was right.

"Anybody who ain't in with the law is scared of gettin' caught," he said defensively, "but that ain't one of them phobia things. It's just common sense! I got good reasons to be scared of cops!"

Paxton brightened. "Why, certainly. That's it, then. This acquaintance said it usually would be a realistic fear, one well-justified by the person's circumstances."

"But Stan . ." Barfield hesitated. "This guy I know who can levitate. The cops would like to get the goods on him, too. How come he don't fall?"

"I'm really not an expert in all this, Friend. But I would suppose the person you speak of is insensitive. Others might consider him extremely brave, but the truth could be that he is insensitive to fear, even when being afraid is quite sensible."

"Yeah, that's him, all right," mumbled Barfield.

"A dangerous man to the people around him."

"Yeah?" Barfield looked up. "Why?"

"Because, being without fear, he might take risks that endanger others as well as himself."

Barfield looked at his watch.

Damn that Stony Stan, anyway! If something had gone wrong with the job, to hold up the action this long, why didn't he phone and call it off? Stan was gambling, just like Paxton said. But would Stan get caught if something went wrong? Oh, no, not him, the damned levitator! He would sail away, leaving Barfield and the other guys to take the rap!

The sensible thing to do was scram out of this place right now. Just leave Paxton where he was. Damn if that wasn't exactly what he was going to do!

With the decision made, Barfield felt better, and his mind turned again to the talk about the fall-syndrome.

"A good shrink could get rid of a guy's fear, and then he wouldn't fall no more in his dreams. Right?"

Paxton shook his head. "No. That's why I didn't want to talk about all this. A psychoanalyst can't help."

"Why the hell not?"

"Because they deal with irrational responses, and often can relieve them. But when a fear is rational, based on a clear recognition of a real danger, an analyst can do nothing."

Barfield's shoulders drooped. There went his hope of ever sitting tall on a horse in real life. For a little while this Paxton guy had really had him stirred up. Right now, the thing to do was lam out of here fast while he had the opportunity.

"The only solution," Paxton was saying, "would be to remove the need to feel fear, to change one's actual circumstances so as to eliminate—"

At the door, Barfield turned and came back. "What are you mumblin' about, Body?"

"Nothing you would find helpful, I'm sorry to say. For you to get rid of your fear of the police, it would be necessary for you to clear yourself with them. I'm sure you find that out of the question."

"I don't find nothin' out of the question!" Barfield stormed.

"You mean you'd have the nerve to give yourself up, turn state's-evidence against your associates, and depend upon the gratitude of the police and perhaps the goodwill of certain highly-placed individuals such as myself? Really, my friend, I can't buy that. Not with your fear of the police."

There was a drawn-out silence.

"You say you'd pull strings for me?" asked Barfield.

"Certainly. That would be the least I could do."

Barfield's hands were shaking so much he could hardly unlock the cuffs on Paxton's wrists and ankles, but he ignored the shaking with grim determination. He had to do this, or his dream would never come true.

"O.K., Bod . . . uh, Mr. Paxton, let's go talk to the cops," he quavered.

Amid the bustle of the police station, the interrogation of Barfield, the hurried and successful efforts to

round up Stony Stan and the rest of the gang, almost two hours passed before Paxton and his younger law partner, Fred Jarman, could have a quiet word together. They were alone in the captain's office, Paxton having a cup of the captain's coffee.

"I hope I handled things right, Don," Jarman said, a trifle uneasily. "I hated to put you in increased danger by holding back on the ransom, but knowing you I assumed that was what you wanted—time to handle the situation yourself."

"You did exactly right, Fred," Paxton assured him. "I admit it was touch and go with Barfield for a while. I had to lie a couple of times, telling him I've never used dream-learning, and promising to pull strings for him. Barfield is quite stupid, you know, and a stupid man is often harder to deal with than an intelligent man." He chuckled. "The poor dope is so uninformed that he didn't even know who I was."

"He didn't know you're presidential timber?"

Paxton shook his head.

"That's why I'm grateful, Fred," he said, "that you handled things the way you did from your end. The public image of a kidnap victim—helpless, intimidated—is inappropriate for a man who aspires to a position of high leadership. A leader must be viewed as a person who can control any situation that confronts him. That's what the public wants."

"But not from on top of a horse," grinned Jarman.

"Never from on top of a horse," said Paxton. "That's something else I lied to Barfield about. I said I rode. Can you imagine what the press would do with a photo of me sitting tall in a saddle?

"I can see the caption now: 'The Modern Napoleon'," snickered Jarman.

"Or some even less-fondly remembered dictator," Paxton said.

"Well, I'm glad it's all over, Don, and you're safe," Jarman said, becoming serious. "This business gave me a very trying afternoon."

"I'm glad to know my partner appreciates me," Paxton smiled, sipping his coffee.

"I do," said Jarman. "I'd love to have your ability . . . to talk anybody into anything—" He halted and glanced about uncomfortably.

"It's O.K., Fred. This office isn't bugged," said Paxton.

"Good. What I started to say is, that while I don't have the ability to talk anybody into anything, it's great to have a partner who can."

Paxton nodded slowly. "Dream-learning isn't a democratic process, Fred. First, you have to have the dream . . . repeatedly. Otherwise, there's nothing to work with. And nobody can choose the subject matter of his dreams. It's a matter of luck, essentially. I was fortunate enough to have grown up having my dreams of influencing people with my spoken words, and—"

He fell silent as the door opened and the police captain entered. The officer wore a concerned expression.

"How are things going, Captain?" asked Paxton.

"Generally O.K.," the officer replied. "I'm wondering if there's going to be a problem later on, though."

"Oh? What's that?"

"Barfield insists that you're going to pressure the courts into turning him lose. I want to know where we stand with you, Mr. Paxton."

Paxton shrugged. "I'm afraid I did promise to pull strings for him, Captain. If I hadn't, I probably wouldn't have remained alive to bring the Stony Stan gang to justice."

The officer eyed him grimly. "Then you're going to get him off," he said.

Paxton stared down at his feet, looking torn with indecision. Suddenly he looked up at the policeman.

"No, Captain," he snapped. "Barfield's all yours. When it comes to a choice between breaking my word to a criminal, or compromising the judicial procedures of our country, my course is clear."

The police captain beamed approval at him. "Thanks, Mr. Paxton. I'll see to it that this stays out of the press, of course." He hurried out of the office.

"You handled that beautifully, Don," said Jarman as they rose to leave.

"Of course," said Paxton. ■

THE FUTURE OF AUTOMOTIVE POWER PLANTS

by R. G. CLEVELAND

Considering a few engineering details such as performance, fuel consumption, specific weight, and economics— can the internal combustion engine be replaced? By what?

In the current furore over ecology and the environment, the automobile usually takes its lumps as the major villain. Or at least its power plant, the reciprocating piston internal combustion engine, does. Most parties seem to agree that the RPIC engine must go, but beyond this point all agreement stops. This article will try to analyze the problem dispassionately, and to predict what alternatives will actually be used.

At the outset, it should be made clear that we will be talking about automotive practice as it appears in the United States. For good or ill, the U.S.A. is by far the largest manufacturer and user of cars on the planet. By sheer weight of numbers, therefore, U.S. automotive practice will, very largely, dominate and determine world automotive practice. Today, even most foreign car manufacturers design their cars largely to U.S. standards . . . since the major ones sell more cars here than they do in their own countries.

PARAMETERS

Before we can discuss the automotive use of any engine meaningfully, we must define the parameters an automotive engine must meet. First, the parameter that determines the performance any engine can give a vehicle is, solely, the engine's horsepower output. This needs some clarifying. Performance can be broken down into two categories: top speed and acceleration. The top speed of any car is that speed at which the maximum power the engine can deliver through the running gear to the drive wheels is just enough to over-

come the aerodynamic drag of the atmosphere on the car. (Some additional power is needed to overcome the rolling resistance of the car. This is a combination of chassis friction and the rolling friction of the tires. However, it is one or more orders of magnitude below the level of the other forces we will be considering here, and so can be ignored in a general discussion of this type.) Since all present engines produce a power output that is a function of engine speed, this theoretical top speed is attainable in practice only when the engine is so geared as to be producing its maximum power at the theoretical top road speed. With other gearing, the attainable road speed will be somewhat less. However, horsepower output is still the only *engine* parameter that determines the top speed.

Acceleration performance is even simpler. Acceleration capability of the car at any speed depends entirely on the surplus of power available at the drive wheels over that needed to maintain the car at that speed. This is the energy available to be converted to kinetic energy of the vehicle and increase its velocity. Obviously, maximum acceleration could only be obtained if the engine could be geared so as to always turn at the maximum power rpm, regardless of road speed. The greatest surplus of power for acceleration would then always be available. The theoretically ideal device that would do this is called, in the trade, an infinitely variable torque converter—and nothing of the sort is presently available. However, modern transmissions behind modern engines can approach its theoretical performance quite closely, so the lack is not seriously felt.

What about engine torque, and its variation with engine speed? If we had an infinitely variable torque converter, this would be totally irrelevant, since we would be interested in only one engine speed. In practice, engine torque characteristics affect the type of transmission required to obtain the desired level of performance from a given engine.

The way this works can be seen from Figure 1, which shows the horsepower versus engine speed characteristics of two different size engines modified to produce nearly equal peak horsepower outputs. The engines are 350-cubic-inch and 427-cubic-inch Chevrolet V8's, and the power curves are from dynamometer tests run by Iskendarian Racing Cams, of Gardena, California. Suppose we desire to produce, with either engine, a horsepower output at all vehicle speeds of 425 or better. We must keep the speed of the 350-cubic-inch engine between 5150 and 7400 rpm to do this. With the 427, we must keep the speed between 4500 and 7100 rpm. The gear ratios required for the purpose are shown in Table 1. (These are very close to the actual gear ratios of most four-speed manual, and three-speed automatic or manual, transmissions.) If

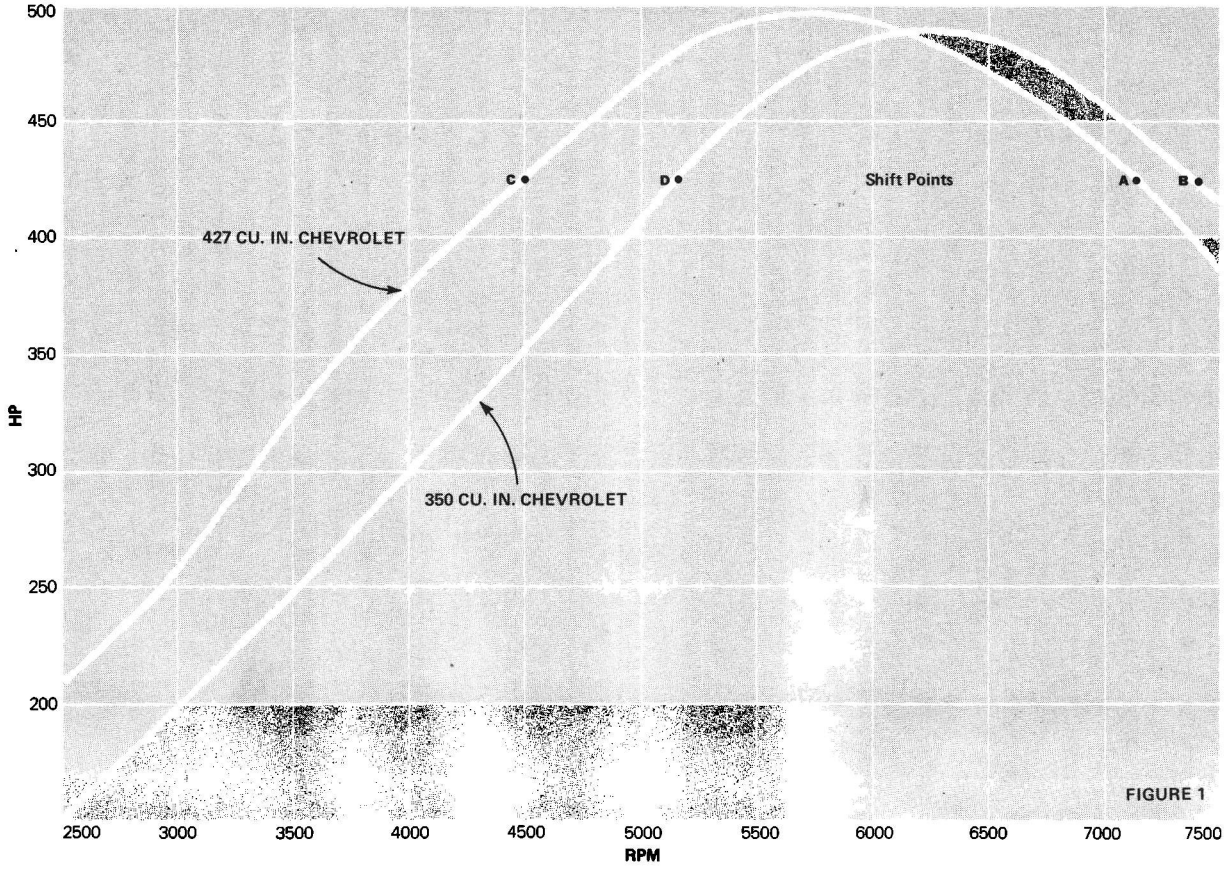

500
450
400
350
300
250
200
HP
427 CU. IN. CHEVROLET
350 CU. IN. CHEVROLET
C
D
Shift Points
A
B
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
RPM

FIGURE 1

the 427 is mated to such a three-speed, and the 350 to such a four-speed, the two engines will give virtually identical performance in cars of equal weight. Under such conditions, with the powertrain designed to match the characteristics of the engine, it is only the available horsepower that determines the acceleration or top-speed performance the engine can deliver in a given car. Equal horsepower, then, means equal performance.

The other parameter then affecting automotive engines has to do with fuel economy, or gas mileage. This is harder to get hold of and is not, in the form of miles-per-gallon, useful in discussing, for instance, an electric car. We will develop a more general parameter in the next section.

REQUIRED PARAMETER LEVELS

Clearly, from the foregoing, the actual top speed of a car depends on its power-to-aerodynamic-resistance factor. Likewise, the actual acceleration it can deliver depends on its power-to-weight factor. Over the past generation or so, the range of car sizes and general type of body styling the U.S. car-buying public desires has been pretty well made clear. Therefore, neither the aerodynamics nor the range of weights in the various car models is likely to change much. This should make it possible for us to determine the required power level for an automotive engine, by an examination of current and recent practice.

TABLE 1

	350	427
1st gear	2.58:1	2.50:1
2nd gear	1.88:1	1.58:1
3rd gear	1.37:1	1.00:1
4th gear	1.00:1	——

Through 1970, the lightest modern car produced in the U.S. was the Corvair. The original model had a curb weight—ready to run, minus driver—of about 2,400 lbs. and came with an 85 hp engine. This was during a time when the public was yelling for economy, and the car was designed for that. Nevertheless, one of the first changes the factory had to make was to increase the horsepower to 102, when most buyers complained that performance with the 85 hp engine was too low. This suggests that the minimum acceptable power level for an automotive engine is about 100 hp. The conclusion is strengthened since the present generation of subcompact cars, such as the Chevy Vega, all come with engines rated at 100 hp or more, even though these cars are presumably lighter than previous compacts.

We can, then, set the minimum power level for an automotive engine at 100 hp. What about the other end of the scale, the maximum power needed?

The most powerful engines of-

fered in U.S. cars have been rated between 400 and 450 hp. Let's first dispose of the idea that such engines are not necessary, and that people who want to order and pay for them in their new cars should not be permitted to do so. In the first place, moral considerations and "big brotherism" aside, a definite and quite large proportion of the buying public wants them. This is a profitable market which the car manufacturers, as profit-making corporations, cannot afford to pass up. Second, and perhaps more important, extremely powerful engines are necessary to auto racing. Now, auto racing is more than merely the second largest spectator sport in the U.S.; it is also the highly competitive and 100 percent pragmatic (did you win the race?) arena from which virtually all improvements in automotive technology have historically come and still come. This is particularly true in the case of tire technology. Although its documentation is beyond the scope of this article, that "racing improves the breed" is a thoroughly demonstrated *fact,* which is, therefore, not open to argument. Its elimination would slow the rate of automotive development an order of magnitude or more—certainly an undesirable situation.

Although power ratings in this range are somewhat deceptive (more on this later), we can say that a top-rated engine of 450 hp would be about right. Therefore, the needed range of maximum power outputs for any automotive engine is roughly 100 to 450 hp, with the average falling probably in the 200-to-300 hp range.

What about fuel economy? If we are to discuss such things as electric cars, a more general parameter is needed, as follows. The *specific fuel consumption* of a modern RPIC engine is about one-half pound per horsepower hour. This simply means that a 1 hp engine, run for an hour, will burn half a pound of gasoline. Now, gasoline weighs about 7 lbs./gal., and an average gas tank holds about 20 gallons, or 140 lbs. of fuel. This represents 280 horsepower-hours of available mechanical energy from the engine.

This should perhaps be clarified a bit. Two hundred eighty hp-hrs. of available energy in the tank means that a 100 hp engine, *run at full throttle and maximum-power-rpm* so that it is actually delivering 100 hp, will drain a 20-gallon gas tank in 2.8 hrs. Under the same conditions, a 560 hp racing engine will drain the same tank in half an hour. This can be seen at any major stock-car race, in which the race cars must make pit stops for fuel just about that often: every thirty minutes.

Under other than racing conditions, however, automotive engines are called upon to deliver their full power only occasionally. Even then, they are usually so called upon only for brief periods. Now, the specific fuel consumption is not a true constant of any engine. It tends to rise

somewhat at lower engine speeds and reduced power outputs, so it is not true that an engine running at 10 percent output will require only 10 percent of the fuel delivery it requires at maximum output. However, the difference is not very great, and hp-hrs. of available energy in the tank is quite a close approximation and, therefore, useful. If a vehicle with an alternative power plant is to be competitive in range and performance with present cars—a necessity for acceptance by the buying public and commercial success—this is the amount of energy the vehicle must store in recoverable form. This is equally true regardless of whether the fuel in a tank is for an engine or fuel cell, charge on a battery, or any other form of energy storage.

We are now in a position to discuss the parameters of various types of engines, as installed in cars. To get a baseline, it seems best to start, as usual, with our old friend, the RPIC engine.

THE RECIPROCATING PISTON INTERNAL COMBUSTION ENGINE

Although the RPIC engine is basically a complex, crude, and brutal device, three or four generations of dedicated engineers have refined the beast to an amazing extent. The 100 hp in-line, four-cylinder engines that represent our lowest performance level are smooth, economical, fairly quiet, and trouble free. The 250-300 hp V8's in the middle range are even smoother, quieter, just as trouble free, and provide plenty of power for the average driver with only a small sacrifice of economy. The 450 hp fire-breathing monsters are rough, noisy, temperamental, and greedy . . . but capable of absolutely unreal performance when properly fed and maintained. The latter makes their otherwise obnoxious characteristics not merely acceptable but a joy for the person who buys one, knowing what he's getting. It has been said that hp ratings in this range are deceptive. They are fairly accurate for the engines as delivered. However, these are basically racing designs, slightly detuned; therefore they are highly responsive even to small modifications. An owner who knows what he's doing, and starts modifying, can readily get 700 hp or more for his pains. This is a rewarding experience for this type of person . . . but such an engine is *not* for the average driver, who lets his service station attendant do all the hood lifting.

The above is relevant to deriving specific power outputs for the various engine sizes in terms of weight. The small, 100 hp engine weighs about 350 lbs., which gives a specific output of about 0.3 hp per pound of engine weight. The medium-power engine, in the vicinity of 600 lbs., gives a factor of about 0.5 hp/lb., while the monsters, modified, and weighing 650 to 680 lbs., give a factor of slightly better than 1.0 hp/lb. As with the amount of energy storage required, any alternative engine

must be at least capable of meeting these figures in order to be a practical substitute for the RPIC engine.

It can be seen that the present version of the RPIC engine, considered strictly as a power plant, is eminently suitable for normal automotive applications, including racing. An engine that can produce better than 1 hp/lb. for hours of continuous full-throttle operation, as in a major stock-car race, is certainly an efficient and reliable power plant. If there were any doubt of this, the presence of 80,000,000 of the things on U.S. roads would eliminate it.

However, and unfortunately, that same presence of 80,000,000 engines means they can no longer be considered strictly as power plants. The fatal flaw is known to virtually everyone in this country, and can be summed up in one word: pollution.

Unfortunately, the RPIC engine is inherently a dirty-burning device. This is implicit and inescapable in the Otto cycle, on which such engines run. The Otto cycle simply means that the engine compresses a fuel and oxidizer mixture, burns it and allows it to expand to yield mechanical power, then expels the combustion products to make room for a fresh charge of fuel-oxidizer mixture. Combustion in such an engine *must* be pulsed. In the common RPIC engine, combustion in any one cylinder occurs for a brief period of time every other engine revolution. Necessarily, in such a system the fuel can never be completely oxidized. When hydrocarbon fuels are used, the combustion products will not be the simple, completely oxidized carbon dioxide and water vapor, but will contain a large proportion of carbon monoxide and complex organics. This is inherent in the nature of the device, and it is futile to try to eliminate it.

Since our atmosphere is not a pure oxidizer, but contains 80 percent nitrogen, an additional pollution product is produced. This is the direct result of having nitrogen and oxygen together at elevated temperatures and pressures and is, as may be expected, the various oxides of nitrogen. Unlike the various hydrocarbons, nitrogen oxide emission is not the result of imperfect combustion. It can be reduced only by reducing flame temperature and pressure. In an Otto-cycle engine this is accomplished by reducing the compression ratio. Unfortunately, that is the exact opposite of what is required for improving performance, both in power output and general engine efficiency (including gas mileage).

Note that the above discussion says nothing about the use of pistons or gasoline fuel. It is just as true of diesels, two-cycles, free-piston setups, and Wankel rotary combustion engines as it is of the conventional RPIC engine. All of these use the same Otto cycle. In a more general sense, the same pollution problem will probably exist with any engine

that must use a pulsed combustion system.

We've said that the pollution from the RPIC cannot be eliminated. This is true, but it *can* be reduced. All 1971 cars sold in this country came with engines that had been factory-modified from the previous designs to produce a smaller amount of pollutants. Unfortunately, most of the modifications and adjustments necessary for this purpose are the direct opposite of those used to increase performance. This is not merely a matter of top-end, all-out horsepower. If it were, only a relatively small proportion of people—those who buy the fire-breathers—would be bothered. Instead, a normal engine modified and adjusted for low emissions becomes hard to start, slow to warm up, poor in general low- and medium-speed performance, rough idling, and lower in fuel economy. In short, it acquires some of the obnoxious characteristics of the fire-breather, without the fire-breather's ultra-high performance that makes these characteristics pleasant to a particular type of owner.

In fact, the general performance level is drastically reduced. Any driver who has ever taken off from a stoplight, in his new 1971 V8, against an earlier model (and this includes, at least occasionally, almost everyone who buys a new car), knows that the comparable '66 or '68 version of the same car will run away from the '71. This is rather annoying to the man who has just shelled out $3000 to $5000 or more for that same '71. Furthermore, in order for the emissions to stay at the design level, the engine must be very precisely adjusted, which it is not in the nature of a complex device like the RPIC engine to be. And, since it is these same adjustments that produce the poor running described above, millions of owners and mechanics disgustedly readjust the cars to run better—which they promptly do, while producing the earlier level of emissions.

This is the case for cars that must meet the present emission standards. And it is bad enough. However, the emission standards that have already been enacted into law, to apply to all new cars sold in the U.S. from 1975-1976 on, are over an order of magnitude tougher. It is extremely unlikely that the RPIC engine can be cleaned up to this extent and run at all . . . let alone retain operational characteristics suitable to the average driver. The probability is not quite zero, of course, but it is awfully damned close.

There remains one last possibility for cleaning up the RPIC engine. It is not inherently ridiculous to propose passing the dirty exhaust from an RPIC engine through a device that would oxidize the various organics and hydrocarbons to carbon dioxide and water vapor. Theoretically, such a device need produce little, if any, more restriction than a normal muffler; and it would not

have to affect the performance of the engine at all. The engine could then be designed, as engines were until recently, for the desired characteristics as a power plant. The add-on exhaust system would take care of the pollution.

In practice, such a device would have to be compact as well as cheap, in order to be practical as original equipment on cars to be manufactured by the millions per year. Additionally, considering the maintenance habits of the average driver (sloppy, to say the least), it would also have to be capable of trouble-free service with *no* attention for at least 2-3 years. Detroit would consider this by far the best solution, since the car manufacturers are extremely reluctant to scrap their investments in the RPIC engine. If such a device can be developed, it—in conjunction with more or less conventional RPIC engines—will comprise the power plant of most cars for a long time to come. However, despite 5-10 years of crash research

programs, and multimegabuck expenditures, none of the various forms of afterburners and catalytic mufflers that have been developed so far come anywhere near meeting the requirements. The best are not only initially expensive, but would cost the car owner $400-$600 to recharge *each year.* Furthermore, nothing suitable is even on the horizon. It seems probable that, if a suitable device were feasible in the present stage of our technology, the amount of research already done on the subject would at least have given a glimmering of how to go about producing it.

Thus, we can say with fair certainty that, barring the unlikely development of a suitable post-combustion oxidizer system, the death of the RPIC engine as a power plant for new cars will occur in the 1975-1976 period. The engine itself, of course, will hang on for a long time afterwards . . . but once an alternative power plant is being put in the new cars, the numbers of RPIC engines on the road will rapidly drop below the point where their contributions to pollution problems are significant.

What, then, are the alternatives?

THE ELECTRIC CAR

The simplest and most direct way to get away from pollution by the combustion products of an automotive engine is, obviously, with an engine that doesn't involve combustion. At present, this means some form of electric motor.

An electric car, of course, must meet the same power and energy storage requirements as any other car. The first problem, then, is the motor. At first thought, this would seem to be serious. Any machinist or hobbyist familiar with the size and weight of a normal 1 hp electric motor "knows" that electric motors produce far less than the 1.0-plus hp/lb. of the racing RPIC engine . . . or the 0.3 hp/lb. of the economy RPIC engine, for that matter. However, this is one of those cases where what people "know" just ain't so. The problem has been solved for some years. Back in 1966, General Motors built a 110 hp electric motor, weighing 145 lbs., for use in an experimental electric Corvair. This is roughly 0.79 hp/lb. This motor, as is, would be completely satisfactory for the economy end of the scale, as an automotive power plant. Scaled up four to one, to produce 440 hp, it would still be ahead of the stock high-performance RPIC engine, even if the weight also went up fourfold, to 580 lbs. And any engineer knows that, in such a scaleup, power will go up considerably faster than weight.

The motor, then, is not a problem. But the energy storage to run it is something else again.

We calculated earlier that the gas tank of a normal car stores approximately 280 hp-hrs. of energy that is mechanically recoverable from the engine. This equals approximately 210 kilowatt-hours of electrical en-

ergy. Estimating an 87.5 percent efficiency for the electric motor of the car (to make the figures come out even) we find the necessary charge capability of the battery—or other storage device—to be 240 kw-hrs. Remember, this is absolutely necessary to be competitive in range and performance with the RPIC engine, which is absolutely necessary for the car to be commercially successful—which is absolutely necessary for the car to be successfully produced.

Regenerative braking, another factor often mentioned in connection with electric cars, simply makes use of the fact that an electric motor, of the sort that would be used in a car, becomes a generator when the output shaft is mechanically driven, and an electric load, rather than an electric power source, is connected to the terminals. Electric cars would certainly be set up to take advantage of this. It would be arranged so that, during braking, the drive motors, driven by the wheels, would be used to pump some charge back into the battery and at the same time help slow the car. Sadly, this does not significantly alter the picture. It might make for a nice bonus while the car is being driven around town. However, nearly all cars are taken occasionally on long trips, which means a sustained run at high speed with only occasional use of the brakes. Besides, in many cities, such as Los Angeles, a major part of the mileage put on most cars is freeway mileage, where the driving conditions are similar to those on trips. Thus, 240 kw-hrs. must be available to be stored in any practical electric car.

In the March '67 issue of Analog, John Campbell had an editorial on batteries. Table 1 of this editorial (reproduced here—with additions—as Table 2) listed a number of high-energy-type batteries, of which the highest had a theoretical maximum energy storage capability of 620 watt-hrs./lb. If that could be attained, a battery to store the needed 240 kw-hrs. would weigh just under 400 lbs. This is considerably more than 140 lbs. of gasoline plus 30 lbs. of fuel tank—considering, though, that the electric motor would be 100-200 lbs. lighter, at least, than the RPIC engine it replaces, and could get along with a much simpler transmission. (Or none. The transmission needed could only be determined by test driving such a vehicle. Obviously, this information is not yet available.) A simpler transmission would presumably also be lighter, so there would be enough weight saved to absorb the difference. But wait! This is the theoretical, unattainable maximum. If practical engineering could give us a bit over half of that—say, 330 watt-hrs./lb—the battery would weigh 720 lbs. This is marginal, to say the least. It is 550 lbs. heavier than the filled gas tank . . . the weight of a medium-small V8 RPIC engine (a Chevrolet 327). Even if the electric motor is 200 lbs. lighter than the RPIC engine it replaces, and uses a transmission an

TABLE 2

Battery type	Theoretical max. storage watt-hrs./lb.	Engineering estimate watt-hrs./lb.	Weight of 250 kw-hr. battery, in lbs. Theoretical	Engineering
Goulton Lithium-Nickel Chloride	437	100	550	2400
Ford Sodium-Sulfur	340	150	706	1600
General Dynamics Zinc-air	400	50	600	4800
Goulton Lithium-Nickel Fluoride	620	330	388	720
Lead acid, diesel truck type (220 amp-hrs., 150 lbs.)	—	18	—	13,300

additional 100 lbs. lighter than the transmission on the RPIC engine, the overall car weight, with other things equal, will go up 250 lbs. You might be able to shade this in other areas; for instance, there is 200 lbs. or more of noise and heat insulation in most cars that would not be needed in an electric. In general, though some engineering would be required, it is probable that a 330 watt-hr./lb. battery could be used to power a practical electric car.

However, if you have to use the Ford sodium-sulfur battery, with its expected capability of 150 watt-hrs./lb., the situation becomes hopeless. Battery weight then goes up to 1,600 lbs., which approaches the weight of a Volkswagen, and exceeds the weight of many other foreign cars on U.S. roads. Such a battery, in an even larger size, might be practical to power a long-haul, large-size truck, where the load is forty or fifty thousand lbs. and an extra ton or two makes little difference. However, no practical passenger car could ever be designed around it.

Consider that a 330 watt-hr./lb. (or better) battery becomes commercially available in the not-too-distant future. Does this make the electric car ready to become a going proposition?

Well, it does solve the major problems. But there are a couple of minor ones that are pretty sticky, too. Let's

take the simplest one first: The 100 hp, 87.5 percent efficient, economy-type motor that we decided was the smallest size we could use in a car will draw, at full output, approximately 85 kw of electrical power. This means that the battery must be capable of supplying at least this much—say 1,000 volts at 85 amperes. Needless to say, a power source with this capacity is going to be slightly lethal if you touch it. Considering that people like to poke around, in and under their cars, and could defeat any interlocks put on the hood if they decided to, people are going to get killed. And you can't drop the voltage the twentyfold or so it would need to make it nonlethal, because you'd have to make it up in current. Even 85 amps requires #2 wire to handle it . . . wire with a conductor a quarter of an inch in diameter. It just isn't practical to increase the wire size enough to handle twenty times the current.

Remember . . . this is for the *economy* engine. Power for the high-performance version will have to be provided by increasing the voltage. This really doesn't matter . . . a 4,500-volt, 85-amp power source won't kill you any deader than a 1,000-volt, 85-amp power source.

However, this probably isn't too serious. People will get used to the danger, and the few who goof will simply be added to the statistics. After all, 120-volt, 30-amp house power occasionally kills people too, and no one suggests going back to gaslight.

There is also a recharging problem. Consider the attitude of the average motorist when he pulls into a service station for gasoline. He expects service *right now.* Anyone who's ever worked in a gas station knows that, if a customer has to wait as much as 2 or 3 minutes because of a car or cars ahead of him, there is a good chance he will pull out and head for the next station. This attitude is common enough that Gulf Oil, for one, considers it worthwhile to advertise that in *their* stations a customer can expect to be served within 10 seconds. (They make it good, too.) This means that the car owner, who is accustomed to having his nearly empty gas tank filled in a minute or so, is definitely not going to be willing to wait an hour or more to have his drained-down electric car recharged. By a campaign of advertising the other benefits, you might be able to get the general public to accept a charging time of 5 or 6 minutes, though even this would be a strain on the patience of most drivers. But consider. To charge a drained 240 kw-hr. battery in 6 minutes requires a charging power level of 2.4 *mega*watts. Per car. For 6-minute periods.

How are the power companies going to like feeding *that* kind of load into every corner service station?

In the matter of costs, the electric car is going to come out just about even with the RPIC engine car. We have seen that one gallon of gas rep-

resents about 14 hp-hrs. of recoverable mechanical energy from the RPIC engine. If you consider that the average car gets around 14 miles per gallon, which is close, this gives an energy requirement of 1 hp-hr./mile, or about .75 kw-hr./mile. Fourteen mpg, at 35¢/gal., gives a cost of 2.5¢/mile for the RPIC engine car—0.75 kw-hr./mile, at a cost of 3.5¢/kw-hr., gives a cost of 2.6¢/mile for the electric. This is not a significant difference.

Of course, many car owners will want to do a large part of the recharging at home. The power companies would like this, since it would be mostly overnight, and would spread a lot of the load over their normally slack hours. However, if you are going to recharge a drained-down, 240 kw-hr. battery over a 12-hr. period, this is still a charging rate of 20 kw. Allowing a slight excess to run the normal household appliances at the same time (4 kw), this would require a 200-ampere service to be brought into each house. The normal residential electric service is 30-50 amperes, which means that virtually every car owner who wanted to charge his own electric car would have to have his house or apartment rewired for it. Furthermore, the distribution networks that bring the power to residential areas are not designed for these kinds of loads. So they would have to be replaced or augmented, as well. Also, remember that a 200 hp electric car will run at about 2,000 volts, and will have to be recharged at this same voltage level. And it requires DC, of course. This means you would have to have a 2,000-volt, 10-amp DC power source to plug into your 200 hp electric car in order to recharge it overnight. This approximates quite closely the voltage and current commonly used in the electric chair . . . not the sort of equipment to have around the average home!

Finally, there is the matter of the total power required by a countryful of electric cars. This can be approximated quite easily. 80,000,000 cars, driven an average of 7,500 miles yearly (which is probably low), is a total of 600,000,000,000 vehicle miles. At an average of 15 mpg, this requires 40,000,000,000 gallons or about 280,000,000,000 lbs. of gasoline. At 0.5 lbs./hp-hr., this is 560,000,000,000 hp-hrs., or 420,000,000,000 kw-hrs., or 420,000 gigawatt-hrs. of energy. Figuring an average electric car efficiency of 87.5 percent, we arrive at a figure of 480,000 gigawatt-hrs. of electric energy that will have to be provided yearly to run all the cars. This is 1,315 gigawatt-hrs. per day or, if the load could be spread with perfect evenness, a constant power drain of about 54.8 gigawatts, 24 hours a day, 365 days a year. In practice, of course, this load would show large peaks and valleys just as present power loads do, and I would guess that at least 100-150 gigawatts of capacity would be needed to handle it. I don't know what the total electric

power production capacity of the U.S. presently is, but I would guess it is in this neighborhood. This would mean that the power-generating capacity would have to be approximately doubled. This is not absurd, but it would certainly involve tremendous practical difficulties.

Examining the above, it appears that it would be just barely possible, in the present state of our technology, to switch over completely to the electric car. However, it is clear that the transition would be extremely painful, and it is not something that is going to happen if there is any other choice. There is also the question as to whether, if the transition were made, the pollution from automobiles would simply be replaced by the pollution from the generating plants that provide the energy to run the pollution-free electric cars. The answer to this, however, is probably no. It is far easier to clean up, and keep clean, a single multigigawatt generating station than it is several million automobile engines. And nuclear power plants, of course, do not pollute . . . at least, not in the same way.

Before we leave the subject of electric cars, there is one other possibility that should be discussed. This is not something which can be accomplished with present-day technology, but it will undoubtedly be the eventual solution to the problem of automotive power. It is, of course, a small fusion reactor, producing electrical energy to run the car directly from hydrogen which, in turn, could be dissociated directly from ordinary tap water. Such a car would exhaust only helium, oxygen, and possibly a little steam. There would be no enormous generating plants and power distribution networks needed to feed it. Even the safety problem would be solved, since the electrical connections could be well-insulated and would not have to be accessible for recharging purposes. Barring matter transmission or personal teleportation, this type of vehicle will almost certainly, in time, become the final solution to personal ground transportation. Sadly, though, that time is not yet. It must await the commercial availability of a lightweight, compact fusion reactor in the 100-400 kw range, which is not likely to occur by 1975.

At this point, one might ask: If fusion power, which we cannot yet produce, would make a practical electric car possible, what about fission power? How about a small fission reactor, producing heat that could be converted into electricity, or used to run some sort of mechanical heat engine? This might, technically, be possible. Theoretically, at least, a 300-to-400-kw fission reactor could be designed physically small enough for automotive use. The engineering problems would be formidable. Particularly bad would be the problem of shielding the thing adequately, while retaining provisions to use its heat output and keeping the

total weight below the 700 lbs. or so that we have found to be the absolute maximum tolerable for use in a car. One good point . . . the problem of energy storage and/or recharging does not exist. Any decently designed reactor can run at full continuous output for a lot more years than the total lifetime of a car is likely to be, without refueling. When you consider that, on the average, the total number of hours a 5-year-old car, for example, has spent *running* is something like 10 percent or less of its age, and then mostly at partial outputs . . .

Anyway, suppose the engineering problems are solved.

Compact fission power sources must use "enriched" fuel. The "natural" mixture of Uranium isotopes (1 part U235 to 140 parts U238) will not work. In fact, "natural" Uranium can be made to chain react at all only by special techniques. This means that additional fissile material would have to be added to the fuel, in the form of purified U235, Plutonium, or Thorium 232. The higher the percentage of U235, Pu239, or Th232, the smaller the reactor can be and the higher the power that can be drawn from it. (The ultimate end of this process is, of course, a fission bomb. There, pure U235 or Pu239 is used, the size is as small as possible, and the power output . . . briefly . . . is maximum.) Now, fissile fuel is *the* most strategic of all strategic materials. Can anyone seriously imagine the government or the Atomic Energy Commission of this country (or their equivalents in other countries) releasing enough of the stuff yearly to produce eight or ten million car-sized reactors? If they would, how long would the planetary supply last at that rate? What about the radiation hazard in case of a vehicle accident violent enough to crack the shielding? Nuclear fission products include some of the most violently radioactive, and therefore deadly, isotopes known. Finally, how do you convince Joe Average Carbuyer that he isn't sitting on a fission bomb? It isn't true . . . a power reactor *cannot* explode like a bomb, but Joe will never believe that. It's hard enough to convince him in the case of large, stationary nuclear-electric power plants. No such problem arises with the hypothetical fusion reactor. ("Hell, Joe, the thing runs on plain *water!* Everyone knows *water* can't blow up!")

I see that there is one last possibility for the electric car that hasn't been mentioned thus far. A 100-400-kw fuel cell, one in which the total weight (of the battery plus a tank with enough fuel to provide the needed 240 kw-hrs.) did not exceed 700 to 800 lbs., would provide some of the same advantages as the fusion reactor . . . at least, in the important areas of recharging, energy distribution, and safety. However, such a fuel cell seems to be nearly as far beyond our present technological capabilities as the fusion reactor is.

It seems, then, that we are not go-

ing to be able either to (1) clean up the RPIC engine sufficiently, or (2) replace it with a practical combustion-free power plant, by the necessary target date of 1975-1976. At least, the probability that we will be able to do this is quite low. What, then, are the alternatives to the RPIC engine that are *not* combustion free?

THE GAS TURBINE

We have seen that the major reason for the dirty output of the RPIC, diesel, Wankel, and other Otto cycle engines is the pulsed nature of the combustion in such engines. It would seem logical, therefore, to examine engines which use a continuous rather than a pulsed combustion system. The simplest and best known of these is the gas turbine.

This engine has completely taken over the aircraft field, except for the smallest private planes. Even aircraft jet engines are simply gas turbines minus the mechanical power takeoff, with the exhaust gases used for pure thrust. It is the engine which the U.S. government advisory committee on the subject expects to be the replacement for the RPIC engine. It is also the only substitute engine on which the three major U.S. auto manufacturers have instituted, and are still maintaining, extensive research and development programs.

Chrysler, in '63 and '64, actually went to the extent of building fifty prototype turbine-powered cars, which were then loaned for several months each to members of the general public for user evaluation. Chrysler claims to have learned a great deal from this experiment, and to have made much progress since. Ford has reached the point where they have a gas turbine in the 400-plus hp range in actual production for truck applications. These are available in some of their '72-model large trucks. General Motors also has some turbine engines for trucks.

Finally, the gas turbine is the only substitute engine that has been used with any success in modern auto racing. One very nearly won at Indianapolis a couple of years ago. Only the failure of a non-turbine-connected part in the car in the very last laps of the race prevented it. Probably, only the panicky restrictions placed on the engine afterwards (to prevent obsoleting millions of dollars' worth of RPIC-engined racing equipment) has prevented its happening since. Several other turbine cars have appeared in various races and given impressive showings, such as a Rover-BRM turbine-powered sports racing car at Le Mans in 1964. All in all, the gas turbine appears to be the logical successor to the RPIC engine, provided it can be made suitable for regular automotive service.

A detailed discussion of the gas turbine is beyond the scope of this article. Anyone interested in such a discussion is referred to the *Road & Track* article cited in the bibliogra-

TABLE 3

Engine type	Weight, in lbs.	Max. hp	Specific power—hp/lb.
Economy RPIC	350	100	.286
Standard RPIC	600	300	.500
Racing RPIC	650-680	700-plus	1.0-plus
Electric (GM)	140	110	.786
Helicopter gas turbine	310	960	3.0-plus
Chrysler gas turbine	400	130	.325
Ford truck gas turbine	Estimated 600	Estimated 450	.750

phy. Here, we are going to discuss only those parameters we have discussed in regard to the other automotive power sources.

In regard to specific power output, referenced to engine weight, the gas turbine scores heavily. This is shown in Table 3. The commonest aircraft turbines of relatively small size are those installed in helicopters. One such, the only one on which I have definite figures, weighs just over 300 lbs. and is rated at 960 output shaft hp. This, about 3.0 hp/lb., is far above the figure for even the most radical racing RPIC engines. And of course, the single most important factor in any aircraft engine is reliability, so this is certainly not a fragile, overstressed design. On the other hand, it is a cost-no-object design of a turbine engine designed for essentially constant speed and load operation. Because of several of its operating characteristics—such as part throttle fuel consumption, and a lag of several seconds in response to the throttle when the engine is accelerated—as well as cost, this would not really be a suitable engine for a car.

The figures on automotive turbines are not quite this good. Various modifications and additions have to be made to a "pure" gas turbine to make it suitable for use in a car, and these add to the weight, though they need have little effect on the power output. The engine of the Chrysler turbine car that was loaned out was rated at 130 hp and weighed about 400 lbs. This is about the same as the 0.3 hp/lb. of the 100 hp RPIC engine. The Ford truck turbine, with a power rating of up to 450 hp, is said to be "50 percent lighter than a diesel of similar output." This probably means about 600 lbs., which would

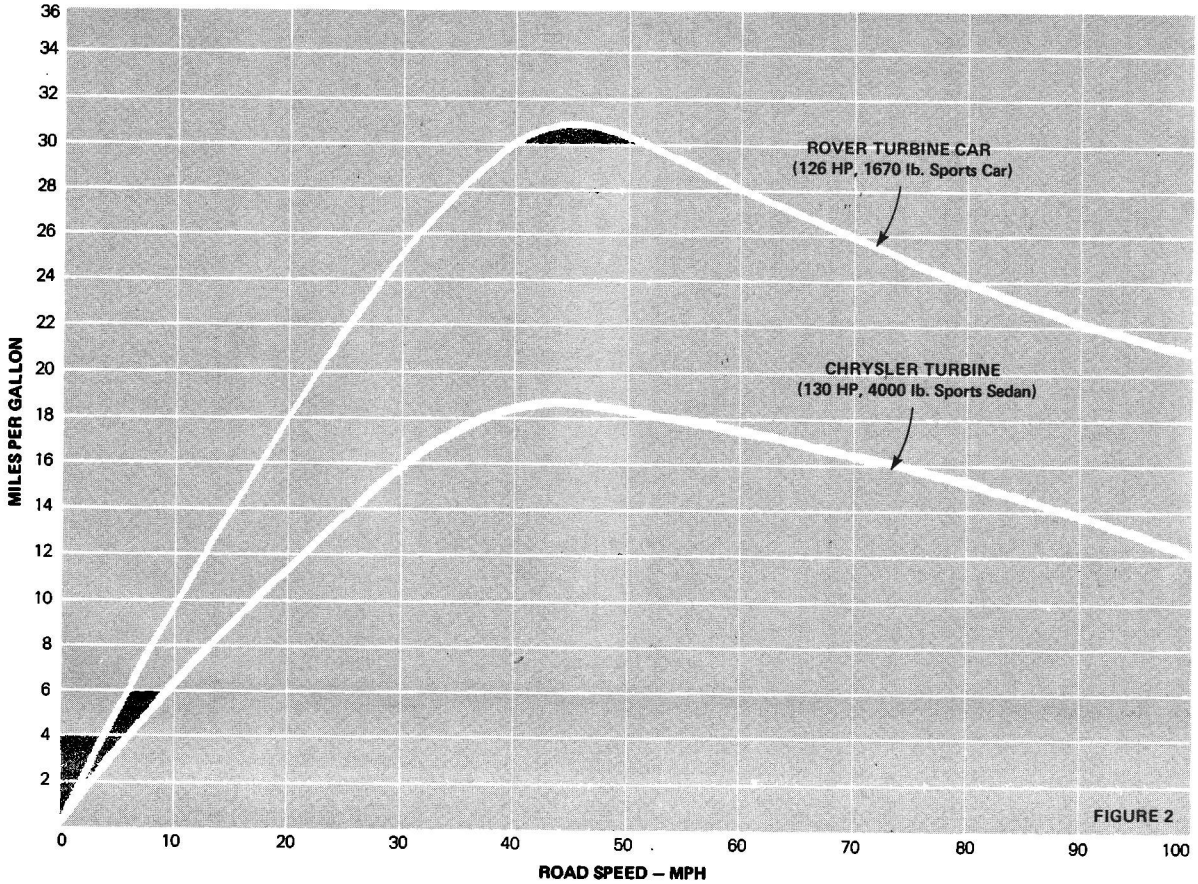

MILES PER GALLON
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
10
20
30
40
50
60
70
80
90
100
ROAD SPEED – MPH
ROVER TURBINE CAR
(126 HP, 1670 lb. Sports Car)
CHRYSLER TURBINE
(130 HP, 4000 lb. Sports Sedan)

FIGURE 2

put it slightly ahead of an RPIC engine in the same power range. Note, however, that the Chrysler "testbed" engine was designed for a horsepower figure that was deliberately kept on the low side. Note also that neither light weight nor maximum power output is an important design parameter for a truck engine. Yet, both of these turbine engines manage to be at least equal to comparable RPIC engines in specific power output. Therefore, specific power output is not going to be a problem—even less of a problem than with the electric car.

How about fuel consumption? Figure 2 shows miles-per-gallon figures versus steady road speed, for the Chrysler and Rover turbine cars. Although the two engines have nearly identical power outputs, the Chrysler car is obviously far thirstier than the Rover. This is certainly due to the Chrysler's weight of 4,000 lbs., as opposed to the Rover's 1,670 lbs., and graphically illustrates the penalty in running costs paid for automotive weight. Nevertheless, these figures are reasonable, even impressive. Seventeen mpg at the California freeway speed of 65 mph is pretty good for a 4,000 lb. sedan like the Chrysler. And how many sports cars capable of 142 mph top speed, like the Rover, can get 21 mpg at 100 mph? An additional bonus is that virtually any flammable liquid, from moonshine whiskey to kerosene to high-octane gasoline, will do nicely as fuel. (At least one turbine engineer, George Huebner of Chrysler, claims that even the unburned hydrocarbons in polluted air ingested by a turbine engine will be burned!) There is one additional factor, that does not show in Figure 2: the idling fuel consumption of a turbine may be as much as two or three times that of a comparable RPIC engine. Fortunately, except for police cars, most vehicles spend little of their time idling. This factor would only show up in very slow bumper-to-bumper traffic, which is a situation most drivers avoid as much as possible anyway.

What about performance? Figure 3 shows the hp versus rpm curves of a typical 2,200 cc RPIC engine and the Chrysler turbine engine, with slightly modified output shaft gearing. (This has no effect on the power output, but was necessary to bring the speeds of the two engines into the same range for easy comparison.) The two engines produce nearly equal power at engine speeds above 5,000 rpm. However, at 2,500 rpm the turbine produces 50 percent more hp than the RPIC; at 1,500 rpm twice as much. This simply means that the turbine has a great deal of low-speed torque. In fact, the maximum torque of the turbine is produced at *zero* output speed, with the output shaft stalled. We said earlier that low-speed torque characteristics have little effect on available performance, provided the rest of the powertrain is properly matched to the engine. This remains largely

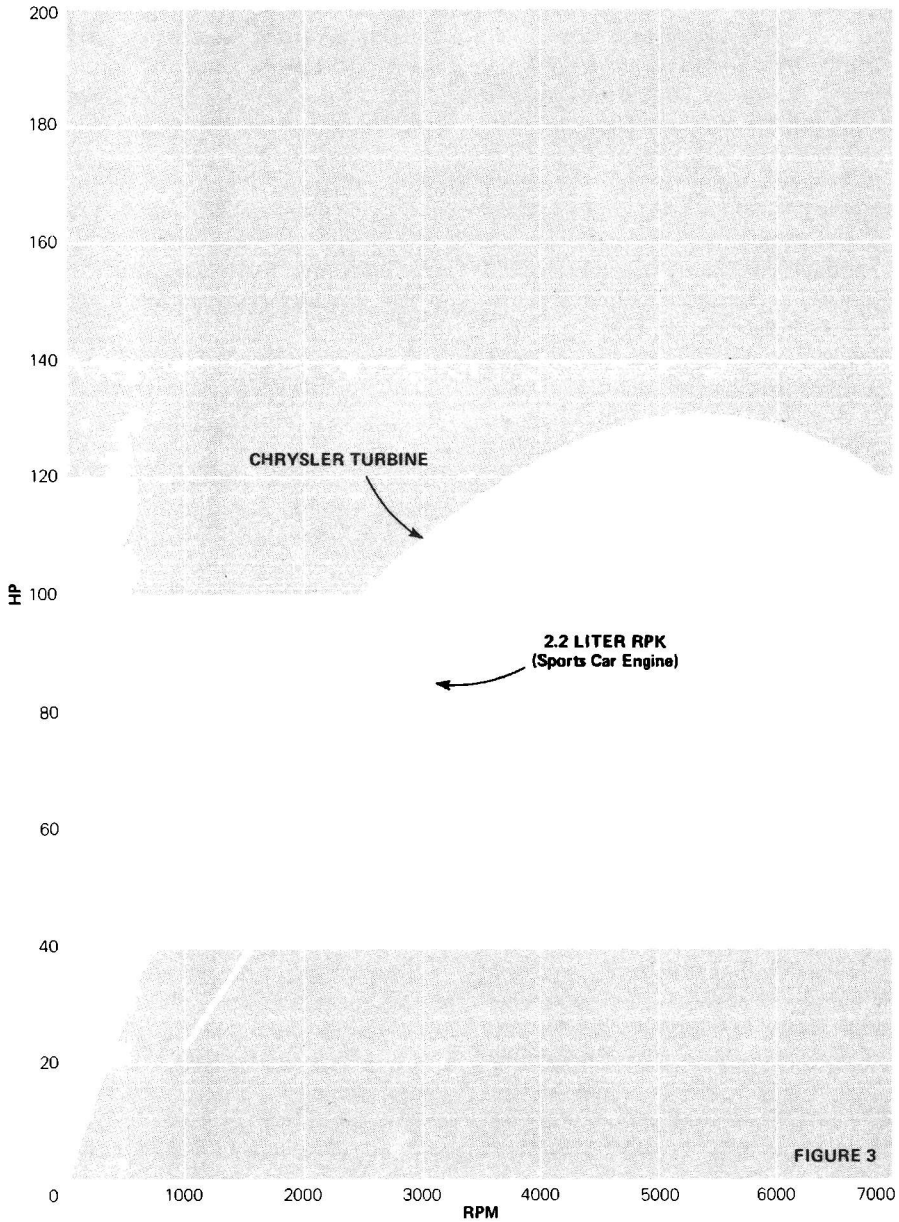

200
180
160
140
120
100
80
60
40
20
0
HP
CHRYSLER TURBINE
2.2 LITER RPK
(Sports Car Engine)
1000
2000
3000
4000
5000
6000
7000
RPM

FIGURE 3

true. The main difference here is that the turbine neither needs nor has use for any form of torque converter or clutch, but would be coupled directly to the gearbox. In practice, this would probably be a three-speed automatic, which is what Chrysler used on their turbine cars. This is more transmission than the turbine needs merely to match the RPIC engine, so with such an arrangement a turbine-engined car will have some slight performance edge over an RPIC-engined car of similar weight and peak horsepower.

However, there is one factor in turbine performance that is not quite so rosy. This is the well-known throttle-lag. It is *not* engine sluggishness. Once it is brought to wide-open throttle, a turbine engine will accelerate any given car as fast as, or faster than, an RPIC engine of similar output. However, unlike the RPIC engine, a turbine cannot be brought to full throttle as fast as the driver can jam down the gas pedal. This is because the "throttle opening" of a turbine depends, not on the position of a valve, but on the rotational speed of an internal engine part—the compressor turbine. This cannot be accelerated instantaneously. In the first Chrysler turbine car, the lag was a full 7 seconds! This is one of the two areas at which the major thrust of automotive turbine research has been directed. (Fuel consumption is the other.) Chrysler claims to have got this lag time below half a second. Other sources disagree, claiming that the Chrysler turbine cars still showed throttle lags of a second or slightly more. Splitting the difference, a throttle lag of .7 or .8 seconds would feel, to the driver, like a slight carburetor stumble. Most drivers have experienced this, when the carburetor is out of adjustment and, when the gas pedal is stabbed suddenly, the engine hesitates briefly before starting to pull. Seven seconds of this would, of course, be intolerable in a production car. However, anything below one second would probably be adapted to by most drivers almost without noticing.

It seems, then, that the gas turbine is suitable, basically, for use as an automotive power plant. The remaining problems are those types which engineering normally deals with. And it seems, to this writer, that they are considerably less than the problems the RPIC engine faced at *its* outset. However, the RPIC engine, as a power plant, is also suitable. But what about the problem which is going to kill the RPIC engine—pollution?

Here again, the turbine scores; and this is the basic reason why it looks attractive to the car manufacturers. It is not, of course, a zero-pollution power source like the electric motor. However, according to the figures given by *Road & Track,* present turbines *without being specially designed or modified to do so* are comfortably below the 1971 emission standards; and two of the

three listed will virtually meet the 1975-1976 standards as well, for everything but nitrogen oxide emission. Even here, the reduction in nitrogen oxide required is only 60 percent, as opposed to the several orders of magnitude needed by an unmodified RPIC engine.

It seems, then, that we have validated the theory previously expressed herein, that a continuous combustion as opposed to a pulsed combustion engine would be likely to solve the pollution problems of automotive power. There is one other type of continuous combustion engine that should be mentioned—the steam engine.

THE STEAM ENGINE

Let us admit, at the outset of this section, that the steam engine as a power plant for cars deserves much better treatment than it is getting from the manufacturers . . . or will get here. From a strictly engineering and technical standpoint, steam power shares many of the advantages of the gas turbine and lacks some of the disadvantages though, of course, it has its own disadvantages as well. Basically, though specific data is sparse, a modern steam engine would seem to be quite capable of meeting the power and weight requirements we have specified for an automotive power plant. Its fuel consumption would seem to be also quite acceptable. As for the pollution problems, steam, being continuous combustion, would share the low emission characteristics of the gas turbine. Since the much lower flame temperatures would probably produce fewer oxides of nitrogen, it might even be somewhat superior to the gas turbine in that respect. And, while a steam engine has its own special engineering problems, the total engineering required for a practical automotive power plant might be somewhat less than the gas turbine needs.

Nevertheless, the basic purpose of this article is to predict, for the reader, what is likely to happen in the field of automotive power. And, for whatever reason, there seems to be little interest in steam in the automotive industry. Those parties who have been pushing steam, despite considerable efforts, seem unable to spark this interest to a useful pitch. This may be because, of the three alternatives—electric, turbine, and steam—only the electric is a true zero-pollution device, and therefore a final answer. While between the two continuous combustion engines, so much more research and development has already been done on the gas turbine that the engineers see no point in switching to another power plant which would give similar results, but on which they would have to start over again almost from the beginning. In other words, the gas turbine got a head start—largely due to its wide application as an aircraft power plant—and the steam engine is simply too far behind to catch up.

CONCLUSION

We have derived a set of performance parameters which a practical automotive power plant must meet, and compared various power plants against them. While the present version of the RPIC engine obviously meets these performance parameters, we have seen that this engine is almost certainly doomed when the new federal emission standards go into effect in 1975-1976, by its inherent dirty-burning pollution characteristics. Of the alternatives, only the electric car is a true zero-pollution device. However, we have seen that the problems of portable energy storage and recharging for such cars are very great. It might be barely possible to build the cars in the present state of our technology, but so much revamping of the electric power generating and distribution networks would be required to feed them that this would be practical only as an absolutely last-ditch resort. The practical electric car will, therefore, probably have to await the marketing of a portable fusion reactor of suitable cost and characteristics.

Between the alternative continuous combustion engines, the steamer and the gas turbine, either could probably be developed and marketed in new cars by the 1976 deadline, and either can be made to meet the requirements. However, the main interest of the auto manufacturers seems to be in turbines, and all have turbines which could be mass-produced and put in cars in a short time. In fact, at least one manufacturer, Ford, is already mass-producing a turbine engine for trucks.

Therefore, and always barring unexpected developments or breakthroughs, it appears unmistakable as a conclusion that the gas turbine, at least in the U.S., will almost entirely replace the RPIC engine in all new cars manufactured from 1976 on. This situation will probably continue until the development of a practical, portable fusion reactor. At that time, the turbine, in turn, will probably be replaced by the final solution . . . the water-fueled, fusion-powered electric. ■

BIOGRAPHY

R. G. Cleveland is the pen name for a California engineer/writer. He studied physics and electrical engineering in college, and has worked in industrial electronics since age 20. He has also done stints as a technical writer, judo instructor, racing driver and racing car builder. He has been reading science fiction since he first learned to read.

BIBLIOGRAPHY

"Portable Power" by John W. Campbell, *Analog*, March, 1967.

"Steamer Time?" by Wallace West, *Analog*, September 1968.

"The Gas Turbine" by Ron Wakefield, *Road & Track*, April 1971.

"The Sports Car, Its Design and Performance" by Colin Campbell (third revised edition), published by Robert Bentley Inc., Cambridge, Mass., 1970.

"Iskendarian Cam Catalog" published by Iskendarian Racing Cams, Gardena, Calif., 1970.


MONSTER IN THE WATERHOLE

Some men build and some men destroy. A determined fool can make a shambles of the finest ideas. Alas, there's no such thing as an "idiot-proof" system.

GLENN L. GILLETTE

Illustrated by John Schoenherr

When the alarm rang, Jim Bob placed the book he was reading on the arm of the chair, and rising from a sitting position, he pulled the mask from where it hung on his left shoulder. Wheeling on the ball of his left foot, he took two leaping steps and flung himself at the wall, body horizontal three feet above the floor. The sensor, prepared by the activation of the alarm circuit, sensed the flying body and, barely in time, dilated the door. The retreating circle revealed a face of water, surprised by the sudden disappearance of its restraint. Jim Bob pierced the vertical surface cleanly and the door shut. It had been open for less than two seconds and scarcely more than a cup of water fell inside.

Jim Bob activated his transponder and switched on his radio to talk to the controller. The words were piped to within five millimeters of his tympania by the special earphones, and the controller's words fought with his own to see which were indigenous to his brain.

"This is Jim Bob. I am five seconds out of Chute Bravo, expecting sled in ten seconds. What is the emergency?"

"Controller here. Young male fell through a drain. Breakthrough came in Sector six dog, five romeo. Sensors indicate splashing in that sector so he should still be alive. Still, utmost dispatch is encouraged for your transit. Cutter is being launched now. Advise if further aid is desired. Out."

"Roger, Control. Sled is in sight. Will advise further. Out."

"Good luck, Jim Bob."

"Thanks, Harry."

The torpedo-shaped underwater sled cut sharply to parallel Jim Bob's course, and he rolled and slipped his left hand into the handgrip as it pulled past. As his right hand made contact, he squeezed the throttle with it and felt the acceleration stretch the ligaments around his shoulder joints until the inertia had been assumed by his entire body.

The surface was just ten feet above him, but men, it had been found, could travel faster with a sled underwater than on the surface. The dark that handicapped his eyes was as pervasive in the air above as it was beneath the surface, but he was used to that by now. He guided the sled by an instinct bred by training and reason. In two minutes, he crossed the final intangible boundary and broke outside the watery environ.

He sensed more than saw the boy several feet away. He swam that short distance and caught the youth

as he made his last feeble efforts to defeat the weight of water-sodden clothing. Jim Bob slipped his arms around the lad and fastened the life-belt in front. As he pulled his hands away, he jerked the lanyard that activated the CO_2 cartridges. Exploding into three dimensions, the belt thrust the boy's head above the water and shook the nearly comatose youth into consciousness.

The boy opened his eyes on a Lethe-like span of water, lit only slightly by an anonymous source; the monstrous unseen cavern echoed eerily the lapping of the water. As he rotated, his eyes could grasp nothing except the near water until he saw a head rising from the surface. He took in the bulbously goggled eyes, the glisteningly slick head, the heaving at the neck where gills sorted the air, the bulging ears, and the single antenna that sprouted from a crest that ran the center of the head. The boy was sure that he had actually drowned and that now he floated in hell, being approached by the demon that was to escort him farther down. And he screamed, trying to burst the throat from his body in his efforts to be heard on faraway Earth.

"Stupid damn kid," Jim Bob said loud enough for the boy to hear. The youth shut up, and turned as he heard the sound of a boat cutting through water. Soon a motorboat neared them and slowed. Inside the boat were normal men looking anxiously about the water. He hollered again and waved a hand over his head. The boat coasted near him and strong arms reached into the water to haul him aboard. As he sat upright again in the boat, he saw the men wave at the waterborne creature. The monster submerged again into the depths.

"Another kid fell in the pool, Hank," the General Manager said coming through the door of the office. Henry Sims looked up from his desk, which was scattered over with yellow legal-size paper.

"Christ. How'd he manage to do that?" Hank pushed his swivel chair away as James Swearingen pulled the client chair back and sat down.

" 'Borrowed' his old man's acetylene torch and chopped up the screen." He paused and then smiled mischievously. "He also saw a monster down there. Scared the everlovin' out of him. He's telling everyone, so our biggest repercussions out of this may be that."

"Yeah, I can see it now: Mothers demand to know why inhuman monsters are allowed to swim in the city's reservoir, in the very water we drink. Do you think PR was right in the design of that equipment and the whisper campaign?"

Jim put one booted foot up to the edge of the desk and leaned the chair back on two legs. "Well, intrusions and accidents have been cut by two-thirds since the word that there were monsters down in the pool went out, so I think that it's done its job. But this incident, where someone ac-

tually saw one of the deep boys, could cause you and me some headaches."

Hank shook his head easily. "Not really, Jim," he said. "All we have to do is deny that such things exist, that none of our hourly patrol cutters and aqualogists have ever seen any evidence of such a thing. We can invite the various public officials down for another tour of the facilities, et cetera. Bring the boy and his parents along, plus whatever public wants to come. That's PR's decision, of course."

"Yeah, they can say that the boy was probably having delusions caused by the long fall, the impact of the water, and his own fear. Emphasize that the light is rather poor down there, and so on. Sounds good. But you had better put together a brief for the home office to reassure them. They'll probably ask."

"Sure thing, Jim. You'll have it tomorrow morning."

"Fine," Jim said, setting the chair back down on all fours and standing. Hank stood as well. "See you later," Jim said as he walked out the door.

Craig Stevenson, head of the Public Relations Department, conducted the small group of public officials and the Kings, father, mother, and the boy who had fallen in the pool, into the small control room. He urged them to crowd in front of the rectangular window that faced out on the reservoir and signaled the controller to turn on the floodlights. As the high-intensity beams sliced the darkness into pieces and dispelled them, the PR man began the patent spiel.

"There has been a trend of climatological changes noted, beginning in the middle of the Sixties, and by the start of the Seventies, the alteration of weather patterns was having an increasing impact on several areas of the United States. Los Angeles, for instance, was suffering from too much rain; while the Southwest—in particular, West Texas—was getting far less rainfall than it was used to. This area around here, in fact, became quite used to water rationing every summer and to seeing its lakes and reservoirs no more than dusty depressions in the ground.

"Actually, the greatest problem facing the people of this region was not the shortage of water, because there were ways to make sufficient water available to the citizenry. The largest difficulty was exposing city governments and the populace to the modern techniques, and their vast but necessary expense, in a way they would accept and initiate them. Near Brady, Texas, it was discovered that there was a gigantic underground deposit of saline water. To properly utilize this source, a huge processing plant would have had to have been built, and a complementary system of water reclamation—the treatment and reuse of sewage water—would also have had to've been constructed. Total price: minimum of sixteen

million dollars. An awfully big step for any one small city to take by itself, especially considering the appeal of drinking one's own sewage.

"A small executive firm in the Midwest was aware of the problem and began to work on a solution, for both humanitarian and profit motives. They remembered the low-keyed excitement that had been spurred by a Project Plowshare in the Fifties, checked into a few matters, enlisted the aid of the Atomic Energy Commission, hired engineers and public relations people, sank several millions into a corporation, and started out to do one of the biggest selling jobs this country has ever seen.

"For a minimal fee and some property risk, the company promised a city a final solution to its water problem. They would explode a small atomic device beneath the city, creating a vast cavern that would be sealed hermetically by the heat of the explosion. This cavern would act as a cistern for the town, receiving all the previous inputs to the water supply plus whatever drainage there was from the city itself. The huge underground reservoir, or 'pool' in the lingo of the company, would eliminate seepage, evaporation, and pollution losses; being immediately under the city, it would reduce pumping expenses and provide an extremely effective drainage system. It did have a drawback in that it did not easily offer itself as a recreational facility, but the company emphasized that the appeal to industry of the water source would outweigh the loss of tourist revenue, especially in West Texas and New Mexico.

"The company solicited all cities in the country, working especially on those that had water shortages. Then, on March 22, 1974, they flew representatives of interested cities to Piñol, Utah, then a large expanse of desert flat. The next morning, the demonstration began with a nuclear device being detonated beneath that barren waste. For the next two months, the company shuttled those representatives back and forth so that they could witness the progress being made. The explosion had not breached the surface and the radiation level above ground never reached even fifty percent of the maximum safety level. Within two weeks, radiation levels in the cavity were low enough that the initial construction could begin, and at the end of the two months, the entire facility was capable of operation—and there was forty feet of water in the pool. Many cities, including this one, were sold on the project: it offered a sure and long-lasting solution to the water problem and at the very cheap price of two million dollars."

Stevenson paused and scanned the faces that were turning back and forth between him and the great panorama out the window. The father of the boy frowned slightly and tentatively raised a hand.

"Yes, Mr. King?"

"Billy Joe said thar wasn't any

lights on when he was in the water. How come?"

"Well, Mr. King," Stevenson's manner dropped into the obsequious, "I wish you hadn't asked me that question. You see we had a system failure that night. When the alarm went off, the lights should have turned on automatically—we don't keep them on all the time because of the expense—but they didn't. The controller was too busy directing the rescue of your son to be able to mend the circuit at fault. It didn't, however, slow down his rescue any; our men are trained to be able to compensate for any difficulties without any loss of time. We since traced the trouble and corrected it."

"And now, Mr. King," the PR man continued, his lie convincingly in place, "if you will kindly lead the way, I will show you the apparatus our men use to patrol the pool and keep all the equipment operational."

Stevenson watched the group file out, noting with a bit of pleasure that the boy walked gingerly, as though his buttocks were quite sore.

"Hah thar, Dogie," the tall man hollered from the entrance of the small bar. At Dogie's wave, he set off through the scattered bent-steel tables and chairs with a loping stride. He wore mud-clogged cowboy boots, beat-up blue levis, a long-sleeve Pendleton, and a battered Stetson on the back of his head. The man he walked up to wore an almost identical outfit.

"Howdy, Bubba," said Dogie. "Have a beer." He threw a hand toward the bar where a rather dowdy waitress nodded her understanding. Bubba sat down, swinging his left leg up over the top of the chair and dropping his bulk onto the seat. They chatted about family, pickup trucks, and hunting until the beer arrived.

Then Bubba said, "Ya'll hear 'bout the monster down i'the res'voy? Kid fell in thar yest'day and saw one. Said it was bubble-eyed and had a pulsing neck and a 'tenna stickin' out the back of its head. It almost got him 'fore the water boys got thar in a boat and saved his hide."

"Ain't right those Northerners 'lowing monsters down in that water what we drink. Maybe we oughta go down thar and do somethin' 'bout it." Dogie chugged the last of his beer and waved the empty bottle in the air.

"Like what, Dogie? That's all water down thar and it's purty deep at that."

"You ever scuba dive, Bubba?" Dogie squinted across the smoky dark at his friend, the right side of his face creeping up in a conspiratorial wink.

Dubiously, Bubba shook his head slightly and murmured, "No, ne'r have."

"Wall, Ah have and Ah got two sets e-quipment back at home. Even have some spear guns. We could cut through one of them screens, drop down in the water, and get us some

of them critters. Can you imagine bringing one of them things home and mounting the rack? Nobody 'round here could beat that." Dogie nodded certainly as the waitress cleared away the last round and left a new one in its place.

"Yeah, never thought o' that. Have to get two though. Ah'll bring the old man's .44. Water don't stop it none. When we gonna do it?" Bubba was getting excited now.

"Get a little more juiced up here, buy a couple six packs on the way home, borry your old man's scet-lene torch, and we'll do it tonight."

Jim Bob was a little tired as he let the sled pull him through the water in reaction to another alarm. He only pulled these emergency shifts because they paid double-time-and-a-half; and in one of those rare instances, this one had come on the same day as he had regular work patrolling the submarine outlets and inlets and machinery of the waterworks. Besides, this was twice in one week they'd had an emergency. Didn't people ever learn?

The controller had told him that it looked like two bodies this time but they weren't splashing in a normal manner. The sector was quite near the standby room so Jim Bob didn't have time to think about the unusual inactivity.

He broke the surface and moved the sled aside, set on idle. He saw two figures floating easily in the water, their heads glistening in the faint light. He had time to realize that they too were wearing wet suits when a voice rang out.

"There's one, Bubba!"

The nearest man turned in the water, his right arm flowing with the movement, rising in an arc and coming down to point at him. Quicker than he could think, Jim Bob's brain recognized the silhouette of the six-shooter and dove beneath the surface just as flame burst from the gun barrel. The bullet pinged into the water and Jim Bob scrambled deeper, his awareness catching up with the situation, his fatigue flowing away before the onslaught of adrenaline.

"Harry!" he called into his throat mike.

"What's the matter, Jim Bob?"

"There's two idiots down here in wet suits and scuba gear and they're shooting at me!"

"My God! Hold on!" Harry, in his control center where he monitored the off-hours operation of the plant, slapped switches that alerted the cruiser and the general manager. He warned the men on the boat about what Jim Bob had said and then returned to his underwater microphone.

"What's going on?" he asked calmly.

"I'm at forty feet, holding steady. I'm trying to remotely override the sled's controls and call it back to me. I had to leave it up there." Pause. "Here it comes now. Now I'll get the hell out of—there's someone riding it

and he—" The scream of pain rattled the speaker in the control center.

"Jim Bob!"

Floating in the water, Dogie and Bubba waited, each movement to stay up allowing in new swirls of cold water that brought them closer to sobriety. Neither one of them knew how to stalk an underwater monster and only Dogie's fierce personal pride kept him from calling off the fool's game. Suddenly, in the hellish light of the pool, Dogie saw a head appear above the water and turn in their direction. His stomach and anus tightened in fear but his mindset overrode the terror. He yelled at Bubba who was shivering slightly in the water, his back to the monster. In a practiced move, the other man turned and, pulling the .44 from where it hung at his shoulder, fired as soon as he could see the silhouetted head. The report ricocheted off into an eternity of echoes and the monster dove from sight.

Jerking quickly about in the water, the pair tried to watch all sides simultaneously, their burgeoning fear a real entity. Had Bubba hit the beast, and wounded, would it turn back at them in a submarine rage? An anxious minute passed and Dogie broke out of his fear-born eddy to swim to the spot where the monster had disappeared. Casting about, he found the underwater sled, floating inertly just on the surface.

The presence of the sled, complete with stylized trademark, spoke the truth in Dogie's mind, and he turned back to Bubba with a wry grin twisting his features.

"That there was a man," he said.

"What?" Bubba still searched the near water carefully, the six-shooter held alertly in a crooked arm. "How'd ya know?"

Dogie trudged the sled back to his partner. "He were usin' this to get 'round. Them Northerners must have some fancy, 'vanced e-quipment they're usin' here to make a guy look like a monster."

"Mah Gawd, Dogie, what'll we do now?" The import of the information dawned on the armed man. "Ah maht've killed the guy—or jes nicked him. We done in trouble now," he concluded accusingly.

Dogie's face became hard behind the glass of his mask as the fear of the known replaced the fear of the unknown. He spoke harshly, "Not if'n he don' tell no one 'bout this."

"Kill him?" Bubba was bewildered and tumbling rapidly toward hysteria. Under Dogie's hand, the sled started its engine and began to turn. As the machine slid beneath the surface, the cowboy rode with it, hoping that it might take him to the man they had encountered. Bubba was left alone in the Hadean depths.

Dogie freed his spear from its place at his side and ensured that it was loaded and cocked. In a mind in which all conscience was momentarily stilled, he organized his forces. The gun was laid on top of the sled, riding its longitudinal axis, and

Dogie gently squeezed its trigger in preparation. He saw Jim Bob an instant before the diver discerned the shadow behind the sled and launched his spear with murderous intent. Only the automatic action of the sled, swinging to parallel the homing signal, prevented the missile from gutting Jim Bob. Instead, it caught his forearm and wickedly slashed through it. Blood gushed from the wound and blanked the already murky water.

Dogie, pressed on by his desperation, pulled his diver's knife and plunged into the reddish cloud that engulfed his quarry. Jim Bob's first reaction was to kick over and drive deeper into the water. In the initial seconds of his escape, he clamped a hand over the streaming injury; then he paused to break open the underwater first aid kit and wrapped the bandage around the six-inch gash. The spear had cut deeply, laying the muscle back from the bone. The increasing pressure of the water helped to stanch the flow of blood but enough had escaped already to cause a faintness to affect Jim Bob's mind. The bandage would stop all flow but the damage had been done.

Jim Bob ripped the string from the plastic that allowed the bandage to hermetically seal itself to the surface of the skin. The pressures equalized inside to keep the blood in the tissues. When that was finally done, Jim Bob called the controller while maneuvering farther into the depths.

"Harry." His voice was weak. "Come in, Harry."

"Jim Bob! Are you all right? Where are you? The cutter just picked up one of those guys. They had to use knockout gas 'cause he took a couple shots at them. Where's the other one? Are you all right?"

"If you'd let me talk a second, I'll tell you." The humor in the faint voice relaxed the controller. "The other one hitched a ride on the sled—oh God! I forgot to turn off the homing switch. There. Harry? Turn on the homing override you've got and get that sled out of here. That guy might still be riding it." Jim Bob reexerted himself and the groans of his effort at swimming came through the mike. He drove his legs furiously, the rubber flippers pushing harshly against the water, trying to put yards of water between him and his last homing position. At last he relaxed, and the air rasping in and out of his throat made a rushing sound in the controller's headset.

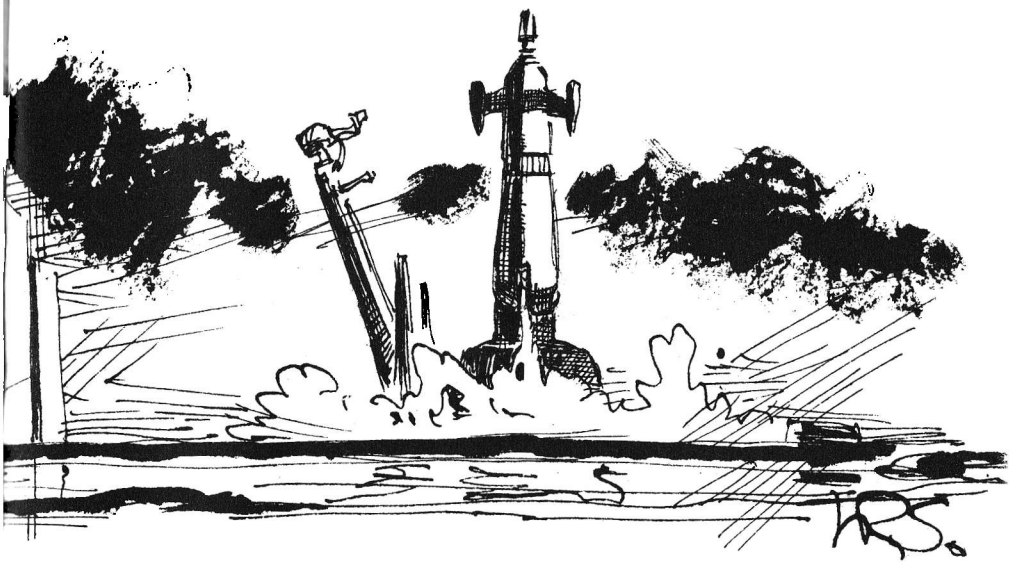
"Jim Bob? The signal's on and I've alerted some men to be at the pickup point."

"Great, Harry. Thanks. Let's hope he sticks with that sled. I'm heading up now. Could you have a cruiser with a doctor come pick me up?"

"Sure, Jim Bob." Pause. "It's on its way. Now, start talking to me, counting or something. I don't want you to get lost out there."

"Sure thing, Harry. You're a captive audience. Did you ever hear the one about . . . ■


13
Leo Summers



COUNT DOWN

It being a fundamental truism
that human beings always act on what
they believe to be true—which has no necessary
correlation with what is true!

LAURENCE M. JANIFER

There exists, first, a class of statements dealing with events which, to the best of present knowledge, appear objectively true, and, second, a class dealing with such various public beliefs as have acquired among the multitude the same force as members of the first class. The duty of an official dealing with the public, therefore, is usually to adjust matters in such a way that events objectively within the scope of the first class are made to appear events within the scope of the second. As the multitude immovably believes that it is primarily fixed upon truth—perhaps the most usual of the second class of statements—its belief may not be denied—nor, as a rule, can this mythical belief serve as a basis for action in the objective world.

The *Public Notes* of Isidor Norin (Minister for the Dichtung, c. 2300 A. D.)

CAPITAL COMPLEX:
CAPITAL CITY:
1500 H., 27 MAY 2113

"If we're ever going to establish a self-sustaining colony we have to support it now; that ship has to go out."

Freeman looked at the round, red, decisive face of Liam Harcourt and sighed. A meeting of the Council, even an informal one, was far from the best place to give Harcourt a lesson in the elementary rules of dealing with human beings—if, after all, there were any such rules. But the Minister for Public Order had to be sat on—an imperative at least as insistent as Harcourt's own *that ship has to go out,* and as important. More: he had to be made to understand. The damned fool had, as of May 2113, the ear of the emperor, and a good deal of influence with Dace and the rest of the Interplanetary Flight people as well; and neither Walther IV, nor the respected Dr. Dace, was the sort of paragon, it appeared, of whom Dall Freeman dreamed: a man immune to irrelevant personal influence. Rule one, perhaps: there are no paragons.

However: "I see," he said, as mildly as possible. No minister present showed the least surprise at the tone. It had been a long time, Freeman supposed, since he had trained himself into Old Mildness-Whenever-Possible, and though recognizable outbreaks of the old Unreconstructed Bastard occurred, he took as a minor triumph, all in all, that the new character had become accepted as—quite normal. Quite predictable. "The ship has to go out," he went on in the same tone. "We all see that much, Liam. But it cannot go out this week. And there seems no way whatever of arguing with that limitation."

Harcourt made a sound two-thirds of the way from a cough toward a dog's wet bark. "I've heard quite a lot of argument with it," he said, and sent a fast, heavy look around the Council table.

Prater Shaw blinked behind his

enormous imitation-ancients' spectacles, and leaned forward as if he were eager for his cue. "Oh, *scientists,*" he said, with immense high-tenor scorn. Behind the facade of Old Mildness-Whenever-Possible, the Unreconstructed Bastard began to curse rapidly, steadily and explosively. "They're not *practical* men, Lee," Prater went on, as if he were saying something totally new. "Surely you know that. They just don't understand the way most people think, that's all. And we have to take that into account the very first—"

"Most people," Harcourt said—a trombone interrupting an English-horn solo—"don't think. And I won't bother bandying idiocies even with a Minister for . . . what's the new title? . . . Travel and Communications."

Freeman forced himself to interrupt the Unreconstructed Bastard's picturesque, if silent, soliloquy. "We don't really need to fight about this, you know, between ourselves." The four other ministers present helped out with a background mutter of agreement; and Prater, of course, with several more blinks, chimed in.

"Oh, I had no *intention*—"

"Yes," Harcourt said dully, "we know that. You seldom have." And, while Prater was apparently sorting that one out for possible insults, the big red-faced man went on. "I don't give twenty credits for the opinions of most people. In a matter like this, they have no competence at all. The decision has to be left to technical men—to experts, if you like the word."

Freeman sighed again. "Would you want to tell that to 'most people'?" he asked.

"The public,'" Harcourt spat, "has no competence in the matter!"

"Very well," Freeman said, a little weariness showing through; he had been fighting a single battle, on the same terms, for a week and a half, and was inclined to think boredom the chief terror of war. "Explain it all to them—tell them they are not competent."

"They wouldn't agree! They wouldn't *understand*—"

"Exactly," Freeman said, still in his softest tones. "And they wouldn't even agree to the parts they did understand; they'd like none of it." Perhaps a small victory in the continuing war occurred; only Prater—thinly eager—and Harcourt—turning from red to purple-decisive—showed any interest at all. Neutrality was an advantage to anyone who knew how to use it, as it nearly always was. "The only difficulty," Freeman went quietly on, "is that, unless someone re-invents the ancient fuel and firing methods in a great hurry, we will have to go on with our own techniques. Which involve a single, inalterable exhaust speed, and—therefore—a single, inalterable track for the *Roubins* to follow. The experts, Liam, have been through all of this for us, in testimony and otherwise, and their figures are scarcely

questionable now. It's simple enough: exactly one point eight years, plus a few-odd days and hours, elapse between one trip and the next. Given only one ship speed and only one Earth-Mars track, we can send one ship every—well, call it every twenty-one months. If we pass this one, we wait for twenty-one months, and so does Thoth. And Thoth isn't even *that* self-sustaining, not yet."

"We know all this," Harcourt said. "Why don't you—"

But boredom was a weapon for both sides. "Liam," Freeman said, "after ten days of talk I have no idea at all what anyone knows. I respond to what you say; but I've got to lay a ground of some sort here."

"Now—"

"Please," Freeman said, even more gently. "Thoth isn't self-sustaining. That's why the *Roubins* is needed. Thoth won't wait twenty-one months; they'll start right back here long before then, probably via the Moon—ours, or one of theirs."

"Exactly," Harcourt said, as if he'd won something. *A prize for bull-headed idiocy, perhaps*, Freeman thought. *A steel carving of an animal head with an open cavity where the brain might have been expected. Suitable for ashtray, paperweight, or missile.* "Exactly. That's why we have to ignore this—silly outcry. It will wear itself out, Dall; you'll see. As soon as the *Roubins* reaches Thoth safely, it will die down completely."

"Eighty days from lift-off," Freeman said.

Sam Murin spoke up weightily, around his great black pipe. "It seems a long time."

"Seems, Sam? It is a long time," Freeman said. "As Minister for Information, you know the effect of eighty days of uproar better than anyone else."

"Except the emperor," Sam put in.

Freeman shrugged. "If you like," he said. "At any rate, this is supposed to be a popular government—an elective government. Responsive to the wishes of the people." He let the words hang in the dead air for a second. "The government would fall."

Harcourt muttered something inaudible. He seemed to be practicing looking noble. "If it has to be—" he began.

Freeman caught the shadow of an immense distaste on Sam Murin's square face, and broke in. "Very well. If we're to be sacrificial, let's consider the result. The government falls." He looked round at the others: neutrality in most faces, stubbornness in Harcourt's, while Sam Murin went carefully blank and Prater Shaw seemed to be trying for *dutiful*. "But what government succeeds us?" he went on. "A government pledged to 'cut all this space-adventuring to the bone'—you've heard the speeches. Dismantle Thoth. Continue Moonbase by yearly shuttle and no more. Drop all probes, all attempts at colonization

or exploration. Yank the human race right back to Earth. If you want to step out in favor of *that*–"

"Moonbase," Sam Murin said. "Dall, why not get the rocket to Moonbase and start it to Thoth from there? It'd get rid of the numbers problem, wouldn't it?"

"It would, Sam," Freeman said, "except for another numbers problem. It would be approximately three times as expensive–and despite what the Dichtung says every time a new budget item for Rocket and Interplanetary Flight Group comes along, there just isn't that kind of available credit for the asking."

Murin nodded very slowly. "Nor likely to be," he said. "According to research and interview groups, and spot eavesdrop checks, the public has had about as much spending for 'cold, empty, airless, useless space'–I quote a recent speech by one of our Opposition friends–as they're going to stand. Nevertheless, contingency funds–"

"Are useful for many things, Sam," Freeman said. "But not for anything this big. Contingency funding is like petty cash; immensely useful, but you can't draw on it indefinitely, or to any large extent."

Prater looked up suddenly–struck, obviously, by what Prater considered an idea. "But the Opposition . . . I mean, if they did get in, if we went ahead and the government did fall on this issue–if they got in, I mean–well, they wouldn't stay in office forever, you know."

"They wouldn't have to, to do the damage we're talking about." There were times, Freeman reflected, when he seemed to be teaching a primary school. Remotely, he imagined that everyone, probably, felt the same now and again. Still . . . "Give them two years–and I think they'd have two years without much trouble–and we'd have to start over again from scratch. No probe program, no proto-colony, nothing in this area at all would last two years without real support. And–we'd have to start over again with the people, too, Prater." He looked over at Murin. An authentically calm man, Freeman thought, and wondered whether or not he envied the quality.

"Two years is a long time," Murin agreed, on cue. "People forget. They have to be educated, or reminded . . . well, find your own word for it . . . all over again. They have to be re-convinced. And God, if any, has no more idea than I do whether, after two years, re-convincing would be in the least possible. It isn't the sort of question you can expect Information to answer–we deal only in very immediate futures."

"Well, then–" Harcourt began heavily.

"Well, then, we have to send the *Roubins*," Freeman cut in. "Except that we can't–which is where this talk began."

Harcourt nodded. Judicious. Thinking it over. "With–it occurs to me–your fond acquaintance Richard Hamsun in command. Dall, it ir-

ritates me to have to work for that man's success—"

"It isn't his success, and there's nothing really irritating about him," Freeman said as mildly as he knew how. "He's the best available—and he knows it—which is why he was invited to the Year Day Gala. I took some care to introduce myself to him then, and to make as sure as I could that he remembered me. Admittedly, he has an unfortunate habit of saying what he thinks . . . but he *is* the best available, and the success won't be his, or mine, or yours. The success will belong to the human race. We need to spread out—"

"I remember Hamsun's speech," Harcourt snapped. "It hadn't occurred to me that you'd had one of your staff write it—or written it yourself."

"I didn't." *Quite tiring,* Freeman told himself—*exhausting, in fact. Also, necessary.* "It's just that the proposition is sufficiently obvious to occur to more than one person."

"Perfectly obvious," Harcourt said.

"And every survey—am I right, Sam?—makes it more and more evident we're stalled. The *Roubins* has to leave within a six-hour period. We have that much leeway—but all of it falls on Friday. Friday, June 13th, in the year 2113. Which puts a curse on the ship—for all I know, on Thoth, on Hamsun, and on the entire program; I wouldn't put anything at all past the quasi-rational hysteria a good superstition can work up. The people won't stand for the curse."

"Damn it," Harcourt exploded, "it's perfectly ridiculous!"

And Freeman wearily nodded. "I know," he said. He gestured toward the sunken imitation window of the Council chamber, a ten-foot square purporting to display the world outside the Complex. "I know," he said once more. "And you know. And we all know." He gestured tiredly at the window. "Now, Lee—tell *them.*"

CAPITAL COMPLEX:
IMPERIAL AUDIENCE
CHAMBERS.
1040 H., 29 MAY 2113

"Very well," Sam Murin said, tamping shreds of something or other carefully and precisely down into his big black pipe. *An authentically calm man.* At times, the most irritating type of human being available. "We have secured—at any rate, Dall, you have secured—an audience with the emperor, which will begin in twenty minutes and, for all I know, end in twenty seconds." The pipe was, apparently, sufficiently loaded. Murin touched one of those new things—an Induction Coal—to it and began surrounding himself with smoke. "After all, I am the Minister for Information, Dall. I think the least I deserve is a small bit of information. Such as: What am I doing here? What are you doing here? What in the name of God-if-any is this whole official audience all about?"

And in all those words he had

never raised his voice. *It was*, Freeman thought, *an admirable performance, of its kind. And Sam wasn't a bad fellow, take him all in all . . .*

"I think we can get Imperial backing for the *Roubins*," Freeman said. "And for a small idea of mine."

Murin made a sound rather like hm-m-m. "I know your small ideas. One of them almost cost Prater Shaw his nomination—not that Prater knows it, and not that it's worth my telling him."

"I hadn't meant to—"

"Doubtless," Murin said comfortably. "And what you *did* mean to do—well, you did. Playing politics, as they say—the only game for adults."

Freeman tried to sound relaxed. "Who was it called it that?"

"Eberhardt," Murin said. "Psych professional, and—at the moment—influential. In fact, psych man in charge of that section for the Interplanetary Flight Center." A cloud of smoke lifted his words to the domed, undecorated ceiling. "Thinks politics is harmless and ignorable—you know the type. But don't sidetrack me."

"I wasn't trying to," Freeman said. "What I want to do is attack the whole stupidity of superstition directly—on 3V, wherever and whenever possible. Ministerial dignity might make a dent here and there; but of course I need Walther's permission. And yours."

"Mine?" Murin managed to look rosy-cheeked, innocent and sly, all at once. For a man of Murin's experience, with Murin's oversized features and flat long face, it was distinctly a feat.

"Yours," Freeman said flatly. "You control 3V—all of it that counts, anyhow. Don't give me the sort of bafflegab you hand the public. If I want to spread a view on 3V, I need you with me."

Murin nodded. "I'm with you," he said.

At the far end of the great plain room, a set of double doors opened, two uniformed men entered and stood at attention, and, as Freeman and Murin watched stiffly, a reasonably tall man, run a bit to fat, with a spiky whitish beard, curled white-yellow hair and the tiny pair of half-eyeglasses that were his public trademark, walked in between the uniforms, glanced round the room, and waved a somewhat languid hand. The doors banged shut; the men in uniform remained inside the audience chamber, one at each door, at full attention, and fully armed.

As he came toward the small Imperial seat at the room's center, Walther took a sad look back. "Very disappointing for them, isn't it?" he said. "I mean: one would think they'd be horribly bored, guarding one man month after month, with never the slightest hint of an assassin to guard against—" He reached the chair, slid into it, and waved Freeman and Murin to seats nearby and facing him. "You wouldn't be planning to kill me, now, would you?" he asked. "Or anything exciting like

that? I really do feel a certain responsibility for the way I've wasted the time of these poor young men—"

"Damn it," Freeman cut in, "you don't have to stick to the public manner here. You know that."

The emperor blinked. "Minister," he began, very slowly, "there are moments when one nearly understands the reputation you once had—the reputation one had thought you had long lived down. Such impatience—" He made a vague gesture with one hand.

Freeman took a deep breath. *Old Mildness-Whenever-Possible.* "My most sincere apologies, Sire," he said, most quietly. "I have been so frustrated by recent events that even the basic forms of politeness at times drop from me. I most sincerely beg your pardon."

Murin, at Freeman's right, made a strangled sound and managed to sit still. Walther IV nodded with elegant, precisely calculated graciousness.

"Very well, Minister. I had hoped for an enjoyable chat . . . but, then, of course, one must be businesslike, even when Imperial, mustn't one? And, as you have requested this audience, I shall ask you to state our subject—which, I take it, is somehow connected with your recent . . . ah . . . frustrations?"

Freeman waited for a polite second and nodded. "If Your Imperial Majesty please—" he began.

"No need to overdo the manner," Walther put in quietly.

Freeman shrugged. "I'd like you to hear something," he said. "This is a copy of a tape taken for record at the Space Center. We've been going through a good deal of material, and perhaps this—to provide background and an emotional setting—will be of use."

The emperor appeared to hesitate; then, with a wave of one thin hand, he said: "Oh—very well, Dall. Go ahead."

Freeman reached to the small box on the floor at his left, and touched two buttons. There was a small, continuing hiss. "The first voice belongs to Richard Hamsun," he said, "our selected pilot for the shoot to Thoth. The second belongs to a Dr. Beirin Eberhardt, the acting head of the Psychological Section there. The occasion was one of the scheduled 'unofficial chats' with psychological personnel."

"I see," the emperor said. Nothing could have been more noncommittal than those two sounds.

Suddenly a harsh voice began to speak in the room. "How did it start?"

"This business about thirteen?" Eberhardt's much smoother, older voice asked.

"All this—superstition," Hamsun said. "Suddenly it's all over the place. How did it start out?" There was a brief pause.

"The men at the Center," Freeman put in hastily, "know that curiosity is considered a healthy trait, when allied with safeguarding traits;

they occasionally make a point of displaying it."

"Of course," the emperor said, and Freeman snorted to himself: what need was there to explain the obvious to a politician who worked at his job all the time—not part-time, only when chosen for the Council, like semiprofessional Dall Freeman?

"No one," Eberhardt was saying reflectively, "really knows. Though of course Dr. Allerton's work has brought a good deal of it to public attention with—ah—a certain amount of force. His diggings and subsequent research into the days of the ancients . . . well, of course it's been established that the superstition didn't spring out of the Clean Slate War itself—though the myth that followed it, the 'thirteen hydrogen bombs,' gave it . . . ah . . . a new lease on life."

"Myth?"

"The truth is," Eberhardt said in an oracular tone, "that no one has any clear idea how many such . . . ah . . . devices were set off. I doubt whether even Dr. Allerton's researches will tell us that in any certain way. But—the superstition long predates the War, and was quite common among the ancients. They had begun the exploration of interplanetary space, you will recall—and when accidents of a serious nature developed during the Moonflight which one 'country' had numbered thirteen, the significance of the number—to such persons as owned to the old superstition, of course—was naturally much increased."

"I can see that," Hamsun said. He had no chance to say more; Eberhardt was sailing straight on.

"One line of research, duplicating the principles involved in the hydrogen-bombing techniques themselves," the psychologist said cheerfully, "and then attempting to fix very precisely the amount of residual radioactivity in ordinarily . . . ah . . . stable materials . . . as well as other techniques . . . all this may eventually provide some trustworthy figure, though I doubt it, for the number of bombs used, their exact power, and so forth. But current belief merely asserts, without feeling the need for any proof whatever, that the number was in fact *thirteen.*"

"Sure," Hamsun said, a bit distantly. "Heard it all my life."

"The basic superstition, however, extends into the past beyond any records which the ancients were kind enough to leave in the chaos our ancestors inherited. Quite a lot of material, actually, though with a few odd gaps, and a certain . . . ah . . . reluctance among our immediate ancestors to pursue the records at all. We must understand, you see, that—though the War was much more than a century ago, we call those who suffered it *ancients*: a psychological mechanism to displace them further from us, to put the entire period so far into the past that it need not be the concern of any living person. *Ancients* indeed—when avail-

able material coherently displays a *written* history more than five thousand years long! But popular terminology is inescapable."

In a short pause, Hamsun muttered: "I imagine so." No one else spoke.

"And in any case," Eberhardt went on, having apparently taken on new breath, "the horror of the number thirteen can be traced back as far as written records go; doubtless it was common in the Stone Age. There are numerous theories regarding its origin, none being finally convincing. Where it began, and why, we simply do not know."

Another pause. The hiss of the tape filled the big chamber. "But . . . well, did they take it so damned *seriously,* back then? You'd think—"

"Some, doubtless, did," Eberhardt said, "and some did not. The proportion seems to have favored . . . ah . . . sanity more than it now does; we have records, at least, of a flight numbered fourteen."

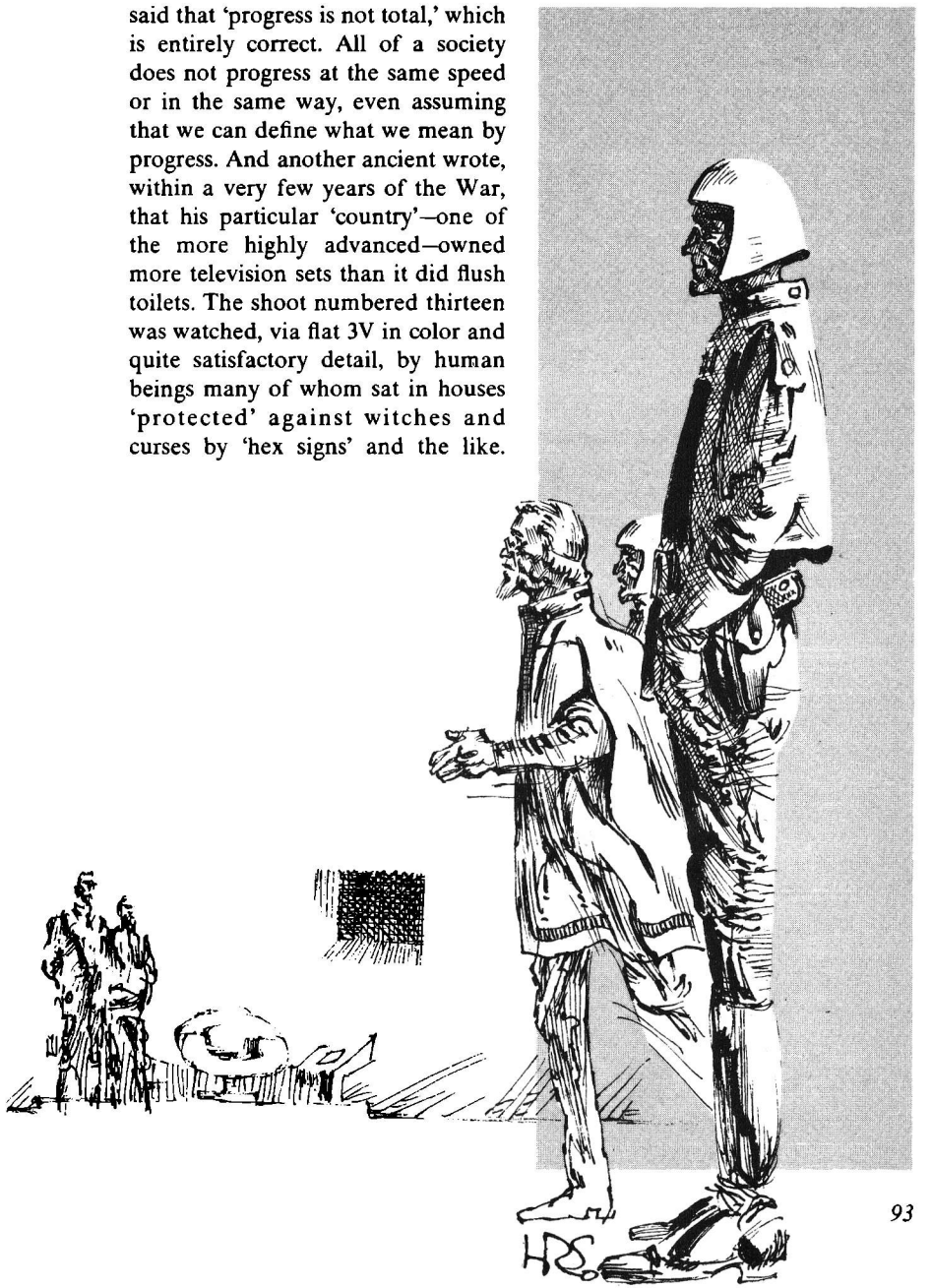
"Sanity?" Hamsun asked, sounding shocked. "The . . . ancients?"

"Precisely," Eberhardt said calmly. "You make a common error, Richard: you assume that society—that even one man—is all-of-a-piece, so to speak. The ancients were suicidally mad: the Clean Slate War is sufficient proof of that. They were also, as regards . . . ah . . . serious superstition, more sane than we. I believe that their various 'countries' were pervaded by a—miasma, so to speak—of generalized superstition, cropping up here and there in specific forms. But, certainly so far as *thirteen* is concerned, we are less sane; we allow the superstition, which has no rational base and for which no rational base is ever offered, to influence rational acts."

"Like this shoot," Hamsun said.

"Exactly," Eberhardt said at once. "One of the . . . ah . . . ancients

said that 'progress is not total,' which is entirely correct. All of a society does not progress at the same speed or in the same way, even assuming that we can define what we mean by progress. And another ancient wrote, within a very few years of the War, that his particular 'country'—one of the more highly advanced—owned more television sets than it did flush toilets. The shoot numbered thirteen was watched, via flat 3V in color and quite satisfactory detail, by human beings many of whom sat in houses 'protected' against witches and curses by 'hex signs' and the like.



And we . . . we are attempting the colonization of Mars, and we may be hurtfully, even fatally delayed by a superstition absolutely sense-free and older than recorded history."

"You really think they can stop us?" Hamsun said after a second or so. The three listening men sighed and stretched somewhat, out of weariness; the psychologist's tendency to lecture was hard on everyone. Dall Freeman felt, briefly, a bit sorry for Hamsun.

"I have no idea," the professional voice said calmly.

"Then maybe—"

"But I have learned," the voice went on, with no change in tone whatever, "never to underestimate human stupidity."

Freeman moved forward and cut off the recording. The silence that came down on the room seemed exceptionally empty, exceptionally sad. "It goes on for some time," Freeman said as briskly as he knew how, trying to dispel the general wash of emotion. "But you've heard the essentials."

"Very well," Walther IV said rather slowly. Murin, hands behind his back, kept silence, watching and waiting; Sam was a good man, all in all. Not a subtle man but a good one. "What is it you want of me?"

Freeman shrugged. "It ought to be obvious, Sire."

Walther's grin was as sharp and distant, as cold and plain, as ever Walther had been. An unusual man to be elected emperor, Freeman thought briefly; one would expect a friendlier type, more accessible, more obviously "understanding." But then—

The phrase *father image* occurred to him and he dismissed it with impatience. Whatever the truth was it went deeper than that. Another ancient saying, from God knew who or where: *The most thorough lie that can be told is: It was as simple as that.* Probably quite true, which was why politicians were in the lying business. . .

"I'm afraid," Walther said coolly, "you'll have to tell me, Minister. I'm not in the mood for riddles this afternoon."

Which bothered Murin, a good man but not a subtle one. Freeman knew that the luxury of responding to personal insult had to be jettisoned in the first month of elective-political life, if there were to be a second month. Walther had got rid of it long ago. "Very well: I want Imperial backing for a series of appearances on 3V. Appearances by me—"

"Obviously," Walther said dryly.

"—Talking about this superstition and trying to combat it with the facts."

Walther's grin returned. "The facts, Minister?"

Sam said: "Dall—"

"The facts," Freeman said. Walther appeared to assess the idea for a minute.

"You'll lose," he said then. "The *Roubins* won't take off. Why, Dall—

you know as well as I do that the public isn't influenced by facts."

A very odd person for an elective emperor. One would think . . . well, Freeman told himself, *never mind.* "Nevertheless," he said.

Walther turned away, washing his hands of the matter. "Minister, I want the *Roubins* in flight as much as you do, and you know that."

"Then—"

"But this—giving facts to the public . . . this has no chance of success. And you must know that, as well."

"I've made my request," Freeman said.

The room seemed to hold its breath. After a long time—perhaps fifteen seconds—Walther's dry, distant voice said, almost casually: "Granted."

"I thank you, Sire."

"But I shall not speak—"

"Of course not," Freeman said, shocked. Did the man want to ruin everything? "I'd never considered it."

Walther turned away from them, nodded slowly. "I have learned, Minister, that you almost always know what you're doing. I very much hope that this time you are right. And if there were any other way—"

"If there were any other way," Freeman said flatly, "I wouldn't have made my request."

CENTRAL BUILDING,
PUBLIC VIEW SERVICES:
STUDIO 3:
JUNE 1, 2113—1930 H.

"And here, brought to you by *Public View,* the first with the best, to be interviewed by our panel of accredited newsmen, is the Minister for the Dichtung himself, whom you're all anxious to see and hear, so I won't stand in his way any longer: Minister Dall Freeman."

"Thank you, Sidney. Before we begin the interview this evening, I'd like to make a brief statement, if you don't mind."

"Not at all, Minister, not at all; anything you desire, of course. Ladies, gentlemen: The minister is about to make a statement. Minister Freeman?"

"Thank you. It has been brought to my attention that many of you watching—and many who are not now watching; there are doubtless better things to do on a Sunday evening—are opposed to allowing the interplanetary ship *Roubins* to take off on June 13th of this year—a Friday, as you know—because you feel that no good can come of so great an event occurring on Friday the thirteenth. Well, ladies and gentlemen—and I mean to include those of all colors, our white brethren as well as the rest—I hope you won't be seriously influenced by what is nothing more than a bit of ancient superstition. There is no magic in the number thirteen, no magic in the day Friday, no magic in their combination. I'm sure you are sensible enough to realize that. The *Roubins* is needed; it cannot take off on any other practicable date. I hope you won't allow this scrap of discredited

superstition to influence you against the takeoff; and I'm sure that, on reflection, you will be the sensible people I have always known you to be."

"Thank you, Minister. And now, if perhaps there is a response . . . yes, Mr. Delvora?"

"I'd like to ask the minister . . ."

COLORADO SPRINGS ARCHAEOLOGICAL SITE: 1600 H. (2000 CAP. COMP.), 3 JUNE 2113

"I've seen that idiot on five programs in four days," Parran Allerton said as he punched off the portable 3V. "And I hope I never see him again."

His sister Marian, keeping him company in the main tent of the expedition, sighed. It was going to begin all over again. "Why, Parr? It seems to me—"

"It seems to you he makes sense," Allerton snapped. "Of course it does. But to the great public . . . he's doing harm, not good. *They* don't want sense. They want . . . oh, God, I don't know what. Cosseting. Reassurance. Simplicity." He turned to face his sister, his thin frame blazing with anger. "You, now: you're a logical creature."

"I am?" Marian asked gently.

"And those others—the people—now who was it said *Your people, sir, are a great beast*—"

"Hamilton," Marian said. "Alexander. An ancient."

"—Those others don't want logic and won't listen to it. They're crazed with their damned superstition, and it will rule them. It can't be stopped . . . and Freeman, the idiot, is trying to stop it with logic. Like stopping a flood with—I don't know what—a sheet of paper."

Marian sighed again. "But what else can he do? What else is there to be done?"

"Damn it," Allerton said, "he's the politician. He's the one who manages people. He's the one who *ought* to know what to do; what else is a politician good for?"

"Perhaps—"

"No perhaps about it," Allerton said. "The man's an idiot; I've known it for years, ever since I met him when we got those silly medals for our second dig; and I'm having it confirmed for me every time I turn on the 3V."

"Then don't turn it on." Marian thought of herself as a practical woman, a breed which had great value around a dig, where emotional upsets, or sudden accesses of happiness and knowledge, were commonly messy matters.

"But I won't let him bar me from—"

"From what?" Marian said. "A heart attack? Please, Parr, listen to me. You've no business getting so upset about—"

Whereupon the wireless, pictureless 'phone rang in the tent.

Parran Allerton was greatly surprised to find that Minister Dall Freeman wanted to speak with him.

And, after half an hour of talk,

chatting between Freeman—that idiot—and his sister Marian, and Marian's explanations, followed by further talk with the minister, Allerton was even more surprised to discover that he had—as he expressed it to Marian immediately afterward—joined the ranks of idiocy. "And the ranks of hypocrisy as well, I suppose," he said. "But, tell me, Marian: what else could I have done?"

"Nothing," Marian said with perfect assurance. "You did the right thing—the only thing. You were exactly, entirely, thoroughly correct, and you deserve congratulations for it."

"Marian—"

"But I'm afraid all you're going to get right now is a report of the findings in square six. Disappointing."

"There's always tomorrow," Allerton said automatically, and then, blinking: "Do you know, Marian, I begin to believe there is? I begin to believe there really always is?"

CENTRAL BUILDINGS,
VARIOUS SERVICES:
JUNE 3-JUNE 5, 2113

"And I'm sure that you fine people out there won't be influenced by a silly notion of the ancients, and will ignore their idea that numbers have a power of their own. We all know now that numbers won't influence the *Roubins* . . ."

"The upcoming flight of the *Roubins* has aroused a great deal of controversy, Minister Freeman. Would you care to make a comment on that?"

"Why, yes, I would, Charles. It would appear that the people are trying to get the entire matter straight in their own minds, and come to the realization that numbers have no influence over the flight of this ship. And I'm sure that, in the end, they will see that the only sensible attitude—the only logical attitude . . ."

"Friday the thirteenth is just another day, ladies and gentlemen. It means nothing to me, nothing to you—and nothing to the *Roubins*. I'm sure you all know that. And if you do, then the *Roubins* can take off, can supply our people, stranded and awaiting this needed ship, this desperately needed ship . . ."

". . . Five minutes, Minister."

"Thank you. Sam, what in God's name are you doing down here?"

"I came to see you. To try to talk some sense into you. Dall, do you know how much harm you're doing?"

"Harm?"

"Damn it, don't you read the sampling sheets? The *Roubins* takeoff gets less popular by the day. Every time you mention numbers, or superstition, you give the nonsense free publicity: people talk it over among themselves. And . . . well, you know. 'There just might be something in it.' Dall, every speech you make strengthens the whole idea that numbers run the world. That this

silly superstition runs the world."

"Exactly. But why is this harmful?"

". . . If you want the *Roubins* to take off—"

"Sam, I've always thought of you as a good man."

"Thanks."

"An intelligent man, a good minister. But not a subtle man. Not, really, a politician. A politician has only one job."

"To work *against* the things the Comity needs? Dall—"

"I'm not working against what the Comity needs, Sam. Time enough; you'll see where all this is going very shortly now, so I'll give you a preview."

"Don't do me any favors."

"It's the same favor I did the emperor—yesterday. He had to be ready, you see."

"Ready?"

"All right, Sam. Now listen . . ."

"*First News* is happy to present, in its regular weekly interview series, the renowned archaeologist, Dr. Parran Allerton. Some recent discoveries made by him are spreading in influence throughout the Comity. Dr. Allerton is here to explain their significance, and to tell the story of their finding . . ."

"Minister Freeman?"

". . . Thank you. Now, I want to begin by saying once again that numerology has no influence on the real world, the world of events. It's all just a silly superstition. I'm sure none of you fine people out there really believes that numbers influence our world, or influence the takeoff of that vitally necessary ship the *Roubins* . . ."

GREAT HALL:
CAPITAL CITY:
2100 H., JULY 17, 2113

Hamsun, after several hours of trying, had finally managed to corner Minister Freeman in a comparatively quiet section of the Great Hall. Around them, the Space Gala was picking up speed and volume. If it hadn't been for Freeman, Hamsun told himself, he'd never have come to the damned thing. But what he knew was that Freeman had almost killed off the shoot. What he'd heard—the sort of chatter nobody pays any real attention to—was that Freeman had made the shoot possible.

Well, the gala was, more or less, in Hamsun's honor; and no matter what he knew, he couldn't quite keep the chatter out of his head. He needed explanations . . .

"There are all sorts of rumors," he was saying. "People are convinced you made the shoot possible, I mean. I . . . well, you know."

Freeman smiled. The way a politician smiles, Hamsun thought; there's never any way to find out what he *really* thinks. "There are always rumors," he said. His eyes flicked from one person to another as he spoke: studying people, Hamsun realized.

Studying—the materials of his profession; and why wasn't that as respectable as . . . say . . . studying equations?

"But—Look, you made those speeches," Hamsun said. "One right after another. All about how sensible people were, how they'd never let superstition hold them back—"

"That's right," Freeman said. A girl went past them, laughing much too loudly.

"And those speeches damn near sank the entire shoot," Hamsun said. "Every time you told people they were too smart to believe in superstition—Look, we have a psychologist on the base and he explained it this way—you reminded them of the superstition. You forced them to think about it. And—when it comes to superstition—people *don't* think."

"By definition," Freeman put in.

Hamsun blinked. "By . . . I suppose so." He took a breath. "So you kept stimulating the whole thing, making people think about that Friday-the-thirteenth business, making them even more positive they weren't going to let the *Roubins* take off."

Freeman nodded. "Something like that," he said. "Yes."

"So," Hamsun said, "you almost did kill the shoot. What I thought. What everybody thinks. Only there was some crackpot talk that you . . . well, that you made the shoot possible."

"I did," Freeman said.

Hamsun opened his mouth and shut it again.

"First of all, you see, I made those speeches," Freeman said. "No, wait a minute, I did one more thing—I bribed an archaeologist."

"You—*what?* What does that have to do with . . ."

"I made those speeches," Freeman said into the silence; around them the gala went loudly on, but even Freeman noticed that with no more than the corner of his eye. "I made everyone conscious of the power of numbers. The superstition. Numerology. Thirteen." He gestured. "People who didn't care, people who were unsure . . . I got them all thinking about numerology."

"And believing in it, damn it!" Hamsun broke in.

"Exactly," Freeman said. "Otherwise my bribe wouldn't have done any good, you see."

"But—"

"Thirteen," Freeman went on, sententiously, "is an unlucky number. Correct?"

"Well, sure," Hamsun said. "But when it came out that—"

"That—the sixth month, the thirteenth day, the year 2113—all that isn't nearly so unlucky. Attend: 6 and 13 and 21—from 2113—and then an extra 5—for Friday, normally considered the fifth day of the week—add up to 45. And 45 is the luckiest possible number. It was the number of a great and famous weapon used by legendary heroes among the ancients. It was the year—

1945–in which one of their major wars ended. Look it up."

"Sure, I know that," Hamsun said. "The ancients thought 45 was the luckiest number there was."

Freeman smiled, very briefly. "But let me go on," he said. "It's also 9 times 5–9 for the planets, and 5 for the planets known in deep-ancient times, before the telescope. It's also 21–the age of maturity for a long period during the history of the most civilized ancients–plus 24, which is twice as lucky as a simple dozen . . . a dozen, of course being lucky because it was the number of the apostles. Among other things." He paused to breathe. "Right so far?"

"Well–everybody knows that," Hamsun said. "Sure. I mean–"

"Everybody knows it," Freeman repeated. "Everybody knows it, and it isn't true. Not a word of it. Not one word."

Hamsun nearly dropped his half-full glass. "But–"

"An archaeologist said it was true, over and over," Freeman went on. "And everyone else picked it up, of course. There I was, making speeches about the silliness of numerology and–your psychologist is perfectly correct–thereby making more and more converts to the damned superstition. And there everyone else was–knowing that numerology made the *Roubins* shoot a marvel, a wonder and an absolute delight, because–within days, in fact–'everyone knew it.' And all I did was bribe an archaeologist–with a grant for a future dig, incidentally, out of what we like to call a contingent fund–to 'discover' the entire good-luck superstition dealing with 45."

Silence surrounded the two men again. After a second Hamsun said: "You mean there never was–"

"Never," Freeman said. "It just happened to work that way. Because, of course, we made it just happen. I'm afraid it will have to be a secret between us, son–and because keeping that secret is in both our interests, it will stay a secret–but we've rewritten history."

This time Hamsun did drop the glass. It shattered. Neither man moved. "Well–talk about just sheer luck," Hamsun said after a while. "If it'd been some other number–one you couldn't work with . . ."

"It could have been," Freeman said. "And it wouldn't have mattered: *any* number could have been used. Let's see: 6 for the month, 13 for the day, 13 for the specific year: 31. Add 5 for Friday and get 36–three dozen. Three times as lucky as a dozen. Then add the 21 and get 47–a fine number, has a seven in it, which the ancients really did believe was lucky: we wouldn't have had to invent that part. For that matter, we didn't invent the *lucky dozen* part, either. But, son: *any* number could have been used. We just fiddled round with what we had available."

Hamsun tried to think it over. Obviously, the way to get people to do something was to make sure you per-

suaded them *not* to do it, and then—

"Politics," he said. "It's all politics."

"Exactly," Freeman said, and smiled very briefly indeed. "Politics: which is *my* science, I suppose. The science of people—which is an art."

Hamsun tried it again. When you had all the pieces, it made sense. But without them—

He stared at the face of the . . . the politician. The useless, talky politician. The . . . Good *Lord.* "But how could you figure in advance . . . how could you push the whole thing—"

"The basic rule," Freeman said, "is simple enough." He looked, Hamsun thought, quite satisfied; almost at peace. "I can put it all in one sentence—and all in words of one syllable."

"If you can't lick them, and you can't join them, there is just one thing left to do: lead them."

This was said two hundred years ago by the first great Minister for the Dichtung, Dall Freeman. It remains true; the present writer cannot improve on its wording.

The *Public Notes* of Isidor Norin
(Minister
for the Dichtung, c. 2300 A. D.)

IN TIMES TO COME

"The Pritcher Mass" is the title of Gordon R. Dickson's new novel, which opens next month's issue. Take a world-wide plague, cities sealed inside domes, a group of psionically talented people trying to construct a telepathic bridge to another star, witches and warlocks, a wolverine "familiar," an international crime ring, and stir them all up around the central character of a man who is very human, very fallible, yet very talented . . . and you've got an inkling of what "The Pritcher Mass" is all about.

This novel marks something of a new departure for Gordy Dickson. An acknowledged master at illuminating the workings of alien cultures and the military mind, Gordy now turns to a very realistic and humanistic treatment of how man can blend his technology with his innate psionic talents to create a new way of dealing with both the objective and subjective worlds we live in. Kelly Freas' cover shows the Pritcher Mass itself—a blend of hard engineering and telepathic creation.

The factual article next month deals with computers that play chess. Champions made of transistors, eh? Well, not yet. Computers don't rank anywhere near the best human chess players. They're nowhere near smart enough! In fact, in chess terms, the computer is a "fish." Which is the title of George R. R. Martin's article.

And, space permitting, there will also be stories by Christopher Anvil, Wade Curtis, Jack Wodhams, and others.

UNFAIR TRADE

A little knowledge is a dangerous thing.
Especially when you don't
realize who your competition is.

PATRICK WELCH

Michael Gilbert

The wind tore across Gren's face, ripping away at his lips and eyes. He snarled, but it couldn't be heard long above the storm. The Aldian pulled the fur collar tighter around his neck and checked to see if his companions were all right. Inside a copious pocket the Llyl trilled softly and burrowed deeper into the warmth. He closed the flap with a swift tug—it would be secure the remainder of the journey. Bre, just behind and to his right, was almost hidden by the swirling snow. He flicked his tail and kicked his mount forward. Fjen, the last, waved and adjusted the packs on his back. Ordinarily the three felines would not be out in weather like this. It was not good for hunting or traveling; such times were best spent drinking *stek* and fornicating before a warming fire. But it was time for the Trader, and they had been chosen to take the furs to him.

Gren couldn't see it now, but somewhere on the plain below stood the six-foot cube the Trader called home. He cursed and thought of the warm lodges and his friends' activities. Still, someone had to go. Just their luck the gods had decided to

storm. Gren's mount shook its head and ice fell from its name. The *cherae* did not like such weather either. Gren kicked it in the ribs. The animal squealed, then continued into the frozen blastfurnace.

One moonset later the travelers stood in front of the Trader's ship. Gren had seen it before, but still the vessel amazed him. The ship was no taller than he, gold and smooth-walled. Yet he knew that inside it was as large as two of his people's lodges. The Trader had said something about "non-Euclidian space" when questioned; then he had laughed and admitted most of his people didn't understand it.

Bre and Fjen looked at Gren for orders. He nodded and they dismounted. He tied the animals securely to a nearby tree while the others removed the packs, jogged quickly to loosen cramped muscles, and finally guided them through the opening that appeared suddenly on the golden wall before them.

Inside it was as warm as summer. Bre and Fjen had never visited the Trader; they stood in wonder at the doorway. A thick red carpet ran from the door twenty feet to the spacious banquet table manufactured from rare alien woods. Art works dotted the walls, and the table was piled high with delicacies; all from planets the Trader frequented. Gren was used to such miracles; he calmly doffed his traveling clothes and bid his fellows do the same.

"Welcome, my friends. I hope you found your journey not too unpleasant," the unseen Trader's voice called in their tongue. "I shall be with you in a moment. Relax yourselves."

The Aldians sat and hurriedly sampled the banquet. Gren had learned long ago that anything the Trader offered was safe and oftimes delicious. He first tried a round, red fruit. It tasted like toasted sawdust. He spat and threw the offending vegetation on the floor. The carpet closed over it and seconds later the litter vanished. Bre and Fjen started; Gren merely grabbed some green and gray berries. They were more to his liking; he munched contentedly until their host made his appearance.

He arrived with the whistling of an opening panel. The Earthman, John Ma-lud by name, was five feet tall, fat and greasy. His hair hung in perfumed braids; rings sparkled on each stubby finger. His gold embroidered indigo robe stretched to the wall even as he sat at the table. The Aldians towered over him, six feet of gold-furred claw and muscle. But he was not intimidated. "Welcome again my friends," he began cheerfully. "I hope you have not waited too long?"

"Not too," Gren purred softly. The others ignored him.

"I trust your village had a very prosperous year. Very prosperous."

"Thank you." Gren continued eating, waiting for the Trader to open negotiations.

Ma-lud decided the time was not yet right. "I see you have brought some new friends. Tell me, what do you think of my humble home?" Bre and Fjen made no acknowledgment. His smile did not quiver. "Well, I see you are in a hurry. Shall we dispense with the formalities?" He pressed a button on the side of the table. Immediately all signs of the banquet vanished and they were faced with a bare bargaining area. Bre snarled, but a quick look from Gren put him back in his seat. "May I see the pelts?"

Gren nodded and Fjen emptied the packs on the table. The merchant chose one and examined it. The fur was soft like chinchilla and long like mohair; yet each strand was a crystal rainbow, changing color with every ray of light. They were the rarest, most prized furs in the galaxy. The Trader ran his fingers through the pelt while staring at the pile before him. There were enough to make him a very rich man, a very rich man indeed.

"Excellent, my friends, excellent. I am sure we can do business." He pressed another button and mugs of steaming ale appeared before all. "How many pelts do you have?"

"Forty-five."

The Trader smiled and calculated rapidly. On the open market they would bring him almost two million solar credits. He pressed another button. "My friends, you deserve something special for this year's work." He chose three gold collars from a tray and presented one to each Aldian. "For your trouble getting here."

Bre and Fjen looked to their leader. He nodded and they placed them carefully in the packs. Meanwhile Gren opened his pouch and released the Llyl. The creature was only half a foot tall, a miniature kangaroo save for a single eyestalk and a beak. It hopped along the table twittering to itself, then took a perch on Gren's broad shoulder. Gren's gaze narrowed. "What do you have for us?"

The merchant watched the Llyl with little interest. He had seen them before—accursed creatures as far as he was concerned. But every Aldian party had carried one with it. For the life of him he couldn't understand why. "Whatever you desire," he replied quickly. A panel opened on the table, revealing bolts of brightly colored textiles, cooking utensils, jewelry, farming and building equipment, boots, jackets, and other clothing designed for the Aldian frame. "Help yourselves, my friends."

Gren's eyes widened at the booty, but he remembered his orders. "No, no more, not this time." The words were edged with ice.

The merchant smiled quizzically. "What is wrong? You don't like what I have to offer? It is not enough? There are other things; medicines, food, luxuries if you prefer. Ask and you shall have."

"Weapons."

"Weapons?" The Earthman scratched his forehead. "I don't have many swords, or crossbows, but I can get—"

"Not ours. Yours."

With difficulty Ma-lud kept his composure. It was against Federation law to sell anything to aliens they could not produce themselves—in theory at least. Supposedly this was to allow the cultures to develop at their own rate. In practice it kept them at the mercy of the Traders, a situation he applauded. Giving the Aldians weapons would alter it considerably. "My friends, I am sorry but I cannot. My people forbid me. But I'm sure that if you look through my other merchandise—"

"No!" Gren stood and his companions followed. "If we don't get your weapons, we don't trade." He told Bre and Fjen to repack.

The Trader paled. If he gave them weapons and the Federation found out, he would lose his license and spend years on Alomar. But the pelts were valuable; even on the black market they would bring more than enough for him to live in exile comfortably. Something else bothered him also. The Aldians were insistent upon weapons, his weapons. Someone else, a pirate or young wayfarer beginning his fortune, probably had found this world and talked to them. He disliked competition; not only because it was illegal but also because the felines might have learned the true value of what he gave in return. Whether he capitulated or not, these might be the last pelts he would ever see. And Ma-lud had no other prosperous territories.

The furs were packed and the Aldians donning their clothing when he spoke. "Do not be so hasty, my friends. I have always treated you fairly, have I not? I have always given you everything you desired? If it is weapons you want, it is weapons you shall have. If you will excuse me." The Aldians had not moved when he returned with an armload of assorted guns. "This," he chose one, "is a rifle. With it you can kill at one hundred yards."

He fired at a vase. Bre and Fjen jumped at the explosion and the Llyl screeched, but Gren was unimpressed. "Insufficient. Show us something else."

The rotund merchant chose an oddly-shaped pistol. "How about a laser?" A picture burst into flame for their benefit.

"No good for game." Gren's orders were clear; he was honorbound to follow them. "The distorter."

The Trader froze. He had been right; someone else had landed, had talked to the Aldians. The distorter was the most sophisticated and powerful weapon the Federation had yet invented; his garments, flimsy though they seemed, could stop any projectile or temperature ray; but nothing could be shielded from a distorter. When he left he would have to warn the Federation—anonymously, of course. "I don't have

one," he lied. "But I'm sure you should find these sufficient."

Gren turned and they headed for the door. The merchant made a swift calculation between greed and exile. "Just one moment," he said heavily. He disappeared and returned carrying a pistol with a prism for a barrel. "This is what you came for."

"Show me how it works."

The merchant carefully adjusted the dials. "Watch." He pressed the trigger. A vase quivered violently, then became dust. "You wouldn't want this. It would destroy your game, not just kill it."

"Yes," Gren snatched it away.

Sweat poured from Ma-lud's forehead. "I have always been your people's friend," he began, almost pleading. "Have I not always given you what you wished? If the distorter is what you want, then it is yours."

"Thank you," Gren said quietly and pressed the trigger. The distorter does strange things to flesh. The Trader's insides—bones, organs, blood—turned to jelly. His eyes exploded and blood poured from his gaping mouth. He made no sound as he collapsed on the floor. Gren placed the weapon carefully in his tunic and the now-content Llyl in its pouch. The carpet was already closing over the Earthman when the Aldians left, carrying their packs with them.

When they arrived at their village another six-foot cube was resting in the square. Its occupant, a lizard-trader from Xnglia-5, was relaxing in the lodge and greeted them when they entered. "I'm glad you didn't let John cheat you this time. What did he have to say when you told him?"

"He was surprised," Gren answered.

"Congratulations on keeping your wits about you. He always had a silver tongue."

Gren sat and quaffed some *stek*. "Are you still interested?"

The lizard gave his equivalent of a smile. "Definitely. I'll let you and your men have a chance to warm up and relax. I'm sure that was quite a cold journey you had. When you're ready come to my ship and we'll talk business."

"We know what we want."

"Really?" His enthusiasm was obvious. "I can guarantee you'll find me more than generous. Clothing? Metals? Medicine? Name it and it's yours."

"We want you to teach us how to fly your ship."

The merchant started. "Why? I mean, of course, but what good will it do you? After all you don't have any."

Wrong, Gren thought as he sipped. *We have one. No.* He fingered the distorter, the weapon the lizard had mentioned one careless, drunken, bragging night. *Two.* He had no idea what would be done with the ships, but then it was not up to him to decide. He finished his *stek* and purred. The Llyl would think of something. ■

Kelly Freas

There are many kinds of power, and many kinds of men who seek power. But it takes a special kind of man who knows how to use raw, brute power to accomplish his objective.

JERRY POURNELLE

THE MERCENARY

The landing boat fell away from the orbiting warship, drifted to a safe distance and fired retros. When it entered the thin reaches of the planet's upper atmosphere, scoops opened in the bows, drew in air until the stagnation temperature in the ramjet chambers was high enough for ignition. Engines lit with a roar of flame. Wings swung out slightly, enough to provide lift at hypersonic speeds, and the spaceplane turned, streaked over empty ocean toward the continental land mass two thousand kilometers away.

It circled over craggy mountains twelve kilometers high, dropped low over thickly forested plains, slowing until the craft posed no danger to the thin strip of inhabited lands along the ocean shores. The planet's great ocean was joined to a nearly landlocked channel no more than five kilometers across at its widest point, and nearly all of the colonists lived near the junction of the waters. Hadley's capital city nestled on a long peninsula at the mouth of that channel, the two natural harbors, one in the sea, the other in the ocean, giving the city the fitting name of Refuge.

The ship extended its wings to their fullest reach, floated low over the calm water of the channel harbor until it touched, settled in. Tugboats raced across clear blue water. Sweating seamen threw lines, secured the landing craft and warped it to dock.

A long line of CoDominium marines in garrison uniform marched out of the boat, were gathered on the gray concrete piers into bright lines of color by cursing officers and sergeants. Two men in civilian clothes followed the marines from the flier. They blinked at the unaccustomed blue-white of Hadley's sun, a sun so far away that it would have been a small point if either of them were foolish enough to look directly at it.

Both men were tall and stood as straight as the marines in front of them, so that except for their clothing they might have been mistaken for a part of the disembarking battalion. The shorter of the two carried luggage for both of them and stood respectfully behind; although older, he was obviously a subordinate. They watched as two younger men came uncertainly along the pier. The newcomers' unadorned blue uniforms contrasted sharply with the bright reds and golds of the CoDominium marines who milled around them. Already the marines were scurrying back into the flier, carrying out barracks bags, weapons, the personal gear of a light infantry battalion.

The taller of the two civilians faced the uniformed newcomers. "I take it you're here to meet us?" he asked pleasantly. His voice rang through the noise on the pier, carrying easily although he had not shouted. The accent was neutral, the nearly universal English of American officers in CoDominium service, marking his profession almost as certainly as did his posture and the tone of command.

The newcomers were uncertain, however. There were a lot of ex-officers of the CoDominium Space Navy on the beach with CD budgets lower every year. "I think so," one finally said. "John Christian Falkenberg?"

His name was actually John Christian Falkenberg III, he thought amusedly. His grandfather would probably have insisted on the distinction. "Right. And Sergeant-Major Calvin."

"Pleasure to meet you, sir. I'm Lieutenant Banners, this is Ensign Mowrer. We're on President Budreau's staff." Banners looked around as if expecting other men, but there were none except the marines. He gave Falkenberg a slightly puzzled look, then added, "We have transportation for you, but I'm afraid your men will have to walk. It's about eleven miles."

"Miles." Falkenberg smiled to himself. This *was* out in the boondocks. "I see no reason why ten healthy mercenaries can't march eighteen kilometers, Lieutenant." He turned to the black shape of the landing boat's entry port, called to someone still inside. "Captain Fast. There's no transportation, but someone here will show you where to march the men. Have them carry all gear."

"Uh, sir, that won't be necessary," the lieutenant protested. "We can get well, we have horse-drawn transport for baggage." He looked at Falkenberg as if he expected the man to laugh, then went on. "Ensign Mowrer will attend to it." He paused again, looked thoughtful, his youthful features knotted in a puzzled expression as if he were uncertain of how to tell Falkenberg something. Finally he shook his head. "I think it would be wise if you issued your men their personal weapons, sir. There shouldn't be any trouble on their way to barracks, but—anyway, ten armed men certainly won't have any problems."

"I see. Perhaps I should go with my troops, Lieutenant. I hadn't known things were quite that bad on Hadley." Falkenberg's voice was calm and even, but he looked intently at the junior man.

"No, sir. They aren't, really . . . just that, well, there's no point in taking chances." He waved Ensign Mowrer to the landing craft, turned to Falkenberg again. A large black shape rose from the water outboard of the landing craft, splashed, and vanished. Banners seemed not to notice, but the marines shouted excitedly. "I'm sure the ensign and your officers can handle the disembarkation . . . the President would like to see you, sir."

"No doubt. All right, Banners. Lead on. I'll bring Sergeant-Major Calvin with me." No point in continuing this farce, Falkenberg thought. Anyone seeing ten armed men conducted by a presidential ensign would know they were troops, civilian clothes or not. Another case of

wrong information; he'd been told to keep their status secret. He wondered whether this was going to make it more difficult to keep his own secrets.

Banners ushered them quickly through the bustling CoDominium marine barracks, past bored guards who half-saluted the Presidential Guard uniform. The marine fortress was a blur of activity, every open space crammed with packs and weapons, the signs of a military force about to move on to another station.

As they were leaving the building, Falkenberg saw an elderly naval officer. "Excuse me a moment, Banners," he muttered, and turned to the CoDominium Navy captain. "They sent someone for me. Thanks, Ed."

"No problem. I'll report your arrival to the admiral, he wants to keep track of you. Unofficially, of course. Good luck, John. God knows you need some right now. Sorry about everything else."

"Way it goes," Falkenberg said. He shook the offered hand warmly. "Pay my respects to the rest of your officers. You run a good ship."

The captain smiled thinly. "You ought to know . . . look, we pull out of here in a couple of days, John. No more than that. If you need a ride out, I can arrange it. The Senate won't have to know. We can fix you a hitch to anywhere in CD territory. Just in case, I mean. It might be rough here."

"And it won't be everywhere else in the CoDominium? Thanks again, Ed." He gave a half salute, checked himself, and strode back to where Banners stood with his sergeant. Calvin lifted three personal effects bags as if they were empty, pushed the door open in a smooth motion.

"The car's here." Banners opened the rear door of a battered ground-effects vehicle of no discoverable make. It had been cannibalized from a dozen other machines, and some parts were obviously cut-and-try jobs done by an uncertain machinist. Banners climbed into the driver's seat and started the engine, which coughed twice, then ran smoothly. They moved away in a cloud of black smoke.

They drove past another dock where a landing craft with wings as large as the entire marine landing boat was unloading an endless stream of civilian passengers. Children screamed, men and women stared about uncertainly until they were ungently hustled along by guards in uniforms matching Banners'. The sour smell of unwashed humanity mingled with the crisp clean salt air from the ocean beyond. Banners rolled up the windows with an expression of distaste.

"Always like that," Calvin commented to no one in particular. "Water discipline on them CoDominium prison ships being what it is, takes weeks dirtside to get clean again."

"Have you ever been inside one of those ships?" Banners asked.

"No, sir," Calvin replied. "Been in

marine assault boats just about as bad, I reckon. But I can't say I fancy being stuffed into no cubicles with ten, fifteen thousand civilians for six months."

"We may all see the inside of one of those," Falkenberg commented. "And be glad of the chance. Tell me about the situation here, Banners."

"I don't even know where to start, sir," the young man answered. "I—you know about Hadley?"

"Assume I don't," John Falkenberg told him. Might as well see what kind of estimate of the situation the President's officers could make. The fleet intelligence report bulged in the inner pocket of his tunic, but those reports always left out important details.

"Yes, sir. Well, to begin with, we're a long way from the nearest shipping lanes—but I guess you knew that. The only real reason we had any merchant trade was the mines. Thorium, richest veins known for a while, until they started to run out. For the first few years, that's all we had. The mines are up in the hills, about eighty miles over that way." He pointed to a thin blue line just visible at the horizon.

"Must be pretty high mountains," Falkenberg said. "What's the diameter of Hadley? About sixty percent of Earth? Something like that. Horizon ought to be pretty close."

"Yes, sir. They are high mountains. Hadley is small, but we've got bigger and better everything here." There was pride in the young officer's voice.

"Them bags seem pretty heavy for a planet this small," Calvin said.

"Hadley's very dense," Banners answered. "Gravity nearly ninety percent standard. Anyway, the mines are over there. Have their own spaceport. Refuge—that's this city—was founded by the American Express Company. Brought in colonists, quite a lot of them, all volunteers. The usual misfits. I suppose my father was typical enough, an engineer who couldn't keep up with the knowledge explosion, got tired of the rat race. That was the first wave, and they took the best land, founded he city, got an economy going. Paid back American Express in twenty years." Banners' pride was evident, and Falkenberg knew it had been a difficult job.

"That was, what, fifty years ago?" Falkenberg asked. They were driving through crowded streets lined with wooden houses, some stone buildings. Rooming houses, bars, sailors' brothels, the usual for a dock street, but there were no other cars on the roads. They could see horses and oxen pulling carts. The sky above Refuge was clear, no trace of smog or industrial wastes. Out in the harbor, tugboats moved with the silent efficiency of electric power, but there were also wind-driven sailing ships, lobster boats powered by oars, a tops'l schooner lovely against clean blue water throwing up white spume as she raced out to sea. A three-

masted, full-rigged ship was drawn up to a wharf where men loaded it by hand with huge bales of what might have been cotton.

They passed a wagonload of melons. A gaily dressed young couple waved cheerfully at them, then the man snapped a long whip at the team of horses which pulled them. Falkenberg studied the primitive scene, said, "It doesn't look like you've been here fifty years."

"No." Banners gave them a bitter look, swerved to avoid several shapeless teen-agers lounging in the dockside street, swerved again to avoid a barricade of paving stones which they had masked. A shower of stones banged against the vehicle. The car jounced wildly, leaped over a low place in the wall, and Banners accelerated rapidly.

Falkenberg carefully took his hand from inside his shirt, noted that Calvin was now inspecting an automatic rifle that appeared from the oversized barracks bag he'd brought into the car with him. When Banners said nothing about the incident, Falkenberg knitted his brows and sat back, listening. The intelligence reports mentioned lawlessness, but this was as bad as a Welfare Island on Earth.

"No, we're not much industrialized," Banners continued. "At first there wasn't any need to develop basic industries. The mines made everyone rich, so rich we imported everything we needed. The farmers sold fresh food to the miners for enormous prices. Refuge was a service-industry town. People who worked here could soon afford farm animals, and they scattered out across the plains, into the forest. Those people didn't want industry, they'd come here to escape it. Then some blasted CoDominium bureaucrat read the ecology reports about Hadley. The Population Control Bureau in Washington decided this was a perfect world for involuntary colonization. The ships were coming here for the thorium anyway, so instead of luxuries and machinery they were ordered to carry convicts. Hundreds of thousands of them, Colonel Falkenberg. For the last ten years, it's been better than fifty thousand people a year dumped in here."

"And you couldn't support them all," John said carefully.

"No, sir." Banners' face tightened. He seemed to be fighting tears. "Every erg the fusion generators can make has to go into basic protocarb just to feed them. These weren't like the original colonists. They didn't know anything, they wouldn't *do* anything . . . oh, not really, of course. Some of them work. Some of our best citizens are transportees. But there were so many of the other kind."

"Why'n't you let 'em work or starve?" Calvin asked bluntly. Falkenberg gave him a cold look, and the sergeant nodded slightly, sank back into his seat.

"Because the CD wouldn't let us!"

Banners shouted. "Damn it, we didn't have self-government. CD Bureau of Relocation people told us what to do, ran everything . . ."

"We know," Falkenberg said gently. "We've seen the results of Humanity League influence over BuRelock. My sergeant-major wasn't asking you a question, he was expressing an opinion. I'm surprised though—won't your farms support the urban population?"

"They should, sir." Banners drove in grim silence for long moments. "But there's no transportation. The people are here, and most of the agricultural land is five hundred miles inland. There's arable land closer, but it isn't cleared . . . our settlers wanted to get away from Refuge and BuRelock. We have a railroad, but bandit gangs keep blowing it up, so we can't rely on Hadley's produce to keep Refuge alive. With about a million people on Hadley, half of them are crammed into this one ungovernable city."

They were approaching an enormous bowl-shaped structure attached to a massive square stone fortress. Falkenberg inspected the buildings carefully, then asked what they were.

"Our stadium," Banners replied. There was no pride in his voice now. "The CD built it for us. We'd rather have had a new fusion plant, but we got a stadium that can hold a hundred thousand people. For recreation. We have very fine sports teams and racehorses," he added bitterly. "The building next to it is the Palace. Its architecture is quite functional."

The city was even more thickly populated as they approached the fortress-like palace. Now the buildings were mostly stone and concrete instead of wood. Few were more than three stories high, so that Refuge spread as far as the eye could see along the shore, the population density increasing beyond the stadium-palace complex. Banners was watchful as he drove along the wide streets, but seemed less nervous.

Refuge was a city of contrasts. The streets were straight and wide, and there was evidently a good waste disposal system, but the lower floors of the buildings were open shops, the sidewalks were clogged with market stalls, crowds of pedestrians; there was still no motor traffic, no moving pedways. Horse troughs and hitching posts had been constructed at frequent intervals, along with starkly functional street lights and water distribution towers. The few signs of technology contrasted strongly with the general primitive air of the city.

A uniformed contingent of men thrust their way through the crowd at a street crossing. Falkenberg looked at them closely, then at Banners. "Your troops?"

"No, sir. That's the livery of Glenn Foster's household. Officially they're unorganized reserves of the President's Guard, but they're household troops all the same." Banners laughed bitterly. "Sounds like something out of a history book, doesn't

it? We're nearly back to feudalism, Colonel Falkenberg. Anyone rich enough keeps hired bodyguards. They *have* to. The criminal gangs are so strong the police don't try to catch anyone under organized protection, and the judges wouldn't punish them if they were caught."

"And the private bodyguards become gangs in their own right, I suppose?"

"Yes, sir." Banners looked at him sharply. "Have you seen it happen before?"

"Yes. I've seen it before." Banners was unable to make out the expression on Falkenberg's lips.

They drove into the Presidential Palace, were saluted by blue-uniformed troopers. Falkenberg noted the polished weapons, precise drill of the Presidential Guard. There were some well-trained men on duty here, although there probably weren't too many of them. He wondered if they could fight as well as stand guard.

He was conducted through a series of rooms in the heavy stone fortress. Each had heavy metal doors, and several seemed to be guardrooms. Falkenberg saw no signs of governmental activity until they had passed through the outer layers of the enormous palace to an open courtyard, through that to an inner building where clerks bustled through halls, girls in the draped togas fashionable two years before on Earth sat at desks in offices. Most seemed to be packing desk contents into boxes, and all around the palace people were scurrying about. Some offices were empty, desks covered with fine dust, plastiboard moving boxes stacked outside them.

There were two anterooms to the President's office. President Budreau was a tall thin man with a red pencil moustache and quick gestures. As they were ushered into the overly ornate room the President looked up from a sheaf of papers, but his eyes didn't focus on his visitors for long seconds. Slowly the worried concentration left his face and he rose.

"Colonel John Christian Falkenberg, sir," Lieutenant Banners said. "And Sergeant-Major Calvin."

"Pleased to see you, Falkenberg," the President said. His expression told them differently; he looked at his visitors with faint distaste, said nothing else until Banners had left the room. When the door closed he asked, "How many men did you bring with you?"

"Ten, Mister President. All we could get on board the carrier without arousing suspicion. We were lucky to get those. The Senate had an inspector at the loading docks to check for violation of the antimercenary codes. If we hadn't bribed a port official to distract him we wouldn't be here at all. Calvin and I would be on Tanith as involuntary colonists."

"I see." From his expression he was not surprised. John thought he might have been as happy if the inspector had caught them. Budreau

tapped the desk nervously. "Perhaps it will be enough. I understand the ship you came on carried the marines who have volunteered to settle on Hadley. They should provide the nucleus of an excellent constabulary for us. Good troops?"

"It was a demobilized battalion," Falkenberg replied. "Those are usually the scrapings of every guardhouse on twenty planets. We'll be lucky if there's a real trooper in the lot." Falkenberg saw Budreau's face relax into a mask of depression, every trace of hope draining out. "Surely you have troops of your own?"

Budreau picked up a sheaf of papers. "It's all here, I was just looking it over when you came in." He handed the report to Falkenberg. "There's not much encouragement in it, Colonel. There's no military solution to Hadley's problems. I never thought there could be, but if you have only ten men plus a battalion of forced labor marines, the military answer isn't worth considering." Budreau gave Falkenberg a thin smile, moved his hands rapidly over the sea of papers on his desk. "If I were you, I'd get back on that Navy boat and forget Hadley."

"Why don't you?" Falkenberg asked.

"Because Hadley's my home!" Budreau snapped. "And no rabble is going to drive me off the plantation my grandfather built with his own hands. They won't make me run out."

Falkenberg took the report, flipped the pages and handed it to Calvin. "We've come a long way, Mister President. You might as well tell me what the problem is before I leave."

Budreau nodded sourly. The red moustache twitched, and he ran the back of his hand across it. "It's simple enough. The ostensible reason you're here, the reason we gave the Colonial Office for letting us recruit a planetary constabulary, is the bandit gangs out in the hills. Nobody knows how many of them there are, but they're strong enough to raid farms, cut communications between Refuge and the countryside whenever they want to. They're serious enough but they're not the real problem, as I presume Vice-President Bradford told you."

Falkenberg nodded. Budreau paused, but when John said nothing, continued. The President's voice was strong, but there was a querulous note in it, as if he were accustomed to having his conclusions argued. "Actually, the bandits aren't my worst problem. But they get support from the Freedom Party, which makes them hard to fight. My Progressive Party is larger than the Freedom Party, but the Progressives are scattered all over the planet and the FP is concentrated right here in Refuge, with God knows how many voters and about forty thousand people they can concentrate when they want to stage a riot."

"Do you have riots very often?" John asked.

"Too often. There's not much to control them with. I have three hundred men in the Presidential Guard, but they're CD recruited and trained like young Banners. Loyal to the job, not to me. And the FP's got men inside it. So scratch the President's Guard when it comes to controlling the Freedom Party."

Budreau smiled without amusement. "Then there's my police force. My police were all commanded by CoDominium officers who are pulling out. My administrative staff was recruited and trained by the CD and all the competent people have been recalled to Earth. There's nobody left who *can* govern, but I've got the job and everybody else wants it. I might be able to scrape up a thousand Progressive partisans, another fifteen thousand loyalists who would fight in a pinch but have no training, to face the FP's forty thousand. And the Freedom Party's demanded a constitutional convention after the CoDominium Governor leaves. If we don't give them a convention, they'll rebel. If we do, they'll drag things out until there's nobody left but their people, throw the Progressives out of office, and ruin the planet. Under the circumstances, I don't see what a military man can do for us, but Bradford insisted we hire you."

"I take it the Progressive Party is mostly old settlers," Falkenberg said casually.

"Yes and no. It's extremely complicated. The Progressive Party wants to industrialize Hadley, which some of our farm families oppose. But we want to do it slowly. We'll close most of the mines, take out only as much thorium as we have to sell to get basic industrial equipment, keep the rest for our own fusion generators. We'll need it later. We want to develop agriculture and transportation, cut the basic rations so that we can have fusion power for industry. Close out the convenience industries and keep them closed until we can afford them." Budreau's voice rose steadily, his eyes shone. "We want to build the tools of a self-sustaining world and get along without the CoDominium until we can rejoin the human race as equals!" The President caught himself, frowned. He seemed angry with John for witnessing his emotional speech.

Falkenberg leaned back in the heavy leather chair, seemingly relaxed, but his eyes darted around the room, noting the ornate furnishings. The office decor must have cost a fortune to bring from Earth, but most of it was tasteless, chosen for the spectacular rather than for beauty. He waited until Budreau was seated again, then asked, "What does the opposition want?"

"Do you really need to know all this in order—I suppose you do." Budreau's moustache twitched nervously. "The Freedom Party's slogan

is 'Service to the People.' They want strip mining—that's got them the miners' support, you can bet. They'll rape the planet to buy goods from other systems. Introduce internal combustion engines—God knows how, there's no technology for them, no heavy industry to make them even if the ecology could absorb them, but they promise cars for everyone, instant modernization. More food, robotic factories, entertainment, all the benefits of immediate industrialization."

"They mean it, or is that just slogans?"

"I think most of them mean it," Budreau answered. "It's hard to believe, but I think they do. Their people have no idea of the realities of our situation, and their leaders are ready to blame anything on the Progressive Party, CoDominium administrators, anything but admit that what they promise isn't possible. Some of the party leaders may know better." Budreau poured brandy into two glasses, waited for Falkenberg to lift one, and muttered a perfunctory "Cheers." He drained the glass at one gulp. "Some of the oldest families on Hadley have joined the Freedom Party. They're worried about the taxes I've proposed, joined the opposition hoping to make a deal . . . you don't look surprised."

"No, sir. It's an old story . . . a military man reads history, if he's smart he'll look for the causes of wars. After all, war is the normal state of affairs, isn't it? Peace is the name of an ideal we deduce from the fact that there have been interludes between wars." Before Budreau could answer, Falkenberg caught himself. "No matter. I take it you expect armed resistance from the Freedom Party after the CD pulls out."

"I hope to prevent it," Budreau snapped. "I do have some gifts at the art of persuasion . . . but they don't want to compromise. They see total victory. As to fighting, the FP partisans claim credit for driving the CoDominium out, Colonel."

Falkenberg laughed. The CD was leaving because the mines weren't worth enough to make it pay to govern Hadley. If the mines were as good as they'd been in the past, no partisans would drive the marines away . . .

Budreau nodded as if reading his thoughts. "They've got people believing it anyway. There was a campaign of terrorism for years, nothing very serious to the CD or the marines would have put a stop to it, but they've demoralized the capital police. Out in the bush people administer their own justice. In Refuge, FP gangs control a lot of the city. I don't even know how many police I'll have left when the CD pulls out." He pointed to a stack of papers. "These are resignations from the force."

Budreau sat very still, gathering his thoughts with an effort, the faraway look in his eyes again. "I'm President by courtesy of the CoDominium," he said bitterly. "They installed me and now they're leaving!

Sometimes I wish Bradford hadn't been so successful in talking to the Colonial Office. Bureau of Relocation wanted to leave a Freedom Party president in charge, you know. I wonder if that wouldn't have been better."

"I thought you said their policies would ruin Hadley," Falkenberg mused. He had little use for weaklings, and Budreau seemed to be one.

"They would. But--the policy issues came after the split, I think," Budreau said slowly. He was talking to himself as much as to John. "Now they hate us so much, they oppose anything we want out of spite. And we do the same thing."

"Sounds like CoDominium politics. Russki senators versus United States senators. Just like home," Falkenberg said. There was no trace of humor in the polite laugh that followed. "You say Vice-President Bradford arranged for the Colonial Office to install you as President against the advice of BuRelock?"

Budreau nodded. "Yes . . . the public relations campaign was expensive, more expensive than I'd have ever dreamed, but once we were in office we had the Ministry of Information funds . . . well, you see the situation, Colonel. If you stay. I'll keep the agreement, you'll be Commander of Constabulary. Your commission's already signed. But really, I think it would be better if you didn't take the post. Hadley's problems can't be solved by military consultants."

"Perhaps you're right," Falkenberg said. He suppressed the impulse to grin at the euphemism for mercenaries and finished his drink.

"Now, Mr. Bradford wants to see you," Budreau said. "Lieutenant Banners will show you to his office. And please let me know your decision."

"I will, sir." Falkenberg strode from the big room. As he did, President Budreau buried his face in his hands.

Vice-President Earnest Bradford was a small man with a perpetual half smile on a round face that might have been cherubic if it weren't so haggard. Falkenberg was conducted into the small office, waited until Calvin and Lieutenant Banners left before speaking. As the others were leaving John glanced around the room. In contrast to Budreau's richly furnished suite, the First Vice-President's office was starkly functional, desk and chairs made of local woods with an indifferent finish. A solitary rose in a crystal vase provided the only color.

"Thank God you're here," Bradford said. "But I'm told you only brought ten men! We can't do anything with just ten men! You were supposed to bring a hundred men loyal to us!" He bounced up excitedly, stopped, then sat again. "Can you do something?"

"There were ten men in the Navy

ship with me," Falkenberg said. "My staff. When you show me where I'm to train the regiment, I'll find the rest of the mercenaries."

"Others—" Bradford gave him a broad wink, beamed. "Then you did get more to come! We'll show them, all of them . . . What did you think of Budreau?"

"He seems sincere enough. Worried, though. Think I would be in his place."

Bradford shook his head. "He can't make up his mind. About anything! Good man, but he has to be forced to every decision. Why did the Colonial Office pick him? I thought you were going to arrange for me to be President."

"One thing at a time," Falkenberg said. "The permanent Undersecretary couldn't justify you to the Minister. It was hard enough for Whitlock to get them to approve Budreau with all his experience, let alone a newcomer like you. We sweated blood on this, Ernie."

Bradford's head bobbed up and down. "Good work, too," he said, but he looked at Falkenberg closely. "You kept your part of the bargain, John. I just wish you could have . . . well, we'll get to it." His smile expanded confidentially, then he grimaced. "We have to let Mr. Hamner meet you now. Then we can go to the Warner estate. I've arranged for your troops to be quartered there; it's got what you wanted for a training ground. Perfect place, nobody will bother you. You can say your other men are volunteers from the countryside."

Falkenberg nodded slightly. "Let me handle that, will you? I'm getting rather good at cover stories."

"Sure." Bradford beamed again. "By God, we'll win this yet." He touched a button on his desk. "Send Mr. Hamner in, please."

"Wait until you see this Hamner," he told John while they were waiting. "He's the Second Vice-President. Budreau trusts him, so he's dangerous. Represents the technocracy people in the Progressive Party; we can't do without him, but his policies are ridiculous. He wants to let go of everything. There wouldn't be a planetary government if he was in charge. And his people take credit for everything, as if technology was all there was to government. He doesn't know about the meetings, the intrigues, all the people I've had to see, speeches . . . He thinks you build a party by working like an engineer."

"Doesn't understand the political realities," Falkenberg finished for him. "Just so. You say he has to be eliminated?"

Bradford shuddered slightly, but kept the thin smile on his face. "Eventually. We do need his influence with the technicians at the moment. And of course he doesn't know anything at all about . . . about . . ."

"Of course." Falkenberg sat easily, looking about the office, studied maps on the walls until the intercom

announced that Hamner was outside.

George Hamner was a large man, taller than Falkenberg and even heavier than Sergeant-Major Calvin. He had the relaxed movements of a big man, and much of the easy confidence that such massive size usually wins. People didn't pick fights with George Hamner, drunk or sober. His grip was gentle, but he closed his hand relentlessly, testing Falkenberg carefully. As he felt answering pressure he looked surprised, and the two men stood in silence for long moments before Hamner relaxed and waved at Bradford.

"So you're our new Colonel of Constabulary," Hamner said. "Hope you know what you're getting into. I should say I hope you *don't* know. If you know about our problems and take the job anyway, we'll have to wonder if you're sane."

"I keep hearing a lot about how severe Hadley's problems are, but nobody's briefed me," Falkenberg replied. "I gather we're outnumbered by the Freedom Party people and you expect trouble. What kind of weapons do they have to make trouble with?"

Hamner laughed. "Direct son of a gun, aren't you? Nothing spectacular in the weapons, just a lot of them . . . enough small problems is a big problem, right? But the CD hasn't permitted big stuff. No tanks or armored cars . . . hell, there aren't enough cars of any kind to make any difference. No fuel or power distribution network ever built, so no way cars would be useful. We've got a subway, couple of monorails for in-city stuff, and what's left of the railroad . . . You didn't ask for a lecture on our transport, did you? My pet worry at the moment. Let's see, weapons . . ." The big man sprawled into a chair, hooked one leg over the arm and ran his fingers through thick hair just receding from his large brows. "No military aircraft, hardly any aircraft at all. No artillery, machine guns, heavy weapons in general. Mostly light caliber hunting rifles and shotguns. Some police weapons. Military rifles and bayonets, a few, and we have almost all of them. Out in the streets you can find anything, Colonel, and I mean literally anything. Bows and arrows, knives, swords, axes, hammers, you name it."

"He doesn't need to know about obsolete things like that," Bradford said contemptuously.

"No weapon is ever obsolete," Falkenberg said carefully, "not in the hands of a man who'll use it. What about armor? Enemy and our own. How good a supply of Nemourlon do you have?"

Hamner looked thoughtful for a second. "There's some body armor in the streets, and the police . . . the President's Guard doesn't use the stuff. I can supply you with Nemourlon, but you'll have to make your own armor out of it. Can you do that?"

Falkenberg nodded. "I brought men and equipment for that. Well, the situation's about what I expected. I can't see why everyone's so worried. We have a battalion of CD marines, not the best marines but they're trained soldiers. With the weapons of a light infantry battalion and the training I can give the recruits, I'll undertake to face your forty thousand Freedom Party people. The guerrilla problem will be a lot more severe, but we control the food distribution system in the city. Ration cards, identity papers . . . it shouldn't be hard to set up controls."

Hamner laughed, a bitter laugh. "You want to tell him Ernie?" When Bradford looked confused, Hamner laughed again. "Not doing your homework. It's in the morning report for a couple of days ago. The Colonial Office has decided, on the advice of BuRelock, that Hadley doesn't need any military weapons. The CD marines will be lucky to keep their rifles and bayonets, because all the rest of their gear is being taken back to Earth."

"I see," Falkenberg said slowly. His lips compressed into a tight line, and he cursed to himself. "Hadn't counted on that. Means that if we do tighten up control through food rationing, we face armed rebellion . . . How well organized are these FP types, anyway?"

"Well organized and well financed," Hamner said. "And I can't agree about ration cards being the answer to the guerrilla problem. The CoDominium was able to put up with a lot of sabotage, since all they were really interested in was the mines, but we can't live with the level of terror we have in this city. Some way we're going to have to restore order—and justice for that matter."

"Justice isn't a commodity soldiers generally deal with," Falkenberg said grimly. "Order's another matter. *That* I think we can supply."

"With five hundred men?" Hamner's voice was incredulous. "But I like your attitude. At least you don't sit around and whine for somebody to help you, the way some of our officials do." He looked significantly at Bradford. "Well, I wanted to meet you, Colonel. Now I have. *I've* got work to do." He didn't look at them again as he strode briskly from the room.

"You see," Bradford said as soon as Hamner was out of sight. "The man's no good. We'll find someone to deal with the technicians as soon as you've got everything else under control."

"He seemed to be right on some points," John said slowly. "For example, he knows as well as I do that it won't be easy to get proper police protection established. I saw an example of what goes on in Refuge on the way here, and if it's that bad everywhere . . ."

"You'll find a way," Bradford said reassuringly. "Lot of it's just teenage street gangs. Not loyal to any-

thing, FP, us, CD, or anything else. They call it defending their turf or something . . . and forget Hamner. His whole group is . . . well, they're just not real Progressives, that's all." He was emphatic, then lowered his voice and leaned forward. "He used to be in the Freedom Party, you know. Claims to have broken with them over technology policies, but you can never trust a man like that." Then he smiled again, stood. "Let's get you started. And don't forget your agreement to train some men for me, too . . ."

Falkenberg woke to a soft rapping on the door of his room. He opened his eyes, put his hand on the pistol under his pillow, but made no other movement. "Yes," he called softly.

"I'm back, Colonel," Calvin answered.

"Right. Come on in." John swung his feet out of the bunk, put on his boots. Otherwise he was fully dressed. Sergeant-Major Calvin came in, dressed in the light leather tunic and trousers of the CD marine battle dress. Falkenberg could see the total black of a night combat coverall protruding from Calvin's war bag. A short wiry man came in with the sergeant.

"Glad to see you," Falkenberg said. "Have any trouble?"

"Gang of toughs tried to stir up something as we was coming through the city, Colonel," Calvin replied. "Didn't last long enough to set any records." He grinned wolfishly.

"What about at the relocation barracks?"

"No, sir," Calvin replied. "They don't guard them places. Anybody wants to get away from BuRelock's charity, they let 'em go. Without citizens' basic supply cards, of course."

Falkenberg was inspecting the man who had entered with Calvin. Major Jeremy Savage looked tired, older than his forty-five standard years, and thinner than John remembered him. "Was it as bad as I've heard?" he asked.

"No picnic," Savage replied in the clipped accents he'd learned as a boy on Churchill. "Didn't expect it to be. We're here, John Christian."

"Good. Nobody spotted you? Men behave all right?"

"Yes, sir, we were treated no differently from any other involuntary colonists. The men behaved splendidly, and a week of hard exercise and good food ought to have us back in shape. Sergeant-Major tells me the battalion arrived intact."

"I sort of filled the major in while we was coming out," Calvin said. "I think he sees the score, sir."

Falkenberg nodded. "But keep your eyes open, Jerry, and be careful with the men until the CD pulls out. Yes, and I've hired Dr. Whitlock to check things for us. He hasn't reported in yet, but I assume he's on Hadley."

"Whitlock?" Savage sat in the room's single chair, accepted whiskey from Calvin with a nod of thanks. "My, that's good. Heard of

Whitlock. Best in the field, although he puts on as a hillbilly. Very appropriate man for us, don't you know?"

John nodded. "Until he reports we won't have a full staff meeting. Just stay with the original plan. Bradford brings the battalion of marines out tomorrow, and a few hundred volunteers from the Progressive Party's little private army for us to train. More recruits coming, supposedly. Now tell me a bit about those toughs you fought on the way out here."

"Street gang, Colonel," Calvin replied. "Not bad at individual fightin', but no organization. Hardly no match for near a hundred of us."

"Street gang." John pulled his lower lip speculatively, then grinned. "How many of our battalion used to be punks just like them, Sergeant-Major?"

"Half, maybe more, sir."

Falkenberg nodded. "I think it might be a good thing if the marines got to meet some of those kids, Sergeant-Major. Informally, you know . . ."

"Sir!" Calvin's faced beamed with comprehension.

"Now," Falkenberg continued. "Recruits will be our real problem. You can bet some of them will try to get chummy with the troops, pump the men about their backgrounds and outfits. We can't have that, of course. Anticipate any problems there, Top Soldier?"

Calvin looked thoughtful. "No, sir, not for a while. Won't be no trick to keep the recruits away from the men until they've passed through training, till then all they'll meet'll be drillmasters. We can do it, sir."

"Right." Falkenberg turned to Major Savage. "That's it, then."

"Yes, sir," Savage answered crisply. He drew himself erect and saluted. "Damned if it doesn't feel good to be doing this again, sir," he grinned. Years fell away from his face.

"Good to have you aboard," Falkenberg replied. He stood to return the salute. "And thanks, Jerry. For everything . . ."

The Warner estate was large, nearly four kilometers on a side, located in low hills outside the city of Refuge but no more than a day's march from the Palace and stadium. Falkenberg's troops found themselves in a partly wooded bowl in the center of the estate. At John's request there were no cooking services or other support activities other than food and fuel and basic military equipment. The troops spent the first week constructing a base camp.

The marines relearned lessons of their basic training. Each maniple of five men cooked for itself, did its own laundry, made tents from woven synthetics and ropes, and contributed men for work on the encampment revetments and palisade. When the recruits arrived they were forced to do the same things under the supervision of Falkenberg's mercenary officers and NCO's. Most of the men who had come with Savage

on the BuRelock colony transport were officers, sergeants, and technicians, while there seemed to be an unusual number of monitors and corporals within the marine battalion, so that there were more than enough leaders for a regiment. Some Progressive Party stalwarts selected by Bradford were given junior commissioned rank and trained separately.

The men learned to sleep in their military greatcloaks, to live under field conditions with no uniform but synthileather battle dress and boots, cooking their own food and constructing their own quarters, dependent on no one outside the regiment. They were also taught to fashion their own body armor from Nemourlon; when it was completed they lived in it, and any man selected for punishment found his armor weighted with a calculated quantity of lead. Maniples, squads, and whole sections of recruits on punishment marches lasting late into the night became a common sight around the estate.

The volunteers had little time to fraternize with the marines as Savage and Calvin and the other cadres relentlessly drove them through drills, field problems, combat exercises, and maintenance work. The number of recruits fell every day as men were driven to leave the service, but from somewhere there was a steady supply of new troops. These were younger men, who came in small groups directly to the camp, appearing before the regimental orderly room at reveille, often in the company of a section of marine veterans. There was attrition in their numbers as well as among the Party volunteers, but the proportion was much smaller, and they were eager for combat training.

One of the regiment's main problems was the commissioned Progressives. They had to be taught basic military arts, yet they were officers by courtesy and couldn't be driven out of the regiment without protest from Bradford. The worst of them were summarily dismissed, but Falkenberg was forced to keep many men as officers who he wouldn't have had as private soldiers if given free choice.

Twice a week John went to the estate house two kilometers from the camp to report to Bradford, Hamner and, infrequently, President Budreau. Budreau had made it clear that he considered the military force as an evil whose necessity was not established, and only Bradford's insistence kept the regiment supplied. After six weeks, Bradford raised the question of the decreasing numbers of Progressive volunteers in training.

"You're letting those men go too easily, Colonel," he protested. "Those are loyal men! Loyalty is important here!"

"Sir, I'd rather have one battalion of good men I can trust than a regiment of troops who might break under fire," Falkenberg answered stiffly. "After we have the bare min-

imum of first-class troops, we can consider taking on others for garrison duties. For now I want men who can fight."

"You don't have them yet," Bradford sniffed. "And where are you getting those new recruits? Jailbirds, kids with police records. I notice you're keeping them when you let my Progressives go!"

"It takes time to train green men. The recruits are all treated the same, Mister Vice-President, and if those street warriors stand up better than your party toughs, I can't help it."

"We'll discuss this later," Bradford said coldly. "There's another thing." He indicated a large man with a fat jowl seated down the table from him. "This is Chief Horgan of the Refuge police. He has some complaints, Colonel."

Falkenberg faced the Chief of Police, stood silently until the other man spoke.

"Your marines, Colonel." Horgan rubbed his chin carefully. "They're raising hell in the city at night. Never hauled any of them in, but I'm not saying we couldn't have if we'd wanted to. But they've taken over a couple of taverns, won't let anybody in without their permission. Have fights with street gangs there every night. And they go out into the toughest parts of town, start fights whenever they can find anyone to mix with."

"How are they doing?" Falkenberg asked interestedly.

Horgan grinned, caught himself. "Pretty well. I understand they've never been beaten . . . but it raises hell with the citizens, Colonel. And another trick of theirs is driving people crazy! They march through the streets fifty strong at all hours of the night playing bagpipes! Bagpipes in the small hours, Colonel, can be a frightening thing." Falkenberg thought he saw a tiny flutter to Horgan's left eye. The man was holding back a wry smile.

"I wanted to ask you about that, Colonel," Second Vice-President Hamner added. "This is hardly a Scots outfit, why do they have bagpipes?"

"Pipes are standard with many marine regiments," Falkenberg answered easily. "Very stimulating to the troops. Since the Russki CD outfits started taking up Cossack customs, the Western Bloc regiments looked around for something equally impressive. A lot of them like the pipes." John grinned openly at the Chief of Police. "I'll try to keep the pipers off the streets at night, though. I can imagine they're not good for civilian morale. As to keeping the marines in camp, how do I do it? We need every one of them, and they're volunteers. They can get back on that CD carrier and ship out, and there's not one thing we can do."

"It's only a couple of weeks until they haul down the CoDominium flag," Bradford added with satisfaction. He glanced at the CD banner on the wall behind him, an eagle with a red shield, black sickle and

hammer on its breast. The flag meant little to the people of Hadley, but on Earth it was enough to cause riots in nationalistic cities in both the U.S. and the Soviet Union. To Earth the CoDominium Alliance represented peace at a high price, too high for many. For Falkenberg it represented nearly thirty years of service ended by court martial.

A week before the departure of the CoDominium Governor and the official independence of Hadley, Bradford visited the camp to make a speech to the recruits. He told them of the value of loyalty to the government, and the rewards they would get as soon as the Progressive Party was completely in power. Better pay, more liberties, and the opportunities for promotion in an expanding army were all promised. When he had finished, Falkenberg took the Vice-President into his cabin and slammed the door.

"Damn you, you don't *ever* make offers to my troops without my permission!" John's face was cold with anger.

"I'll do as I please with *my* troops," Bradford replied smugly. The little smile was on his face, a smile without warmth. "Don't get snappy with me, *Colonel* Falkenberg. Without my influence Budreau would dismiss you in an instant." Then, with a sudden change of mood, Bradford took a flask of brandy from his pocket, poured two drinks. The little smile faded, was replaced by something more genuine. "We have to work together, John. There's too much to do, with both of us working we won't get it all done. Sorry, I'll ask in future. But don't you think the troops should know me? I'll be President soon." He looked at Falkenberg closely.

"Yes, sir," John said. He took the drink, held it up for a toast. "To the new President of Hadley. I shouldn't have snapped at you, but don't make offers to troops who haven't proved themselves. If you give men reason to think they're good when they're not, you'll never have an army worth its pay. Work them until they've nothing more to give, let them know that's just barely satisfactory, and one day they'll give you more than they thought they had in them. That's the day you offer rewards, only by then you won't have to."

Bradford nodded agreement, but then frowned. "That's all very well, but I insist on keeping my loyalists, Colonel. In future you will dismiss no Progressive without my approval. Is that understood?"

Falkenberg nodded. He'd seen this coming for some time. "In that case, sir, I will transfer all of your people into the fourth battalion and place your appointed officers in command of their training. Will that be satisfactory?"

"Provided that you continue to supervise their training, yes." Bradford thought for a moment, then smiled. "I will also expect you to consult me about any promotions in that battal-

ion, in that case. You agree to that, of course?"

"Yes, sir. There may be some problems about finding locals to fill the senior NCO slots. You've got potential monitors and corporals, but they haven't the experience to be sergeants and centurions."

"You'll find a way, I'm sure," Bradford said carefully. "I have some rather, uh, special duties for the fourth battalion, Colonel. I'd prefer it to be completely staffed by Party loyalists. Is this agreed?"

"Yes, sir."

Bradford's smile was genuine as he left the camp.

Day after day the troops sweated in the bright blue-tinted sunlight. Riot control, bayonet drill, use of armor in defense and attacks against men with body armor, more complex exercises, and forced marches under the relentless direction of Major Savage, the harsh shouts of their sergeants and centurions, Captain Fast with his tiny swagger stick and biting sarcasm . . . but the number of men leaving the regiment was smaller now, while there was still a flow of recruits from the marines' nocturnal expeditions. Falkenberg was able to be more selective in his recruiting.

Each night groups of marines sneaked past sentries, drank and caroused with the fieldhands of nearby ranchers, gambled and shouted and paid little attention to their officers. But they always came back, and when Bradford protested their lack of discipline off duty he would get the same answer. "They don't have to stay here," Falkenberg told him. "How would you suggest I control them? Flogging?"

The constabulary army had a definite split personality. And the fourth battalion grew larger each day.

II

George Hamner tried to get home for dinner every day, no matter what that might cost in night work later. His walled estate just outside the Palace district was originally built by his grandfather with money borrowed from American Express and paid back before it was due; a big comfortable place which cunningly combined local materials and imported luxuries, George was always glad to return there, feel the pride of mastery. It was the only place in Refuge where he felt at home in the last few years.

It was less than a week until the CoDominium Governor departed, one week before complete independence for Hadley. That should be a time of hope, but George Hamner dreaded it. Problems of public order weren't officially part of his Ministry of Technology assignment, but he couldn't ignore them. Already half the city of Refuge was nearly untouched by government, an area where police went in squads and maintenance crews performed their work as quickly as possible under the

protection of CD marines. What was it going to be like when the CD was gone?

Hamner sat in the paneled study watching lengthening shadows in the groves outside make dancing patterns across neatly clipped lawns. The outside walls spoiled the view of Raceway Channel below, and Hamner cursed them, cursed the necessity for walls and a dozen armed men patrolling them, remembering a time as a boy when he'd sat in this room with his father, listened to the great plans for Hadley. A paradise planet, and Lord, Lord, what have we made of it? An hour's work didn't help. There weren't any solutions, only a chain of problems that brought him back to the same place each time. A few years—that's all they needed, but he didn't see how they could get them.

The farms could support the urban population if they could move the people out to the agricultural interior and get them working, but they wouldn't leave Refuge. If only they would—if the city's population could be thinned, the power now diverted to food manufacture could be used to build a transportation net to keep people in the interior or bring food from there to the city. They could manufacture the things needed to make country life so pleasant that people would be willing to leave Refuge and go there. But there was no way to the first step. The people wouldn't move and the Freedom Party promised them they wouldn't have to.

George shook his head, thought about Falkenberg's army. If there were enough soldiers, could they forcibly evacuate part of the city? But there'd be resistance, civil war, slaughter. Budreau wouldn't let Hadley's independence be built on a foundation of blood. Hamner laughed bitterly. Not only Budreau. I can't do it either, he thought. I can see what's got to be done, but I can't do it. Bradford would . . . but what then? Besides, there weren't enough soldiers. There was no military answer.

His other problems were of the same kind. He could see that all the government was doing was putting bandages on Hadley's wounds, treating symptoms because there was never enough control over events to treat causes. He picked up an engineering report on the fusion generators.

Spare parts needed . . . how long can we keep things running even at this crazy standoff, he wondered. A few years. After that, famine, because the transportation net couldn't be built fast enough, and when the generators failed, the city's food supplies would be gone. Sanitation services would be crippled too; there would be plague despite the BuRelock inoculations.

He set his slide rule down on the desk, wishing for one of the pocket computers that were common on planets closer to Earth. The Freedom Party leader had one. George had talked to him about the fusion

generators only two days before, and it seemed as if the Freedom Party didn't care that the generators wouldn't last forever. The FP leader's attitude was that Earth wouldn't allow famine, that Hadley could use her own helplessness as a weapon against the CoDominium. The concept of real independence from the CD didn't interest him. Hamner thought about that and swore, went back to engineering. He liked problems he could get his hands on and know he'd solved them, not political troubles that kept coming back no matter what he did.

Laura came in with a pack of shouting children. Was it already time for them to go to bed? The four-year-old picked up his father's slide rule, played with it carefully before climbing into his lap. George kissed the boy, hugged the others and sent them out, wondering as he did every night what would happen to them. Get out of politics, he told himself. You can't do Hadley any good, and you're not cut out for the game. You'll only get Laura and the kids finished along with yourself. But what happens if we let go, if we can't succeed, another part of his mind asked, and he had no answer to that.

But it doesn't matter . . . you'll get your family killed, and for what? Debts, inadequate pay, temptation after temptation to give in, compromise, look after Number One, swim with the stream until you become somebody you don't even want to know . . .

"You look worried," Laura said after she'd seen the children to bed. "It's only a few days . . . What happens, George? What really happens when CoDominium leaves for good? It's going to be bad, isn't it?"

He pulled her to him, feeling her warmth, tried to draw comfort from her nearness and at the same time distract her, but she knew that trick. "Shouldn't we take what we can and go east?" she asked. "We wouldn't have much, but you'd be alive."

"It won't be *that* bad," he told her. He tried to chuckle, as if she had said something funny, but the sound was hollow. "We've got a planetary constabulary . . . at the worst it should be enough to protect the government. But I am moving all of you into the Palace in a couple of days."

"The army," she said with plenty of contempt. "Some army, General Bradford's volunteers who'd kill you just to make that horrible little man happy . . . and those marines! You said yourself they were the scrapings."

"I said it. I wonder if I believe it. There's something strange happening here, Laura, something I don't understand. I went to see Karantov the other day, thought I'd presume on an old friend to get a little information about this man Falkenberg. Boris wasn't in his office but one of the junior lieutenants was. The kid was green, only been on Hadley a couple of months . . . We got into a conversation about what happens after independence. Discussed street

fighting, mob suppression, and how I wished I had some reliable marines instead of the people they were getting here. He looked funny and asked just what I wanted, the Grand Admiralty Guard? But then Boris came in and when I asked what the lieutenant meant, he said the kid was new and didn't know what he was talking about."

"And you think he did?" Laura asked. "But what could he have meant? Stop that!" she added hastily. "You have an appointment."

"It can wait."

"With only a couple of dozen cars on this whole planet and one of them coming for you, you will not keep it waiting while you make love to your wife, George Hamner!" Her eyes flashed, but not with anger. "Besides, I want to know what Boris told you." She danced away from him, sat on the other side of the desk. "What *do* you think he meant?"

"I don't know . . . but those troops don't look like misfits to me. Not on training exercises. Off duty they drink and shout and they've got the fieldhands locking up their daughters but come morning they muster out on that parade ground like . . . And there's more. The officers. They're not from Hadley, and I don't know who they are!"

"Why don't you ask?"

"I took it up with Budreau, and he gave me a stall about it being in Bradford's Ministry, so I asked him, and Ernie told me they were Pro-

gressive volunteers. I'm not that stupid, Laura. I may not notice everything, but if there were fifty men with military experience in the Party I'd know. So why would Bradford lie?"

Laura looked thoughtful, pulled her lower lip in a gesture so familiar that Hamner hardly noticed it any longer. He'd kidded her about it before they were married . . . "He lies just for practice," she said finally. "But his wife has been talking about independence, and she seems to think Earnest will be President. Not some day, but soon . . . Why would she think that?"

George shook his head. "Maybe — no, he hasn't the guts for that, Ernie would never oust Budreau. He knows half the party wouldn't stand for it . . . The technicians would walk out in a second, they can't stand him and he knows it."

"Earnest Bradford has never yet admitted any limitations," Laura reminded him. She glanced at the clock behind George. "It's getting late and you haven't told me what Boris said about Falkenberg."

"Said he was a good marine commander. Started out as a navy man, transferred to marines, became a regimental commander with a good combat record. That's all in the reports we have . . . I got the scoop on the court martial. There weren't any slots for promotion. But when a review board passed Falkenberg over for a promotion that the admiral couldn't have given in the first place, Falkenberg made such a fuss about it that he was dismissed for insubordination."

"Can you trust him to command here?" she asked. "His men may be the only thing keeping you alive . . ."

"I know." And keeping you alive, and Jimmy, and Christie, and Peter . . . "I asked Boris. He said there's not a better man available. You can't hire CD men from active duty, or even retired officers . . . Boris said that Falkenberg's really better than anyone we could get anyway. Troops love him, brilliant tactician, experience in troop command and staff work as well . . . Laura, if he's all that good, why did they boot him out? My God, fussing about promotion should be pretty trivial, and besides, it's not smart, Falkenberg would have to know it couldn't get him anywhere. None of it . . ."

The interphone buzzed, and Hamner answered it absently. It was the butler to announce that his car and driver were waiting. "I'll be late, sweetheart. Don't wait up for me. But you might think about . . . I swear that Falkenberg is the key to something, I wish I knew what."

"Do you like him?" Laura asked.

"He isn't a man who tries to be liked."

"I said, do *you* like him?"

"Yes. And there's no reason to. I like him, but can I trust him?" As he went out he thought about that. Could he trust Falkenberg. With Laura's life . . . and the kids, for

that matter . . . with a whole planet that seemed headed for hell with no way out . . .

The troops were camped in an orderly square, earth ramparts thrown up around the perimeter, tents in lines that might have been laid with a transit. Equipment was scrubbed and polished, blanket rolls tight, each item in the same place inside the two-man tents . . . yet the men were milling about, shouting, gambling openly in front of the campfires. There were plenty of bottles in evidence even from the outer gates.

"Halt! Who's there?"

Hamner started. He hadn't seen the sentry. This was his first visit to the camp at night, and he was edgy. "Vice-President Hamner," he answered.

A strong light played on his face from the opposite side of the car. Two sentries, then, and both invisible until he'd come on them. "Good evening, sir," the first sentry said. "I'll pass the word you're here. Corporal of the Guard, Post Number Five!" The call rang clearly in the night. A few heads around campfires turned toward the gate, then went back to their other activities.

Hamner was escorted across the camp to officers' row. The huts and tents stood across a wide parade ground from the densely packed company streets of the troops, and Hamner saw another set of guards posted around these tents. Falkenberg came out of his hut. "Good evening, sir. What brings you here?"

I'll just bet you'd like to know, Hamner thought. "I have a few things to discuss with you, Colonel. About the organization of the constabulary."

"Certainly." Falkenberg was crisp, and he seemed slightly nervous. "Let's go to the mess, shall we? More comfortable there. Haven't got my quarters made up for visitors."

Or you've got something there I shouldn't see, George thought . . . God, can I trust him? Can I trust anyone? Falkenberg led the way to a building in the center of officer's row. There were troops milling around the parade ground, most wearing the blue and yellow duty uniforms Falkenberg had designed, but others trotted past in synthileather battle dress carrying heavy packs.

"Punishment detail," Falkenberg commented. "Not so many of those as there used to be."

Sound crashed from the officers' mess building, drums and bagpipes, a wild sound of war mingled with shouted laughter. Inside, two dozen men sat at a long table as white-coated stewards moved briskly about with whiskey bottles and glasses. Kilted bandsmen marched around the table with pipes, drummers stood in one corner. The deafening noise stopped as Falkenberg entered, and everyone got to his feet, some unsteadily.

"Carry on," Falkenberg said auto-

matically, but no one did. They eyed Hamner nervously, and at a wave from the mess president at the head of the table the pipers went outside, followed by the drummers and several stewards with bottles.

"We'll sit over here, shall we?" the colonel asked. He led Hamner to a small table in one corner. A steward brought a whiskey bottle and two glasses.

George looked at the officers carefully. Most of them were strangers, but he recognized half-a-dozen Progressives, the highest rank a first lieutenant. Hamner waved at the ones he knew, received a brief smile that almost seemed guilty before they turned back to their companions.

"Yes, sir," Falkenberg prompted.

"Who are these men?" George demanded. "I know they're not native to Hadley. Where did they come from?"

"CoDominium officers on the beach," Falkenberg answered simply. "Reduction in force. Lots of good men riffed into early retirement. Some of them heard I was coming here, chose to give up their reserve ranks and come out on the colony ship on the chance I'd hire them. Naturally I jumped at the opportunity to get experienced men at prices we could afford. Vice-President Bradford knows all about it."

I'm sure he does, Hamner thought. I wonder what else that little snake knows about. Without his support Falkenberg would be out of here tomorrow . . . but then what would we do? "I see. I've been looking at the organization of the troops, Colonel. You've kept your marines in one battalion with, uh, with these newly hired officers. Then you've got three battalions of locals, but all the Party stalwarts are in the fourth, your second and third are locals but again under your own men."

"Yes, sir?" Falkenberg nodded agreement, gave Hamner a look of puzzlement. Hamner had noticed that particular trick of Falkenberg's before.

And you know my question, George thought. "Why, Colonel? A suspicious man would say you've got your own little army here, with a structure set so that you can take complete control if there's ever a difference of opinion between you and the government."

"A suspicious man might say that," Falkenberg agreed. He lifted one glass of whiskey, waited for George, then drained it. A steward immediately brought freshly filled glasses.

"But a practical man might say something else," Falkenberg continued. "You wouldn't expect me to put green officers in command of guardhouse troops, would you? Or put your good-hearted Progressives in command of green troops? By Mr. Bradford's orders I've kept the fourth battalion as free of my mercenaries as possible, which isn't helping their training any. He seems to

have the same complaint as you do, and wants his own Party force, I suspect to control me. Which is silly, Mr. Hamner. You have the purse strings. Without your supplies and money to pay these men, I couldn't hold them an hour."

"Troops have found it easier to rob the paymaster than fight before now," Hamner observed. "Cheers." He drained the glass, then suppressed a cough. The stuff was strong and he wasn't used to neat whiskey.

Falkenberg shook his head. "I might have expected that remark from Bradford, but not you."

Hamner nodded. Bradford was always suspicious of something. There were times when George wondered if the Vice-President were quite sane, but that was absurd. Still, when the pressure was on, Ernie did manage to get on people's nerves, always trying to control everything. Bradford would rather have nothing done than allow action he didn't control.

"Just how am I supposed to organize this coup?" Falkenberg asked. "You can see that I've no more than a handful of men loyal directly to me. The rest are mercenaries, and your locals make up the majority of our forces. Mr. Hamner, you have paid a large price to bring my staff and me to your planet. We're expected shortly to fight impossible odds with nonexistent equipment. If you also insist on your own organization of the forces, I cannot accept the responsibility. . . If President Budreau so orders, I'll turn over command to anyone he names."

Neatly said, Hamner thought. And predictable too. Who would Budreau name? Bradford, of course, and George trusted Falkenberg more than Ernie. Nothing wrong with Falkenberg's answers, nothing you could put your finger on. . . "What do you want out of this, Colonel Falkenberg?"

"Money. A little glory, perhaps, although that's a word not much used outside the military nowadays. A position of responsibility commensurate with my abilities. I've always been a soldier, Mr. Hamner. You do know why I'm no longer in CD service."

"No I don't." Hamner was calm, but the whiskey was enough to make him bold, even in this camp surrounded by Falkenberg's men. . . Who is this man we're going to entrust our lives to? For that matter, haven't we already done that? "I don't know at all. It makes no sense for you to have complained about promotion, Colonel, and the admiral wouldn't have let you be dismissed if you hadn't wanted. Why did you have yourself cashiered?"

Falkenberg inspected him closely, his lips tight, gray eyes boring into Hamner. "I suppose you are entitled to an answer. Grand Senator Bronson has sworn to ruin me, Mr. Hamner, for reasons I won't tell you. If I hadn't been dismissed for the trivial charge of technical insubordination, I'd have had to face an endless series

of trumped up charges. This way I'm out with a clean record."

"And that's all there is to it?"

"That's all."

It was plausible. So was everything else. And Hamner was sure that the story would check out. Yet—yet the man was lying, for no reason George could imagine. Not lying directly, not refusing to answer, but not telling it all . . . if he only knew the right questions.

The pipers came back in, looked at Falkenberg. "Something more?"

"No."

"Thank you." The colonel nodded to the pipe major, who raised his baton. The pipers marched to the crash of drums, an incredibly martial sound, and the younger officers glanced around, picked up their drinks again. Someone shouted and the party was on.

The Progressives were drinking with Falkenberg's mercenaries . . . and every one of the partisans in the mess was one of his own wing, George realized. There wasn't one of Bradford's people in the lot. He rose, signalled to a Progressive lieutenant to follow him. "I'll let Farquahar escort me out, Colonel," Hamner shouted.

"As you please."

The noise followed them outside, along the regimental street. "All right, Jamie, what's going on here?" Hamner demanded.

"Going on, sir? Nothing that I know of . . . you mean the party? Ah, we're celebrating the men's graduation from elementary training, tomorrow they start advanced work. Major Savage thought a regimental dining in would help knit the troops together, be good for morale. . ."

"I do not mean the party." They were at the edge of officers' row now, and Hamner stopped their stroll. Hadley's third moon, the bright one called Klum, cast weird shadows around them. "Maybe I do mean the party. Where are the other officers? Mr. Bradford's people?"

"Ah, they had a field problem that kept them out of camp until late, sir. Mr. Bradford came around about dinnertime and took them with him to the ranch house. He spends a lot of time with them, sir."

"You've been around the marines, Jamie. Where are the men from? What CD outfits?"

"I really don't know, sir. Colonel Falkenberg has forbidden us to ask. He told the men that no matter what their record before, they start new here. I get the impression that some of them have served with the colonel before. They don't like him, curse him quite openly. But they're afraid of that big sergeant-major of his. . . Calvin has offered to whip any two men in the camp, they choose the rules. None of the marines would try it. After the first couple of times, none of the recruits would either."

"Not popular." Hamner brushed his hair back from his brows with both hands, remembered what Ma-

jor Karantov had told him. Whiskey buzzed in his head. "Who is popular?"

"Major Savage, sir. The men like him. And Captain Fast, the marines particularly respect him. He's the colonel's adjutant."

"All right. Look, can this outfit fight? Have we got a chance?" They stood and watched the scene around the campfires, men drinking, shouting. There was a fist fight in front of one tent, and no officer moved to stop it. "Do you permit that?"

"Not—we stop the men only if we officially see something, sir. See, the sergeants have broken up the fight. As to their abilities, really, how would I know? The men are tough, Mr. Hamner, and they obey orders."

Hamner nodded. "All right, Jamie. Go back to your party." He strode to his car. As he was driven away, he knew something was wrong, but he still had no idea what.

The stadium had been built to hold 100,000 people. There were at least that many jammed inside, and an equal number swarmed about the market squares and streets adjacent to it. The full CoDominium marine garrison was on duty to keep order, but they weren't needed. The celebration was boisterous but peaceful, with Freedom Party gangs as anxious to avoid an incident as the marines on this, the greatest day for Hadley since the planet's discovery.

Hamner and Falkenberg watched from the upper tiers of the stadium. Row after row of plastisteel seats like a giant staircase cascaded down from their perch to the central grassy field below. Across from them President Budreau and Governor Flaherty stood in the Presidential Box surrounded by the blue-uniformed President's Guard. Vice-President Bradford, Freedom Party leaders, Progressive officials, officers of the retiring CoDominium government were also there, and George knew what some of them were thinking: Where did Hamner get off to? Bradford would particularly notice his absence, probably thought Hamner was out stirring up rebellion. Lately Bradford had accused George of every kind of disloyalty to the Progressive Party.

The devil with the little man, George thought. He hated crowds, and the thought of having to stand there and listen to all those speeches, be polite to the party officials, was appalling. When he'd suggested watching from another vantage point, Falkenberg quickly agreed. As George suspected, the soldier disliked civilian ceremonies too.

The ritual was almost over. The CD marine bands had marched through the field, the speeches had been made, presents delivered and accepted. A hundred thousand people had cheered, an awesome sound, frightening in its potential power. Hamner glanced at his watch, and as he did the marine band broke into a roar of drums. The massed drummers ceased their beat one by

one until there was but a single drum roll that went on and on and on, until it too, stopped. The entire stadium waited.

One trumpet, no more. A clear call, plaintive but triumphant, the final salute to the CoDominium banner above the Palace. The notes hung in Hadley's crystal air like something tangible, and slowly, deliberately, the crimson and blue banner floated down the flagpole as Hadley's blazing gold and green arose.

Across the city uniformed men saluted these flags, one rising, the other setting. The blue uniforms of Hadley saluted with smiles, the red-uniformed marines with indifference. The CoDominium banner rose and fell across two hundred light-years and seventy worlds in this year of Grace 2079; what difference would one minor planet make?

Hamner glanced at John Falkenberg. The colonel had no eyes for the rising banners of Hadley. His rigid salute was given to the CD flag, and as the last note of the final trumpet salute died away Hamner saw Falkenberg wipe his eyes. The gesture was so startling that George looked again, but there was nothing more to see.

"That's it, then," Falkenberg snapped. His voice was crisp, gruff even. "I suppose we ought to join the party. Can't keep His Nibs waiting."

Hamner nodded. The Presidential Box connected directly to the Palace, and the officials would arrive at the reception quickly while Falkenberg and Hamner had the entire width of the stadium to traverse. People were streaming out to join festive crowds outside and it would be impossible to cross directly. "Let's go this way," George said. He led Falkenberg to the top of the stadium and into a small alcove where he used a key to open an inconspicuous door. "Tunnel system takes us right into the Palace, across and under the stadium," he told Falkenberg. "Not exactly secret, but we don't want the people generally to know about it because they'll demand we open it to the public. Designed for maintenance crews, mostly." He locked the door behind him, looked around at the wide interior corridor. "Building was designed pretty well, actually."

The grudging tone of admiration wasn't natural to him. If a thing was well done, it was well done . . . but lately he found himself talking more and more that way, especially when the CoDominium was discussed. He resented the whole CD administration, the men who'd dumped the job of government after creating problems that no one could solve.

They wound down stairways, through more passages, up to another set of locked doors, finally emerged into the Palace courtyard. The celebrations were already under way, and it would be a long night; and what after that? Tomorrow the last CD boat would rise, and the CoDominium would be gone. Tomorrow, Hadley would be alone with her problems.

"Tensh-hut!" Sergeant-Major Calvin's crisp command cut through the babble.

"Please be seated, gentlemen," Falkenberg said. He took his place at the head of the long table in the command room of what had been the central headquarters for the Co-Dominium marines. Except for the uniforms and banners there were as yet few changes from what people already called the old days. The officers were seated in the usual places for a regimental staff meeting, maps displayed on the walls behind them, white-coated stewards brought coffee and discreetly retired past the sentries outside. The constabulary had occupied the marine headquarters barracks for two days, and the marines had been there twenty years.

There was another difference from the usual protocol of a council of war. A civilian lounged in the seat usually taken by the regimental intelligence officer, his tunic a riot of colors. He was dressed in current Earth fashions, brilliant cravat and baggy sleeves, long sash in place of a belt. Hadley's upper classes were only beginning to acquire such finery. When he spoke it was with the lazy drawl of the American South, not the more clipped accents of Hadley.

"You all know why we're here," Falkenberg told the assembled group. "Those of you who served with me before know I don't hold many staff councils, but they are customary among mercenaries. Sergeant Calvin will represent the enlisted men of the regiment."

There were faint titters. Calvin had been associated with John Falkenberg for eighteen standard years. Presumably they had differences of opinion, but no one could remember one. The idea of the RSM opposing his colonel in the name of the troops was amusing.

Falkenberg's frozen features relaxed slightly, as if he appreciated his own joke. He looked around the room at his officers. They were all men who had come with him, all former marines. The Progressives were on duty elsewhere--it had taken careful planning by the adjutant to accomplish that.

"Dr. Whitlock, you've been on Hadley sixty-seven days. That's not very long to make a planetary study, but you had access to Fleet data as well. Have you reached any conclusions?"

"Yeah. No different from Fleet evaluation, Colonel. Cain't think why you went to the expense of bringin' me out here. Your intelligence people know their jobs 'bout as well as any professor." Whitlock leaned back in his seat, relaxed and casual in the midst of military formality, but there was no contempt in his manner. The military had one set of rules, he had another, both probably right for the jobs they did.

"Your conclusions are similar to Fleet's, then?" Falkenberg prompted.

"Within the limits of analysis, yes,

suh. Doubt any competent man *could* reach a different conclusion. This planet's headed for barbarism within a generation." Whitlock produced a cigar from a sleeve pocket, inspected it carefully. "You want the analysis or just the conclusion?"

There was no sound from the assembled officers, but Falkenberg knew that some of them were startled. Good training kept them from showing it. He examined each face in turn. Major Savage knew. Captain Fast was too concerned with regimental affairs to care. . . Calvin knew, of course. Who else? "If you could summarize your efforts briefly, Dr. Whitlock?"

"Simple enough. There's no self-sustaining technology for a population half this size. Without imports the standard of livin's going to fall, and when that happens, 'stead of working, the people here in Refuge will demand that the Guv'mint do something about it. Guv'mint's in no position to refuse. Not strong enough. Have to divert investment resources into consumption goods. Be a decrease in technological efficiency, fewer goods, more demands, lead to a new cycle of the same. Hard to predict just what comes after that, but it can't be good. Afore long they won't have the technological resources even if they get better organized. Not a new pattern, Colonel. Surprised you didn't just take Fleet's word for it."

Falkenberg nodded. "I did. But with something this important I thought I better get an expert. You've met the Freedom Party leaders, Dr. Whitlock. Is there any chance they could, ah, save civilization here?"

Whitlock laughed. It was a long drawn out laugh, relaxed, totally out of place in a military council. "'Bout as much chance as for a 'gator to turn loose of a hog, Colonel. Even did they want to, what are they goin' to do? Suppose they get a vision, try to change their policies? Somebody'll start a new party 'long the lines of the one they got now. You *never* going to convince all them people that there's things the Guv'mint just *cain't* do, Colonel. They don't want to believe that, and there's always going to be slick talkers willing to say it's a plot. Now if the Progressive Party was able to set up along the lines of the Communists, *they* might keep something going for a while longer."

"Do you think they can?" Major Savage asked.

"Nope. They might have fun tryin'," Whitlock answered. "Problem is the countryside's pretty independent. Not enough support for that kind of thing in the city, either. Eventually it'll happen, but the revolution that gives this planet a real powerful government's going to be one bloody mess, I can tell you. And a long drawn out bloody mess at that."

Whitlock sighed. "No matter where you look, you see problems,

gentlemen. City's vulnerable to any sabotage that stops the food plants . . . and you know them fusion generators ain't exactly eternal; I don't give them a lot of time before they slow down the way they're runnin' 'em. This place is operating on its capital, not its income, and pretty soon that's going to be gone." Whitlock sat up, stretched elaborately. "I can give you a dozen more reasons, but they always come out the same. This place ain't about to be self-sufficient without a lot of blood spilled."

"Could they ask for help from American Express?" The question was from a junior officer near the foot of the table.

"Sure they could," Whitlock drawled. "Wouldn't get it, but they could ask. Son, the Russians ain't going to let a U.S. company get hold of a planet and add it to the U.S. sphere same as the States won't let the Commies come in and set up shop. Grand Senate would order a quarantine on this system like that." The historian snapped his fingers. "Whole purpose of the CoDominium."

"One thing bothers me," Captain Fast said. "You've been assuming that the CD will simply let Hadley revert to barbarism. Won't BuRelock and the Colonial Office come back if things get that desperate?"

"Might, if they was around to do it," Whitlock answered. This time there was a startled gasp from several junior officers. "Haven't told them about that, Colonel? Sorry."

"Sir, what does he mean?" the lieutenant asked. "What could happen to the Bureau of Relocation?"

"No budget," Falkenberg answered. "Gentlemen, you've seen the tensions back on Earth. Kaslov's people are gaining influence in the Presidium, Harmon's gang have won minor elections in the States, and both want to abolish the CD. They've had enough influence to get appropriations cut to the bone—I shouldn't have to tell you that, you've seen what's happening to the Navy and the civilian agencies get the same. Population control has to ship people to worlds closer to Earth whether they can hold them or not. Marginal exploitation ventures like Hadley's mines are to be shut down. This isn't the only planet the CD's abandoning this year—excuse me, granting independence," he added ironically. "No, Hadley can't rely on CoDominium help. If this world's to reach takeoff, it's going to have to do it on its own."

"Which Dr. Whitlock says is impossible," Major Savage observed. "John, we've got ourselves into a cleft stick, haven't we?"

"Ah said it wasn't likely, not that it was impossible," Whitlock reminded them. "It'll take a guv'mint stronger than anything Hadley's liable to get, and some pretty smart people making the right moves. Or maybe there'll be some luck. Like a good, selective plague. Now that'd do it. Plague to kill off about a hundred

thousand, leave just the right ones . . . course if it killed a lot more'n that, probably wouldn't be enough left to take advantage of the technology. Reckon a plague's not the answer at that."

Falkenberg nodded grimly. "Thank you, Dr. Whitlock. Now, gentlemen, I want battalion commanders and the headquarters officers to read Dr. Whitlock's report carefully. Meanwhile, we have other actions. Major Savage will shortly make a report to the Cabinet. I want you to pay attention to that report. Jerry?"

Savage stood, strode briskly to the wall chartboard, uncovered briefing charts. "Gentlemen. The regiment consists of approximately two thousand officers and men. Of these, five hundred are former marines. Another five hundred, approximately, are Progressive partisans, who are organized under officers appointed by Mr. Bradford. The other thousand are general recruits including youngsters who want to play soldier. All locals have received basic training comparable to CD marine ground basic without assault, fleet, or jump schooling. Their performance has been somewhat better than we might expect from a comparable number of marine recruits in CD service."

"This morning, Mr. Bradford ordered the colonel to remove the last of our officers and noncoms from the fourth battalion. As of retreat this P.M. the fourth will be totally under the control of the First Vice-President, for what purpose he has not informed us."

Falkenberg nodded. "In your estimate, Major, are the troops ready for combat duties?" John sipped his coffee, listened idly. The briefing was rehearsed, and he knew what Savage would answer. The men were trained but not yet a combat unit. He waited until Savage had completed that part of the presentation. "Recommendations?"

"Recommend that the second battalion be integrated with the first, sir. Normal practice is to have one recruit, three privates, and a monitor to each maniple. With equal numbers of new men and veterans we'll have a much higher proportion of recruits, of course, but this will give us two battalions of men under our veteran marines, with marine privates for leavening. We will thus break up the provisional training organization and set up the regiment with a new permanent structure, first and second battalions for combat duties, third composed of locals with former marine officers and some noncoms to be held in reserve. The fourth will not be under our command."

"Your reasons for this organization?" Falkenberg asked.

"Morale, sir. The new troops feel discriminated against. They're under harsher discipline than the former marines, and they resent it. Putting them in the same maniples with the marines will stop that."

"You have the new organization plan there, Major?"

"Yes, sir." Savage turned the charts from their wall recess. The administrative structure was a compromise between the permanent garrison organization of CD marines and the national army of Churchill, so arranged that all of the key positions had to be held by Falkenberg's mercenaries. The best officers of the Progressive forces were in either the third or fourth battalions, and there were no locals with the proper experience. . .

John looked at it carefully, listened to Savage's explanation. It ought to work. It looked very good, and there was no sound military reason to question the structure. . . He didn't think the President could object. Bradford would be pleased about the fourth, hardly interested in the other battalions now, although give him time.

When Savage was finished, Falkenberg thanked him and stood again at the head of the table. "All right. You've heard Major Savage give the briefing. If you have critiques, let's hear them now. We want this smooth, without problems from the civilians. Another thing. Sergeant-Major!"

"Sir!"

"As of reveille tomorrow, this entire regiment is under normal discipline. Tell the 42nd the act's over, we want them back on behavior. From here on the recruits and the old hands will be treated the same, and the next man who gives me trouble will wish he hadn't been born."

"Sir!" Calvin smiled happily. The last months had been a strain for everyone. Now the old man was taking over again, thank God. The men had lost some of the edge, but he'd soon put it back again. It was time to take off the masks, and Calvin for one was glad of it.

III

The sound of fifty thousand people shouting in unison can be terrifying. It raises fears at a level below thought, a panic older than the fear of nuclear weapons and the whole panoply of technology, raw naked power, a cauldron of sound. Everyone in the Palace listened to the chanting crowd, and if most of the government officials were able to appear calm, they were afraid nonetheless.

The Cabinet meeting started at dawn, went on until late in the morning, on and on without settling anything. It was growing close to noon when Vice-President Bradford stood at his place at the council table, the thin smile gone, his lips tight with rage. He pointed a trembling finger at Hamner.

"It's your fault!" Bradford shouted. "Now the technicians have joined in the demand for a new constitution, and you control them! I've always said you were a traitor to the Progressive Party!"

"Gentlemen, please," President Budreau insisted tiredly. "Come now, that sort of language. . ."

"Traitor?" Hamner demanded. "If your blasted officials would pay a little attention to the technicians this wouldn't have happened. In three months you've managed to convert the techs from the staunchest supporters of this Party into allies of the rebels, despite everything I could do." George made a conscious effort to control his own anger. "You've herded them around the city like cattle, worked them overtime for no increase in pay, and set those damned soldiers of yours on them when they protested. It's worth a man's life to have your constabulary mad at him, I know of cases where your troops have beaten my people to death! And you've got the nerve to call me a traitor! I ought to wring your goddam neck."

"This isn't getting us anywhere," Budreau protested. There was a roar from the stadium. The Palace seemed to vibrate to the shouts of the constitutional convention. Wearily, Budreau rose to his feet. The others remained sitting, something they wouldn't have done even a month earlier. "We will adjourn for half an hour to allow tempers to cool," Budreau insisted. "And I want no more accusations when we convene again."

Bradford left the room with a handful of his close supporters. Other Ministers followed him, afraid not to be seen with the First Vice-President. It could be dangerous to oppose him. . .

Outside in the hall he was joined by Lieutenant Colonel Cordova, commander of the fourth battalion of constabulary, a fanatic Bradford supporter. They whispered together until they were out of Hamner's sight.

"Buy you some coffee?" The voice behind him startled George. He turned to see Falkenberg.

"Sure. Not that it's going to do any good . . . we're in trouble, Colonel."

"Anything decided?" Falkenberg asked. "It's been a long wait."

"And a useless one. They ought to invite you into the Cabinet meetings or let you go, there's certainly no reason to make you wait in the anteroom while we yell at each other. I've tried to change the policy, but I'm not too popular right now. . ." There was another shout from the stadium.

"Whole government's not too popular," Falkenberg observed. "And when that convention gets through. . ."

"Another thing I tried to stop last week," George told him. "But Budreau didn't have the guts to stand up to them. So now we've got fifty thousand drifters with nothing better to do sitting as an assembly of the people. That ought to produce quite a constitution."

Falkenberg shrugged. He seemed about to say something, changed his mind. They reached the executive

dining room, took seats near one wall. Bradford's group had a table across the room from them. All of Bradford's people looked at them suspiciously.

"You'll get tagged as a traitor for sitting with me, Colonel." Hamner laughed, then grew serious. "I think I meant that, you know. Bradford's blaming me for our problems with the techs, and between us he's also insisting that you aren't doing enough to restore order in the city."

Falkenberg ordered coffee, waited until the waitress had left the table. "Do I need to explain to you why we haven't?"

"No." George shook his head slowly. "God knows you've been given almost no support the last two months. Impossible orders, never allowed to do anything decisive. . . I see you've stopped the raids on rebel headquarters."

Falkenberg nodded. "We weren't catching anyone. Too many leaks in the Palace, too often the fourth battalion had already muddied the waters. If they'd let us do our job instead of having to ask permission through channels for each operation we undertake, maybe the enemy wouldn't know as much about what we're going to do. I've quit asking."

"You've done pretty well with the railroad."

Falkenberg nodded. "That's one success, anyway. Things are pretty calm out in the country where we're on our own. Odd, isn't it, that the closer we are to the expert supervision of the government, the less effective my men seem to be?"

"But can't you control Cordova's men? They're causing more people to join the Freedom Party than you can count. I can't believe unrestrained brutality is useful."

"Mr. Bradford has removed all command over the fourth from me," Falkenberg answered. "Expanded it pretty well, too. That battalion's nearly as big as the rest of the regiment."

"He's accused me of being a traitor," Hamner said carefully. "With his own army, he might have something planned. . ."

Falkenberg smiled grimly. "I wouldn't worry about it too much."

"You wouldn't. Well, I'm scared, Colonel. And I've got my family to think about. I'm plenty scared."

"Would you feel safer if your family were in our regimental barracks?" Falkenberg looked at Hamner critically. "It could be arranged."

"It's about time we had something out," George said. "Yes, I'd feel safer with my wife and children under your protection. But I want you to level with me. Those marines of yours—those aren't penal battalion men. I've watched them. And those battle banners they've got on the regimental standard . . . they didn't win those in any peanut actions in three months on this planet! Just who are those troops, Colonel?"

John smiled thinly. "Wondering when you'd ask. Why haven't you brought this up with Budreau?"

"I don't know. Trust you more than I do Bradford, maybe . . . if the President dismissed you, there'd be nobody able to oppose Ernie. Hadley's going downhill so fast another conspirator more or less can't make any difference. . . You still haven't answered my question."

"The battle banners are from the 42nd CD Marine Regiment," Falkenberg answered slowly. "Decommissioned as part of the budget cuts."

"Forty-second." Hamner thought for a second, remembering the files he'd seen on Falkenberg. "Your regiment."

"A battalion of it," John agreed. "Their women are waiting to join them when we get settled. When the 42nd was decommissioned, the men decided to stay together if they could."

"So you brought not only the officers, but the men as well. . . What's your game, Colonel? You want something more than just pay for your troops. What is it? I wonder if I shouldn't be more afraid of you than of Bradford."

Falkenberg shrugged. "Decision you have to make, Mr. Hamner. I could give you my word that we mean you no harm, but what would that be worth? I will pledge to take care of your family. If you want us to."

There was another shout from the stadium. Bradford and Lieutenant Colonel Cordova left their table, still talking in low tones. The conversation was animated, with violent gestures, as if Cordova were trying to talk Bradford into something. As they left, Bradford agreed.

George watched them leave the room, then nodded thoughtfully to Falkenberg. "I'll send Laura and the kids over to your headquarters this afternoon. There isn't much time, is there? Whatever you've got planned, it's going to have to be quick."

John shook his head slowly. "You seem to think I have some kind of master plan, Mister Vice-President. I'm only a soldier in a political situation."

"With Professor Whitlock to advise you," Hamner reminded him. "That cornball stuff of his doesn't fool me, I looked him up. He's another part of the puzzle I don't understand. Why doesn't he come to the President instead of moving around the city like a ghost? He must have fifty political agents out there." Hamner watched Falkenberg's face closely. "Surprised you with that one, didn't I? I'm not quite so stupid as I look . . . but I can't fit the pieces together. Maybe I ought to use whatever influence I have left to get you out of the picture entirely."

"Go ahead." Falkenberg's smile was cold. "Who watches your wife for you after that? The Chief of Police? Listen." The stadium roared again, an angry sound that swelled in volume.

"You win." Hammer left the table, walked slowly back toward the council room, his head swirling with

doubts. One thing stood out clearly: John Christian Falkenberg controlled the only military force on Hadley that could oppose both Bradford's people and the Freedom Party gangsters. He kept that firmly in mind as he turned, went downstairs to the apartment he'd been assigned. The sooner Laura was in the marine barracks, the safer he'd feel . . . Was he sending her to another enemy? But what could Falkenberg use her for? Mercenary or not, the man was honorable. Boris Karantov had been emphatic about that. And he hadn't any reason to hate George Hamner. Keep remembering that, he told himself. Keep remembering that and try not to remember the rest of it. The crowd screamed again. "Power to the people!" George heard it, and walked faster.

Bradford's grin was back. It was the first thing Hamner noticed as he came into the council chamber. The little man stood at the table with an amused smile.

"Ah, here is our Minister of Technology," Bradford grinned. "Just in time. Mister President, that gang outside is threatening the city. I'm sure you'll all be pleased to know that I've taken steps to end the situation. At this moment, Colonel Cordova is arresting the leaders of the opposition. Including, Mister President, the Engineers' and Technicians' Association leaders who have joined them. This rebellion will be over within the hour."

Hamner stared at the man. "You fool! You'll have every technician in the city joining the FP! And they control the power plants, our last influence over the crowd! You bloody damn fool!"

Bradford's smirk widened, as he spoke with exaggerated surprise. "I thought you'd be pleased, George. And naturally I've sent men to the power plants as well. Ah, listen."

The crowd outside wasn't chanting anymore. There was a confused babble, a welling of sound that turned ugly, but nothing coherent. Then a rapid fusillade of shots.

"My God!" Budreau stared wildly in confusion. "Who are they shooting at? You've started open civil war!"

"It takes stern measures, Mister President," Bradford said calmly. "Perhaps too stern for you?" He shook his head slightly. "The time is come for harsh measures, Mister President. Hadley cannot be governed by weak-willed men. Our future belongs to those who have the will to grasp it!"

Hamner stood, went to the door. Before he reached it, Bradford called to him. "Please, George," he said pleasantly. "I'm afraid you can't leave just yet. It wouldn't be safe for you. I took the liberty of ordering Colonel Cordova's men to, uh, guard this room while my troops restore order."

An uneasy quiet had settled on the stadium, and they waited for long minutes. Then there were screams,

more shots, and the sounds were moving closer, as if they were outside the stadium. Bradford frowned slightly, but no one said anything. They waited for what seemed a lifetime as the firing continued, guns, shouts, screams, sirens and alarms.

The door burst open. Cordova, now wearing the insignia of a full colonel, came into the room, glanced about wildly. "Mister Bradford—could you come outside, please?"

"You will make your report to the Cabinet," Budreau ordered. "Now, sir."

Cordova glanced at Bradford, who nodded. "Yes, sir," the young officer said. "As directed by Vice-President Bradford, elements of the fourth battalion proceeded to the stadium and arrested some forty leaders of the so-called constitutional convention. Our plan was to enter quickly and take the men out through the Presidential Box into the Palace. However, when we attempted to make the arrests we were opposed by armed men, many of them in the uniforms of household guards. There were not supposed to be any weapons in the stadium, but this was in error. The crowd overpowered my officers and released their prisoners. When we attempted to recover them, we were attacked by the mob and forced to fight our way out of the stadium."

"Good Lord," Budreau sighed.

"The power plants! Did you secure them?" Hamner demanded.

Cordova looked miserable. "No, sir. My men were not admitted. A council of technicians holds the power plants and threatens to destroy them if we attempt forcible entry. We will try to seal them off from outside support, but I don't think that will be possible with only my battalion. In my judgment, we will require the full complement of constabulary to restore order."

Hamner sat heavily, tried to think. Council of technicians. He'd know most of them, they'd be his friends . . . but did they trust him now? Was this good or bad? At least Bradford didn't control the plants.

"What is the current status outside?" Budreau demanded. They could still hear firing in the streets.

"Uh, there's a mob barricaded in the market, another in the theater across from the Palace, sir. My troops are trying to dislodge them."

"Trying. I take it they weren't able to succeed." Budreau struck his hands together, suddenly rose and went to the anteroom door. "Colonel Falkenberg?" he called.

"Yes, sir?" John entered the room as the President beckoned.

"Colonel, are you familiar with the situation outside?"

"Yes, sir."

"Damn it, man, can you do something?"

"What does the President suggest that I do?" Falkenberg looked at the Cabinet. "For three months we have attempted to restore order in this city. Even with the cooperation of the technicians we have been unable to do so for reasons which ought to

be obvious. Now there is open rebellion and you have alienated one of the most powerful blocs within your party. We no longer control either the power plants or the food processing centers. I repeat, what does the President suggest I do now?"

Budreau nodded. "A fair enough criticism."

He was interrupted by Bradford. "Disperse that mob! Use those precious troops of yours to fight!"

"Will the President draw up a proclamation of martial law?" Falkenberg asked.

Budreau nodded. "I have to."

"Very well," John continued. "But I want something made clear. If I am to enforce martial law, I must have command of all government forces, including the fourth battalion. I will not attempt to restore order when some of the troops are not responsive to my policies."

"No!" Bradford stared wildly at Falkenberg. "I see what you're trying to do! You're against me too. You always have been. That's why it was never time to make me President, you're planning to take over this planet yourself! You want to be dictator. Well, you won't get away with it. Cordova, arrest that man!"

Cordova licked his lips, glanced at Falkenberg. "Lieutenant Hargreave!" he called. The door to the anteroom opened fully, but no one came in. "Hargreave!" Cordova shouted again. He put his hand to his pistol. "You're under arrest, Colonel Falkenberg."

"This is absurd," Budreau shouted. "Colonel Cordova, take your hand off that weapon! I will not have my Cabinet meeting turned into a farce."

Bradford stared intently at the President. "You too, huh? Arrest Budreau, Colonel Cordova. As for you, Mister Traitor George Hamner, you'll get what's coming to you. I've got men all through this Palace, I knew I might have to do this."

"What is this, Earnest?" Budreau asked. He seemed bewildered. "Are you serious?"

"Oh, shut up, old man," Bradford snarled. "I suppose you'll have to be shot as well."

"I think we've heard enough," Falkenberg said carefully. His voice rang through the room, although he hadn't shouted. "And I refuse to be arrested."

"Kill him!" Bradford shouted. He reached under his tunic.

Cordova put his hand back on his pistol. There were shots from the doorway, impossibly loud, filling the room. Hamner's ears rang from the muzzle blast. Bradford spun toward the door, a surprised look on his face, then his eyes glazed and he slid to the floor, the half-smile still on his lips. More shots, a crash of automatic weapons, and Cordova was flung against the wall of the council chamber, held there for an incredibly long moment. Bright red blotches spurted across his uniform.

Sergeant-Major Calvin came into the room with three marines in battle dress, leather over bulging body armor, their helmets dull in the bright blue sunlight streaming from the chamber's windows.

Falkenberg nodded, holstered his pistol. "All secure, Sergeant-Major?"

"Sir!"

Falkenberg nodded again. "To quote Mister Bradford, I took the liberty of securing the corridors, Mister President. Now, if you'll issue that proclamation, I'll see to the situation in the streets outside. I believe Captain Fast has already drawn it up for your signature."

"But—" Budreau's tone was hopeless. "All right. Not that there's much chance." The President sat at the head of the table, still bewildered by the rapid events. Too much had happened, too much to do. The battle sounds outside were louder, and the room was filled with the sharp copper odor of blood.

"You'd better speak to the President's Guard," Falkenberg told Hamner. "They won't know what to do."

"Aren't you going to use them in the street fight?"

Falkenberg shook his head. "I doubt if they'd fight. They live here in the city, too many friends on both sides. They'll protect the Palace, but they won't be reliable for anything else."

"Have we got a chance?"

"Depends on how good the people we're fighting are. If they've got a commander half as good as I think, we won't win this battle."

Two hours proved him right. Fierce attacks drove the rioters away from the immediate area of the Palace, but Falkenberg's regiment paid for every yard they gained. Whenever they took a building, the enemy left it blazing. When the regiment trapped one large group of rebels, Falkenberg was forced to abandon the assault to aid in evacuating a hospital that the enemy torched. In three hours, fires were raging all around the Palace.

There was no one in the council chamber with Budreau and Hamner when Falkenberg came back to report.

"They've got good leaders," John told them. "When they left the stadium, immediately after Cordova's assault, they stormed the police barracks. Took the weapons, distributed them to their allies, and butchered the police. And we're not fighting just the mob out there. We've repeatedly run up against well-armed men in household forces uniform. I'll try again in the morning, but for now, Mister President, we don't hold much more than half a kilometer around the Palace.

The fires burned all night, but there was little fighting. In the morning the regiment sallied out again, moved northward toward the concentration points of the rioters. Within an hour they were heavily engaged against rooftop snipers, bar-

ricaded streets, and everywhere burning buildings.

The fourth regiment, Bradford's former troops, were decimated in repeated assaults against the barricades. Hamner accompanied the soldiers to Falkenberg's field headquarters, watched the combat operations.

"You're using up those men pretty fast, aren't you?" he asked.

"Not by choice," Falkenberg told him. "The President has ordered me to break the enemy resistance. That squanders soldiers. I'd as soon use the fourth battalion as to blunt the fighting edge of the rest of the regiment."

"But we're not getting anywhere."

"No. The opposition's too good, and there are too many of them. We can't get them concentrated for an all-out battle, they simply set fire to part of the city and retreat under cover of the flames." He stopped, listened to reports from a runner, then spoke quietly into a communicator. "Fall back to the Palace."

"You're retreating?"

"I have to. I can't hold this thin a perimeter. I've only two battalions—and what's left of the fourth."

"Where's the third? The Progressive partisans? My people?"

"Out at the power plants and food centers," Falkenberg answered. "We can't get in without giving the techs time to wreck the place, but we can keep any of the rebels from getting in. The third isn't as well trained as the rest of the regiment—and besides, the techs may trust them."

They walked through burned out streets, the sounds of fighting following them as the regiment retreated. Worried Presidential Guards let them into the Palace, swung heavy doors shut behind them.

President Budreau was in the ornate office with Lieutenant Banners. "I was going to send for you," Budreau said. "We can't win this, can we?"

"Not the way it's going."

"That's what I thought. Pull your men back to barracks, Colonel. I'm going to surrender."

"But you can't," George protested. "Everything we've dreamed of . . . You'll doom Hadley. The Freedom Party can't govern . . ."

"Precisely. You've seen it too, haven't you? How much governing are we doing? Before it came to an open break, perhaps we had a chance. Not now. Bring your men back to the Palace, Colonel Falkenberg. Or are you going to resist my commands?"

"No, sir. The men are retreating already. They'll be here in a few minutes."

Budreau sighed loudly. "I told you the military answer wouldn't work here, Falkenberg."

"We might have accomplished something in the past months if we'd been given the chance."

"You might. You might not, also. It doesn't matter now. This isn't three months ago. It's not even yesterday. I might have bargained with

them then. But it's today, and we've lost. You're not doing much besides burning down the city . . . at least I can spare Hadley that. Banners, go tell the Freedom Party people I can't take anymore." The Guard officer saluted and left, his face an unreadable mask.

"So you're resigning," Falkenberg said slowly.

Budreau nodded.

"Have you resigned, sir?" Falkenberg asked deliberately.

"Yes, blast it. Banners has promised to get me out of here. On a boat, I can sail up the coast, cut inland to the mines. There'll be a starship come in there sometime, I can get out on it. You'd better come with me, George." He put his face to his hands for a moment, then looked up. "What will you do, Colonel Falkenberg?"

"We'll manage. There are plenty of boats in the harbor. For that matter, the new government will need soldiers."

"The perfect mercenary," Budreau said with contempt. He sighed, looked around the office. "It's a relief. I don't have to decide things anymore." He stood suddenly, his shoulders no longer stooped. "I'll get the family. You'd better be moving too, George."

"I'll be along, sir. Don't wait for us—as the colonel says, there are plenty of boats." He waited until Budreau had left the office. "All right, what now?" he asked Falkenberg.

"Now we do what we came here for," Falkenberg snapped. "You haven't been sworn in as President yet, and you won't get the chance until I've finished. And there's nobody to accept your resignation, either."

Hamner looked at him carefully. "So you do have an idea. Let's hear it."

"You're not President yet," Falkenberg answered. "Under Budreau's proclamation of martial law, I am to take whatever action I deem necessary to restore order in Refuge. That order is valid until a new President rescinds it. And at the moment there's no President."

"But—Budreau's surrendered! The Freedom Party will elect one!"

"Under Hadley's constitution only the Senate and Assembly in joint session can make a change in the order of succession. They're scattered across the city, their meeting chambers have been burned . . . to play guardhouse lawyer, Mr. Hamner, Budreau doesn't have the authority to appoint a new President. With Bradford dead, you're in charge here—but not until you appear before a magistrate and take the oath of office."

"I see . . . and there aren't any magistrates around. How long do you think you can stay in control here?"

"As long as I have to." Falkenberg turned to his aides. "Corporal, I want Mr. Hamner to stay with me. You're to treat him with respect but

he goes nowhere and sees no one without my permission. Understood?"

"Sir!"

"And now what?" Hamner asked.

"And now we wait," John said softly. "But not too long . . ."

Hamner and Falkenberg sat in the council chambers. When Captain Fast came in periodically to give reports on the combat situation, Falkenberg didn't seem interested; but when Dr. Whitlock's agents came in from time to time, the soldier was attentive. After a long wait the regiment was assembled in the Palace courtyard, while the Presidential Guard still held the Palace entrances, refused to admit the rioters. The rebels were obviously instructed to leave the Guardsmen alone so long as they took no action against them, giving an uneasy truce.

After Banners reported the President's surrender, the crowd began to flow into the stadium, shouting with triumph. Still they waited, Falkenberg with outward calm, Hamner with growing tension.

An hour later Dr. Whitlock came into the council room. He looked at Falkenberg and Hamner, then sat easily in the President's chair. "Don't reckon I'll get another chance to sit in the seat of the mighty," he grinned. "It's 'bout like you figured, Colonel. Mob's moved right into the stadium. Nobody wants to be left out now they think they've won. Got some Senators out there on the field, fixin' to elect themselves a brand new President."

"The election won't be valid," Hamner said.

"Naw, suh, but that don't seem to stop 'em none. They figure they've won the right, it seems. And the Guard has already said they're goin' to honor the people's choice." Whitlock smiled ironically.

"How many of my technicians are out there in that mob?" Hamner asked. "They'd listen to me, I know they would."

"Not so many as there used to be," Whitlock replied. "Most of 'em couldn't stomach the burnin' and looting. Still, there's a fair number."

"Can you get them out?" Falkenberg asked.

"Doin' that right now." Whitlock grinned. "Got some of my people goin' round tellin' them they already got Mister Hamner as President, why would they want somebody else? Seems to be working, too. Should have all that's goin' out of there in a half hour or so."

Falkenberg nodded. "Let's speed them on their way, shall we?" He strode to the control wall of the council chamber, opened a panel. "Mister Hamner, I can't give you orders, but I suggest you make a speech. Say you're going to be President and things are going to be different. Then order them to go home or face charges as rebels."

Hamner nodded. It wasn't much of a speech, and from the roar outside the crowd didn't hear much of it

anyway. He promised amnesty for anyone who left the stadium, tried to appeal to the Progressives who were caught up in the rebellion. When he put the microphone down, Falkenberg nodded. "Half an hour, Dr. Whitlock?" he asked.

"About that," the historian agreed.

"Let's go, Mister President." Falkenberg was insistent.

"Where?" Hamner asked.

"To see the end of this. You want to watch, or would you like to join your family? You can go anywhere you like except to a magistrate or to someone who might accept your resignation."

"Colonel, this is ridiculous. You can't force me to be President! And I don't understand what's going on."

Falkenberg's smile was grim. "Nor do I want you to. Yet. You'll have enough trouble living with yourself anyway. Let's go."

The first and second battalions were assembled in the Palace courtyard. The men stood in ranks, synthileather battle dress stained with dirt from training and the recent street fighting. Their armor bulged under the uniforms of the impassive men. Hamner thought they might have been carved from stone.

Falkenberg led the way to the stadium entrance. Lieutenant Banners stood in the doorway. "Halt," he commanded.

"Really, Lieutenant? would you fight my troops?" Falkenberg indicated the grim lines behind him.

"No, sir," Banners protested. "But we have barred the doors. The emergency meeting of the Senate is electing a new President out there. When he's sworn in, the Guard will be under his command—until then, we can't permit your mercenaries to interfere."

"I have orders from Vice-President Hamner to arrest the leaders of the rebellion, and a valid proclamation of martial law," Falkenberg insisted.

"I'm sorry, sir." Banners seemed to mean it. "Our council of officers has decided that President Budreau's surrender is valid. We intend to honor it."

"I see." Falkenberg withdrew. "Hadn't expected this. It would take a week to fight through those guardrooms . . ." he thought for a moment. "Give me your keys!" he snapped at Hamner.

Bewildered, George took them out. Falkenberg examined them, grinned. "There's another way into there, you know . . . Major Savage! Take G and H companies of second battalion to secure the stadium exits. Place anyone who comes out under arrest. And you'd better dig the men in pretty good, they'll be coming out fighting. But I don't expect them to be well-organized."

"Yes, sir. Do we fire on armed men?"

"Without warning, Major. Without warning." Falkenberg turned to the assembled soldiers. "Follow me."

He led them to the tunnel entrance, unlocked the doors. Hamner trailed behind him as they wound down stairways, across under the field. He could hear the long column of armed men tramp behind them. They moved up the stairways on the other side, marching briskly until Hamner was panting, but the men didn't seem to notice. Gravity difference, Hamner thought. And training.

They reached the top, moved along the passageways. Falkenberg stationed men at each exit, came back to the center doors. "MOVE OUT!" he commanded.

The doors burst open. The armed troopers moved quickly across the top of the stadium. Most of the mob was below, and a few unarmed men were struck down when they tried to oppose the regiment. Rifle butts swung, then there was a moment of calm. Falkenberg took a portable speaker from a corporal attendant.

"ATTENTION ATTENTION. YOU ARE UNDER ARREST BY THE AUTHORITY OF THE MARTIAL LAW PROCLAMATION OF PRESIDENT BUDREAU. LAY DOWN YOUR WEAPONS AND YOU WILL NOT BE HARMED. IF YOU RESIST, YOU WILL BE KILLED."

Someone below fired at them. Hamner heard the flat snap of the bullet as it rushed past, then the crack of the rifle.

One of the leaders on the field had a speaker, shouted orders. "ATTACK THEM! THERE AREN'T MORE THAN A THOUSAND OF THEM, WE'RE THIRTY THOUSAND STRONG. ATTACK, KILL THEM!" There were more shots. Several of Falkenberg's men fell.

"PREPARE FOR VOLLEY FIRE!" Falkenberg called. "MAKE READY! TAKE AIM. IN VOLLEY, FIRE!"

Seven hundred rifles crashed as one.

"FIRE!"

Someone screamed, a long drawn out cry, a plea without words.

"FIRE!"

The line of men clambering up the seats toward them wavered, broke. Men screamed, some pushed back, tried to get behind someone, anywhere but under the unwavering muzzles of the rifles.

"FIRE!"

It was like one shot, very loud, lasting far longer than a rifle shot ought to, but impossible to hear individual weapons.

"THE FORTY-SECOND WILL ADVANCE. FIX BAYONETS. FORWARD, MOVE. FIRE! FIRE AT WILL."

Now there was a continuous crackle of weapons. The leather-clad lines moved forward, down the stadium seats, inexorably toward the press below.

"SERGEANT-MAJOR!"

"SIR!"

"MARKSMEN AND EXPERTS. FIRE ON ALL ARMED MEN."

"SIR!"

Calvin spoke into his communicator. Two sections fell out of the advancing line, took cover behind seats. They began to fire, carefully but rapidly. Anyone below who raised a weapon died.

Hamner was sick. The screams of wounded men could be heard everywhere.

"GRENADIERS, PREPARE TO THROW," Falkenberg ordered. "THROW!" A hundred grenades arched out, down into the milling crowds below. Their muffled explosions were masked by the screams of terror. "IN VOLLEY, FIRE!"

The regiment advanced, made contact with the mob below. There was a brief struggle. Rifles fired, bayonets flashed red, the line halted momentarily. Then it moved on, leaving behind a ghastly trail.

Men were jammed at the stadium exits, trampling each other in a scramble to escape. There was a rattle of gunfire from outside.

"You won't even let them out!" he screamed at Falkenberg.

"Not armed. And not to escape." The colonel's face was hard, cold, the eyes narrowed to slits as he peered down at the battle.

"Are you going to kill them all?"

"All who resist."

"But they don't deserve this!" Hamner insisted.

"No one does, George. Sergeant-Major!"

"Sir!"

"Half the marksmen may concentrate on the leaders now."

"Sir!" Calvin spoke quietly into his command set. As Hamner watched, the snipers began concentrating their fire on the Presidential Box across from them. Centurions ran up and down the line of hidden troops, pointing out targets. The marksmen kept up a steady fire.

The leather lines of armored men advanced inexorably, almost reached the lower tiers of seats. There was less firing now, but the scarlet painted bayonets could be seen everywhere. A section fell out of the line, moved to guard a tiny number of prisoners at one end of the stadium. The rest of the line moved on.

When the regiment reached ground level, their progress was slower. There was not much opposition, but the sheer mass of people in front of them held the troopers. In some places there were pockets of

armed fighting, which held for long moments until flying squads rushed up to reinforce the line. Falkenberg watched the battle calmly, spoke into his communicator. Below, more men died.

A company of troopers formed, rushed up a stairway on the opposite side of the stadium, fanned out across the top. Their rifles leveled, crashed in another terrible volley.

Suddenly it was over. There was no opposition, only screaming crowds, men throwing away weapons to run with their hands in the air, falling to their knees to beg for quarter. A final volley crashed out, then a deathly quiet fell over the stadium.

But it wasn't quiet, Hamner discovered. The guns were silent, men no longer shouted, but there was sound. Screams of wounded men.

Falkenberg nodded grimly. "Now we can find a magistrate, Mister President. Now."

"I—oh my God!" Hamner stood at the top of the stadium, held a column to steady his weakened legs. The scene below was unreal. There was too much of it, too much blood, rivers of blood, blood cascading down the steps, pouring down stairwells, soaking the grassy field below.

"It's over," Falkenberg said gently. "For all of us. The regiment will be leaving as soon as you're properly in command. You shouldn't

have any trouble with the power plants, your technicians will trust you now that Bradford's gone. And without their leaders, the city people won't resist. You can ship as many as you have to out to the interior, disperse them among the loyalists where they won't do you any harm. That amnesty of yours—it's only a suggestion, but I'd keep it."

Hamner turned dazed eyes toward Falkenberg. "Yes. There's been too much slaughter today . . . Who are you, Falkenberg?"

"A mercenary soldier, Mister President. Nothing more."

"But—who are you working for?"

"That's the question nobody asked before. Grand Admiral Lermontov."

"Lermontov—but you've been dismissed from the CoDominium! You mean that—you were hired by the admiral? As a mercenary?"

Falkenberg nodded coldly. "More or less. The Fleet's a little sick of being used to mess up people's lives without having a chance to—to leave things in working order."

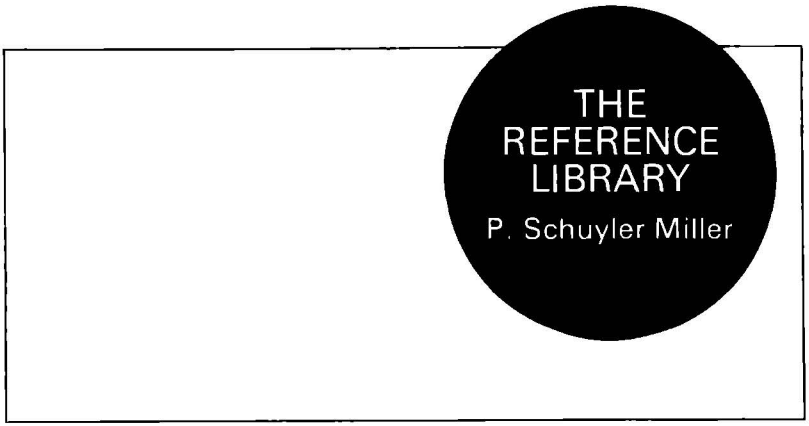
"And now you're leaving?"

"Yes. We couldn't stay here, George. Nobody is going to forget this. You couldn't keep us on and build a government that worked. I'll take first and second battalions, there's more work for us. The third will stay here to help you. We put all the married locals, the solid people in third and sent it off to the power plants where they wouldn't have to fight." He looked across the stadium, turned back to Hamner. "Blame it all on us, George. You weren't in command. You can say Bradford ordered the slaughter, killed himself in remorse . . . people will want to believe that. They'll want to think somebody was punished for—for this." He waved expressively. A child was sobbing out there somewhere.

"It had to be done," Falkenberg insisted. "Didn't it? There was no way out, nothing you could do to keep civilization . . . Dr. Whitlock estimated a third of the population would die when things collapsed. Fleet intelligence put it higher than that. Now you have a chance." Falkenberg was speaking rapidly, and George wondered who he was trying to convince. "Move them out while they're still dazed . . . you won't need much help for that. We've got the railroad running again, use it fast and ship them to the farms. It'll be rough with no preparation, but it's a long time until winter . . ."

Hamner nodded. "I know what to do." He leaned against the column, gathered new strength from the thought. "I've known all along what had to be done. Now we can do it. We won't thank you for it, but—you've saved a whole world, John."

Falkenberg looked at him grimly, then pointed to the bodies below. "Damn you, don't say that!" he shouted. "I haven't saved anything. All a soldier can do is buy time . . . I haven't saved Hadley. You have to do that. God help you if you don't." ■



A QUESTION OF DERIVATIONS

From time to time some historian of science fiction—more often than not it's Sam Moskowitz, because he knows and writes more about past SF than anyone—sounds off about the seeming derivation of some famous story from an older and little-known one. The argument over Edgar Rice Burroughs' Martian yarns is still raging, and as it happens, a new anthology of stories about Mars seems to me to cast some light on the subject.

The book is "Mars, We Love You," edited by Jane Hipolito and Willis E. McNelly of California State College at Fullerton, with an introduction by Isaac Asimov, and published by Doubleday (1971, 332 pp., $6.95). Most of the selections originated here in Astounding or Analog, and I apologize because I am going to talk about my own "The Cave," published here in 1943.

"The Cave" was to have been the first of a series of stories that never got any further, for various reasons. It was to have recast the European overrunning of North America in fictional form, using some of the factual situations of the Indian wars, but more particularly the kinds of relationships that arose between Indians and Europeans. In this story, and as the basis of the series, I coined the term "grak." This was a native Martian term—plural "grekka"—with a number of connotations. Superficially, it was the natives' name for themselves . . . but a "grak" was any living being who understood and adhered to a kind of universal brotherhood of needers and sharers of water. All beings are grekka—if they wish to be.

The editors suggest, in a flattering commentary, that my "grak" is too much like Robert Heinlein's "grok,"

in "Stranger in a Strange Land," to be coincidental. I admit to the same thoughts, but something else in the same anthology convinces me that if there was any derivation it was wholly unconscious.

About the time I quit writing fiction and took up this department, I was discussing another series of possible stories with John Campbell. The gimmick in the first story was to be a monstrous structure, found on a distant planet, and full of weird machines that seemed to do nothing at all but did it very busily. It would turn out, in time, that they were mobiles—sculpture—with no functional purpose at all except to whirr and click and make their wheels go 'round and their lights light up in good Hollywood SF style.

My story never got beyond the talk stage, but after excerpts from articles by Schiaparelli and Lowell, and from Wells' "War of the Worlds" and Burroughs' "Princess of Mars," this anthology gives us one of the finest and most famous stories about Mars ever written: Stanley G. Weinbaum's "A Martian Odyssey" from 1934. I don't know how often I've read the story, or how often I will read it again—it's fresh every time.

And what do I find in "A Martian Odyssey"—a story nobody could possibly forget? Pyramids that were the shells of silicious creatures, even though they looked like structures. (That's what my "building" was going to be, near enough.) Creatures that reproduced in a cloud of spores. (Near enough, though mine was fancier.) Cities full of mysterious machines that never seemed to do anything but sit there and flash and whirr . . .

My "original" ideas of the early 1950's, or a little earlier, were a purely unconscious rearrangement of ideas *and details* from a classic, "unforgettable" story of twenty years before. I didn't realize it. Neither did John—though he might have, if the stories had ever been written. It wasn't plagiarism, though you have to take my word for that. It certainly was direct derivation.

About the same length of time separated my "Cave" from "Stranger in a Strange Land." I rather hope that Heinlein did read the story in Astounding and remember enough of it so that his unconscious dredged the "grekka" concept up when he was forming a philosophical basis for Martian life. I know—after reading this book I really *know*—the derivation was not intentional.

I have said very little about the book, which is a good selection. I've said that most of the best stories were first published here—they include H. Beam Piper's "Omnilingual" and Harry Harrison's "One Step from Earth," plus an excerpt from another of Heinlein's Martian novels, "Double Star." One that is pure early-Campbell Astounding is George O. Smith's "Lost Art" from the Venus Equilateral series—and was ever a series more fascinatingly

technological than this? (Unless Jack Williamson's "seetee" stories?)

There is one of the best and most science fictional of Ray Bradbury's Martian chronicles, "The Lost City of Mars" from *Playboy* (post the book). There is a gentle, wonderful little story, "In Lonely Lands," by determinedly ungentle Harlan Ellison (proving again that he can write anything–if he wants to). There is a longish poem, "Carthage: Reflections of a Martian" by–I'm not putting you on–Frank Herbert, which even I can understand and enjoy, and two very short poems by Californians William Fox and Irene Jackson.

I spent too much time on myself to tell you about all the other, and more important, contributors. Lester Del Rey, for example. Anthony Boucher. Arthur C. Clarke. Damon Knight. Barry N. Malzberg. Donald Wollheim. And an article on "Linguistic Relativity in Middle High Martian" (actually, on "Stranger in a Strange Land") by Professor McNelly. I miss Leigh Brackett. You'll miss other stories. But new readers, in particular, are getting a very good cross section of what good science fiction is . . . Astounding/Analog style, especially.

COLD WAR IN A COUNTRY GARDEN

By Lindsay Gutteridge • G. P. Putnam's Sons, New York • 1971 • 189 pp. • $5.95

This is an English example of the formula that antiquarians and gerontarians remember affectionately from Murray Leinster's "Mad Planet" stories and Ray Cummings' "Golden Atom" (and many self-imitations). The merely middle-aged probably saw the film, "The Incredible Shrinking Man," even if they didn't read Richard Matheson's book. To give the author credit, I don't believe he had the slightest idea that these "classics" had ever been written. He quotes, and probably got his idea from, a poem by Andrew Marvell ("Where men like Grashoppers appear, But Grashoppers are Gyants there.")

As with Cummings (and, as I recall, Matheson), the heroes of this adventure into smallness take the drug route. They are the guinea-pigs in a military experiment, and before the book is done they are serving as quarter-inch secret agents, trying to plant an electronic "bug" (I am sure Mr. Gutteridge never for one moment thought of the obvious pun) in the hair of a Soviet bureaucrat at a pan-communist conference. Unlike Cummings, their belongings aren't shrunk with them, and some of the best parts of the early chapters have to do with their struggles to find tools in the world of "Gyants" where they find themselves.

Murray Leinster's hero (at least, in the original novelettes, "The Mad Planet" and "The Red Dust") lived in a distant future when insects and fungi had become gigantic and men remained the same. The best parts of

this book contrast the miniaturized men with the predatory insects among which they are living. As a whole, the story may make a good film—better than it is a book.

ULTIMATE WORLD

by Hugo Gernsback • Walker & Co., New York • 1971 • 187 pp. • $5.95

I'm afraid this is strictly a curio for collectors and historians of science fiction.

Nobody can deny Hugo Gernsback his place as the "father" of American popular science fiction, nor as a popular science editor, but he simply was not a writer. His concept of science fiction was as a teaching medium, and in both his fictional and factual magazines he was wide open to the "what if" approach which has become essential in SF. He also seems to have had a good knowledge of the electronic technology of his time—better than I have ever had—and his one major SF book, "Ralph 124C41+," holds some kind of record for accurate predictions. Otherwise, "Ralph" makes critics wince—and this new, posthumous book will make them scream in pain.

In an informative introduction, Sam Moskowitz tells us about Gernsback's background as a boy in Luxembourg and a young would-be inventor here in the pre-World-War-I United States. "Ultimate World," though, was not something from these early days as "Ralph" was; he wrote it in 1958-'59. The original was apparently even more filled with lectures on the theoretical background of its marvels than this abridged version is; Sam says he lopped out great blocks of the stuff, and there is still too much—by our standards. However, it was precisely what Jules Verne thought of as necessary in his science fiction—and what is cut out in the "modernized" editions we get now. It was what the German Jules Verne, Kurd Lasswitz, did in his classic novel of Mars and Earth, "Auf Zwei Planeten"—now out in a similarly abridged translation, which I've just started to read. And it was the way to write original science fiction in the late 1920s and early 1930s, before John Campbell changed the whole field. I know, because I did it.

This is the story of an invasion of Earth by extraterrestrials, in 1996. For its time, it contained a daring amount of sexual "science," which was one of Gernsback's enthusiasms. In that, as with his visions of television, fluorescent lighting, automation, and other commonplaces of our time, he was a prophet in the wrong country. The so-called "Xenos" descend on the planet one night, and in a kind of anticipation of John Wyndham's "Midwich Cuckoos" induce a mass-intercourse fiesta. They're not planting alien zygotes in human wombs, though; they are garnering a harvest of optimally fertilized ova which they proceed to develop into a new race of superchildren in eight months. Mean-

while, they have also kidnapped some 188,000,000 young schoolchildren, given them brain grafts to increase their intelligence, revised their physical shortcomings, and sent them back to show the adult world the error in its ways. Meanwhile, also, they are mining an "unknown" element on the Moon, transmitting it by radio to a base farther out in the solar system, converting the planetoid Eros into a super-spaceship, and indulging in other marvels. Finally, the whole thing ends rather abruptly when they are attacked by another space-ranging race of Bad Guys. (Gernsback must have considered publishing the story himself, for he had his favorite artist, Frank R. Paul, do the jacket illustration of this final battle—which the publisher credits to one Carl Weiss.)

The ingredients aren't anything that veteran SF readers haven't seen over and over in good stories. Unfortunately, Gernsback was stuck back in the first decade of the century in everything but content. Even there, his—it can't be the publisher's!—habit of italicizing every coined technical term becomes wearing, if not infuriating, and for a book written in 1959 I can't buy the change of "air conditioning" into "auto air control," or a few others of the same kind. Printers in 1996 are still using plates, though high-speed offset was going strong in '59; radium, rather than the fissionable elements, is still the great energy source as it had been a generation before; and there is a little pure nonsense, such as "radioactive" radio waves.

As for the humor, of which Sam makes much, it is also of pre-WW I vintage—right out of vaudeville and some of the humor magazines that Gernsback published himself, unsuccessfully. But is it any worse than some we get on television?

Maybe I've just turned sour in my old age.

THE ALIEN

By L. P. Davies • Doubleday & Co., Garden City, N.Y. • 1971 • 182 pp. • $4.95

Doubleday's classification of L. P. Davies' books baffles me. Some of his best science fiction, such as "The Paper Dolls" and "The Lampton Dreamers," they publish as "mysteries." (A good half of those I've never even seen.) Books like this, which is borderline SF only in being set in the future, they blazon as science fiction. Maybe it's the author's fault (you just can't tell about Welshmen—says a diluted Irishman); maybe it's some editor's. After all, Simon and Schuster seem to just sit on their real SF and send me stuff on occultism . . .

This story begins in 2016, so it's about the future, so it's science fiction by the rules I wrote myself. "John Maxwell" wakes up in a hospital with no memory of his past—and with something that is not human blood in his veins. He can be traced back only to a time when a flying saucer landed in rural England. Did he come from the sau-

cer? Is he an alien? Are there other aliens among us? Who are the Good Guys and who the Bad Guys?

It's a fair enough mystery, but the honor of this department forces me to tell you this. He didn't come from the stars.

(Incidentally, I question that—even in 2016—anyone will use a slide and coverglass to put specimens in an electron microscope—even a scanning 'scope—or that they will be matching blood types in one either. On the August 27, 1971 *Science* one red blood cell, magnified only 20,500 times, half-fills the cover.)

WHAT'S BECOME OF SCREW LOOSE?

By Ron Goulart · Charles Scribner's Sons, New York · 1971 · 184 pp. · $4.95

The clowns seem to have moved in on science fiction in the closing weeks of 1971 and the beginning of '72—at least, in the books I've picked up. The ten stories here represent Ron Goulart at his zaniest. (The adjective is gratefully lifted from the cover of one of his other current books.)

Two of the ten stories in this collection involve the author's favorite cluster of *non compos mentis* planets, the Barnum System. "Confessions" is one of the stories about Joe Silvera, writer, detective, and whatchamacallit on Murdstone, which this time 'round is plagued with flying houses (and debtors), mechanical watchdogs, a mad murderer, et al. "Hobo Jungle," on the other hand, is a Chameleon Corps yarn—straightish, for Goulart—in which agent Ben Jolson is masquerading as a folklore collector, roving guitarist, and ne'er-do-well on—yep!—Murdstone again. I wonder whether the leads in these various series will ever start tripping over each other? Their respective agencies certainly do.

Most of the other stories, with the exception of one out-and-out fantasy, have to do with Goulart's favorite theme, the domination of man by machine, especially in California of the too-near future. In the title story, Screwloose is a runaway android that converts dishwashers and other seemingly innocuous household appliances into lethal killers. It is also a fairly legitimate detective story. "Hardcastle" opens with an automated house that has a slight German accent and resents the chauvinism of a pair of Easterners who drink New York wine.

"Into the Shop" is the closest to black humor that Goulart comes, with its Law-and-Order lawagon that has its own ruthless way of stamping out crime. "Prez" is a cyborg—a mongrel dog, most of whose inner economy has been converted to more durable form, and who has no intention of giving up the comforts of his old age to a young peckerwood after his heiress mistress. That one has a nasty little touch at the end, too.

A number of Goulart's best stories have been quite straightforward de-

tective stories, in spite of their screwy settings and characters. "Monte Cristo Complex" is one of them: The affair of the Dismantler, featuring the great detective, Vincent Hawthorne, and his robot Watson, DBA-51. In "Keeping an Eye on Janey," on the other hand, Carnahan is the detective—a robot detective disguised as a bed.

Two left. "The Yes-Men of Venus" is a parody of Burroughs, and by no means up to Goulart's straight nonsense. "Junior Partner," on the other hand, is a fantasy and of no interest here.

There's been nothing like these yarns since Gallagher graced these pages . . . and considering the changes in humor over the last thirty years, Goulart is almost as funny as "Padgett," if in a Daliesque way.

DRIFTGLASS

By Samuel R. Delany • Signet Books, New York • No. Q-4834 • 278 pp. • 95¢ • Nelson Doubleday, Inc. • (Science Fiction Book Club), • Garden City, N.Y. • 1971 • 274 pp. • $1.49

Here are ten stories, some long, some short, by one of the "new" masters of words and images and ideas who have appeared in the "other" science fiction, outside the pages and themes of Analog. One, "We, In Some Strange Power's Employ, Move on a Rigorous Line," could very well have been published here, as could "The Star Pit," which opens the book. One other, "Dog in a Fisherman's Net," is fantasy—or, more correctly, a straightforward story about people in the Aegean isles to whom the old gods are real and have never been else.

In all the stories the people are more important than they are in a "typical" Analog story. I realize, and you should, that this is the innovation John Campbell brought to science fiction: It must show what happens to people under strange circumstances—but as "Chip" Delany writes their story, the consequences go deeper and are more real than in most SF.

Go back to "The Star Pit." It has enough concepts to send a fleet of stories to the stars. The "goldens," who can endure deep space where ordinary people cannot. The unsuccessful spaceship mechanic who has to see them go past him to the stars. The hurt people of the space frontier, who have let their failures beat them down, as he has not. And more—much more.

Read ". . . Rigorous Line." It creates a technological society as intricate as any you have ever found here in Analog. A future in which gigantic machines carry the blessings of unlimited power to every corner of the world, whether people want it or not. And the colony of "angels" on a remote Canadian mountaintop don't want it.

Read the title story, "Driftglass," told by a veteran of the Aquatic Corps who watches the children he has brought up go out for the operation that will make them "mer-

people" and take them down into the world he has had to leave.

Or "Corona," which makes you feel telepathy as you have probably never felt it before. "Aye, and Gomorrah," which finds a new sexual deviation for the lonely people of the future. "High Weir," in which a man almost becomes a Martian. The Nebula award-winning "Time Considered as a Helix of Semi-Precious Stones," which concerns itself so beautifully with crime and oppression and singing and dairy farming in Vermont. "Night and the Loves of Joe Dicostanzo," which takes place in a nightmare place that may be inside Joe's head.

The least of the ten is "Cage of Brass," with the most usual plot: prisoners escaping. Even it is richly embroidered with thought, with emotion.

Surely no two writers could be more unlike than Delany and "Cordwainer Smith." Yet, in a way, they seem to be writing about the same world, the same universe, the same kind of people. It is a mistake to pass up any story by either of them. There are no more "Smith" stories but, happily, we should have Delany's insight with us for a long time to come.

SCIENCE FICTION AND FANTASY PSEUDONYMS

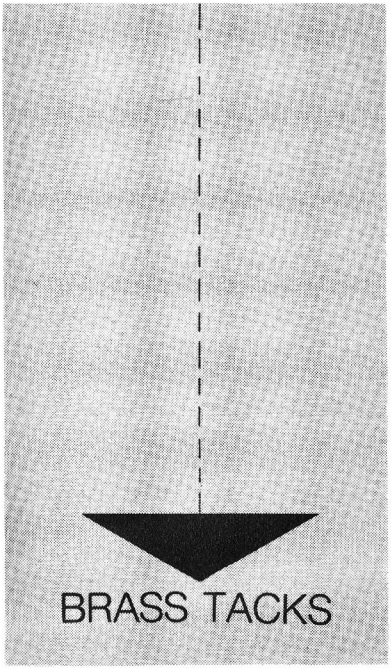
compiled by Barry McGhan. • Howard DeVore, 4705 Weddel Street, Dearborn, Michigan 48123. • 34 pp. • $1.00

Here is one of the most useful fannish publications we have had with a small exception that I'll mention later. Barry McGhan has dug his way through 19 assorted publications and added his own knowledge to give us the most complete listing I have seen of the pen names authors have used in writing SF.

Especially in the boom days, when there were SF magazines everywhere, hard-working authors sometimes wrote the entire issue of a magazine. When they did that, they needed a lot of pseudonyms. This tells you what they are, but it doesn't tell you, for example, which "Ivar Jorgensen" wrote which story. Bob Silverberg was one of them—one of three, it says here—and he has also used more pseudonyms than anyone else: 27. The "house name," "Alexander Blade," was worn by 17 writers at one time or another.

Because McGhan started with the Bleiler-Dikty "Checklist of Fantastic Literature," his directory of ghosts includes a lot of old-timers.

Now that exception. Norm Metcalf wholly disowns the index for 1951-1960 published under his name, and states explicitly that correct pseudonym information, on which he had spent a lot of time, was replaced by false information based on rumors. I don't know whether McGhan managed to correct this situation. So check, if you can, before you use information from Metcalf. The listing tells you the source for each claim.



Dear Mr. Bova:
Re: "The Gold at the Starbow's End"

I liked some aspects of the story. If a significant percentage of the stories are like this one, I will discontinue my subscription . . . "The Gold at the Starbow's End" is a well-written story for those who like to play with words (page 33, column one: 500K milliseconds is a wordy way of saying 500 seconds).

However, the prime objection to the story is its basic philosophy of man—the ideal man is loving, compassionate, nonaggressive and nonviolent.

Man got where he is today because he has the useful and good characteristics of bias, prejudice, aggression, and vengeance. A man in the wilderness should be prejudiced against all tigers—he should not judge them on an individual basis. A village that has a child devoured by a wolf should not punish just that wolf, it should go for vengeance against all carnivores likely to be a threat. Thus will the environment be made such as to permit a life of more than just survival. When a social group has enough bias and aggression to make it strong, then it can permit itself to be benevolent to those outside. Study of other animals shows the aggressive and violent have the strongest loves and loyalties; in many cases, the peaceful vegetarians do not know love or individual loyalty. I think John Campbell understood that without aggression there could be no love and mankind would be as nothing . . .

JOHN H. GAULT
29302 Snapdragon Place
Saugus, California 91350

But the supermen who returned from Alpha Centauri were hardly loving, compassionate, nonaggressive and nonviolent!

Sir:

Pohl's "The Gold at the Starbow's End" is a fine story, but there are some flaws involving his "Gödelized message": $1973^{354} + 331^{852} + 5^{47} + 3^{9606} + 2^{88} - 78$.

For one thing, it isn't that hard to decode, at least in part. Instead of writing out a 5000-digit number, just apply a little knowledge of divisibility to the message as it's written

above. First, obviously it isn't divisible by 2, since it's the sum of five odd numbers and two evens. For 3: 1973/3 leaves a remainder of 2, and 2 raised to any even power leaves a remainder of 1 when divided by 3. So, $(1973^{354})/3$ leaves 1. All this can be written shorter as: $1973^{354} \cong 2^{354} \cong 1 \pmod 3$.

Anyway, we can check the rest of the numbers similarly, and find that Pohl's sum is divisible by 3, but not by 9, and so the second letter of his message is "A." I checked the next seven primes in about two hours, and none of them were factors of the sum. A small computer, plus a programmer armed with some high-powered number theory, could probably reconstruct the whole message in that amount of time.

Because that's where the other big flaw comes in: the message is really very short! The sum is less than 10^{5000}, and if the "average" letter is around J (= 10), that makes the message include the primes up to the point where their product is 10^{500}. That's less than 200 primes! Most "standard unabridged dictionaries" are a bit more than 200 letters long...

On the whole, though, Pohl's story is excellent. If his Gödelized message is a flaw, at least it's an interesting one!

MARK ZIMMERMANN
1808 Branard
Houston, Texas 77006

Several readers have commented on Fred Pohl's math. And his story!

Dear Sir:

In a guest editorial in your January '72 issue, Poul Anderson makes a convincing case that the desire for personal immortality may not be a biological constant or innate human characteristic, but a product of culture: the result of education in particular ideologies. He then, later in the same piece, speaks as if the desire to own a private automobile were a universal human trait, untouchable, unchangeable, immutable. He goes on to draw the conclusion that any plans to deal with the catastrophic anarchy of modern transportation must maintain the inviolable sanctity of this "ongoing catastrophe."

Now, I think that two things should be obvious about the automobile:

First, the people who "choose" to use cars instead of public transportation of any sort make that decision while subject to a number of cultural pressures. They see advertising which teaches them, very cleverly, that the ownership of a car, preferably a large and powerful car, increases status, shows distinction, expresses individuality, attracts the opposite (or, in some ads, one's own) sex, increases sexual potency, and has all sorts of other desirable effects. They live in a hostile, somewhat paranoid, society—a society which teaches the precious value of competition, privacy, and control—so they acquire a morbid and neurotic

fear and loathing of human contact, physical or psychological. They live in a society of private ownership which teaches contempt for common property, thereby creating the bad manners, mess, and litter one finds in the streets, in parks, and in public transportation.

Second, the private automobile is just too damned expensive for modern society to be able to afford it. Even leaving air pollution aside, it is too expensive. It uses too much space. It carries small numbers of people in a large machine. It must have huge highways, roads, streets, parking lots, fueling and/or maintenance stations, using up the land —usually the valuable, arable land near population centers. It is dangerous, more dangerous every year than a medium-size war. Nor is this danger avoidable, since to develop and mass-produce nonmanual control systems for hundreds of thousands of individual, free-moving vehicles is too expensive, too wasteful of labor, of technical skill, of metals, power, plastics, and other resources, and of time, even to contemplate.

Abolishing the private car might, of course, be unpopular. (It might not be, too; any prediction depends on how cynical one is about the intelligence of the average person.) But governments have often done unpopular things to insure the survival of society, of the human race, or just of the regime. The usual, though not the only, method is to kill everyone who disagrees with policy. This is very educational, and combined with large-scale propaganda (usually more effective when it is true) has the desired effect of making the unpopular popular.

Of course, for the American Government to undertake the abolition of the private car, by fair means or foul, would injure many very powerful interests. Conceivably, it would require social, economic, and political changes so great as to amount to a revolution for this to occur. This is not so unlikely, considering everything, as might appear.

There are, I think, several more general conclusions which can be drawn from a consideration of the problem of the automobile, or from a serious consideration of any ecological-environmental problem. First of all, it is clear, as Poul Anderson says, that there is no going back. Only technology, in combination with advances in ecology, biochemistry, and so on, can solve the current crisis. But this shouldn't lead to making light-minded assumptions as to the direction and type of technological change needed. It may be that greater centralization, complexity, and "sophistication" are needed in some sorts of production and transport, but greater decentralization, simplicity, and "primitiveness" in other sorts.

Second, technological change can only be considered intelligently if it is studied in conjunction with inquiries in political economy. These inquiries should be seriously carried

through, although they tend to go to the root of the current economic and social regime and may raise the question of who (what class or classes) will hold the state power over society and for what purposes.

Third, there is no room in realism for complaisantly optimistic talk of mankind's activities only changing one sort of ecosystem for another. There are many sorts of ecosystems that will not support human life. For example, many people, not eco-freaks by any means, but marine biologists and oceanographers, maintain that the life in the seas is dying because of human activity, and will shortly be dead. Since marine plankton produces some seventy percent of the oxygen in the atmosphere it seems likely that if the sea dies, we die. There would still be life, and therefore another sort of ecosystem. And a very beneficial one, if you're a plant, but hell on animals, especially higher animals. This result is only a matter of a few years, or, at most, decades. And, of course, if the sea *doesn't* die, there are several other sorts of ecosystems our misdirected (but very profitable) technology is capable of producing, each with its train of famine, war, pestilence, social collapse, and subsequent barbarism.

All in all, it would seem that the eco-freak, however hysterical, is more right than Mr. Anderson. He at least seems to know that something must be changed radically, and right away. And he is smart enough to be scared.

RICHARD WADSWORTH
P.O. Box 189
Woodacre, California 94973

The only drawbacks to most proposed solutions for our ecological crisis is that the "cures" appear to be worse than the disease.

Dear Mr. Bova:

I have been reading Mr. Burridge's letter in the December issue of your magazine describing the "Smith coil" and have come to several conclusions concerning the device. The device does not make any power disappear except possibly for a very small amount due to the resistance of the wire itself (which is only about five ohms for every thousand feet of wire).

Mr. Burridge seems to be viewing this device as a simple inductor and I believe that this is the source of his problems. For purposes of analysis the coil can be split into two shorter coils with the dividing point at the middle of the wire. Both coils now have identical dimensions except for the fact that the windings are in opposite directions. This means that both coils are producing exactly the same amount of flux since the currents in both coils must be equal. However, the fact that the coils are wound in opposite directions means that the direction of the fluxes from the two coils are opposite in nature, meaning that the total flux produced by the "Smith coil" is always equal

to zero. Since the induced voltage (which is the basis of the inductance of any coil) is equal in magnitude to the rate of change of the flux through the coil, the induced voltage, and, therefore, the inductance must always be equal to zero. Since there are no capacitances in the circuit, the impedance would therefore be simply the negligible amount of the resistance of the wire itself.

The resonance points mentioned are due to the fact that it is very difficult to find perfect electrical components in nature. All resistors and wires have some inductance in them. Also, there is a capacitance between adjacent wires in the coil. These two effects would combine to form the resonance points mentioned in the letter. Without much more data, it would be impossible to determine exactly what frequency range these points would be in but they would be a function of the spacing of the wires, the size of the wires, and the type of insulation.

I doubt if the type of core would make any difference in the action of the coil. Even removal of the ferrite core should not produce drastic changes in the action of the coil since the inductance within the wires mentioned above does not involve the core and the fluxes produced by the partial coils would have to be equal, no matter what the core was made of.

These are my observations on the so-called "Smith coil." I realize that this may not be a full or accurate description but I believe it does explain the effects mentioned in the letter.

BRADLEY A. ROSS
122 Maple Avenue
Bala-Cynwyd, Pennsylvania 19004

Dear Sir:

I am writing this letter just after hearing on the radio that President Nixon has announced a new ten-year space program involving the development of a reusable space shuttle. I expect that government officials and elected representatives will receive many letters decrying this "waste" of public funds.

It's unfortunate that necessary and justifiable movements—ecology, consumerism, population control, et cetera—have been accompanied by anti-technology, and specifically, anti-space exploration sentiments. But it is just as unfortunate when those who have vision enough to see the advantages of a strong space program fail to make their sentiments known.

I hope that all of the readers of Analog will write to their Congressmen, Senators, President—and whoever else they can think of—expressing their support for the space program. Numbers count, so please make your voice heard.

RICHARD LIPPA
3653 Warfield Drive
Huntington, Valley, Pennsylvania 19006

The space shuttle is our first step toward truly "cost-effective" space

transportation. But what will be the pollution effects of a hundred shuttle launches per year?

Dear Mr. Bova:

I may be previous in landing on you before you're settled into your job—but I thought you weren't going to print fantasy? Frederik Pohl's "The Gold at the Starbow's End" doesn't even try to rationalize the impossible accomplishments of its starship team—just mysticizes a bit. And attributing such abilities to a linear extension of the presently "in" thing—drugs, sex, *I Ching*, etc.—doesn't even take much imagination. Eidetic communication won't help unless you have the essential data to communicate. *Correlation* is the problem. (I'll say that isolation to think does help. I use it myself. But I don't work miracles.) Disappointing, and the story does not compensate with drama. Imagery and characterization, yes. Also, with eight known planetary systems not too far away, why send the ship to a planetless star? That's a gimmick to show how villainous the villain is—not up to Analog standards. And, there's uranium in other places than bombs and uranium mines. That shower of baryons would have melted half Earth's crust.

Most of these quibbles are actually directed at Mr. Pohl. The only point the story has is conformity to the "new thing"—which I can find anywhere. (Gloom and doom, et cetera.)

While I'm throwing rocks, "One Man Game" by Joseph Green had two planets in the same orbit, on opposite sides of their sun. Unstable—and five minutes' rewriting could have avoided the flaw . . .

WILLARD HAFLER
Rt. 2, Box 118
Weippe, Idaho 83553

Pohl's "mysticizing" included quite a bit of hard science and valid extrapolation.

Gentlemen:

Rebutting Mrs. Harpling's letter of March: I've found the country capable of creating its own messes without any help from the city.

I lead bicycle trips as one avocation and our greatest bane is perennial attacks and threats from zealous and misguided watchdogs left to police rural roads as per their own philosophy. The property owner gets very defensive and hostile even in the face of one incident involving a broken pelvis! I usually caution my riders to feign back injuries if they're ever thrown. That puts a profound scare into the rural innocents!

One wonders if the constant and odious trespassing of snowmobiles is due to the city folk. I don't believe anybody would purchase a snowmobile to use but three times a year. They do lovely things like running down deer who succumb to frostbite and exhaustion. Compared to this a rifle bullet is a favor! Then, of course, there's poaching. One country-born friend brags of his "year-round hunting license" . . .

Recently I did some target shooting (not hunting) on the Daytona Beach, Florida rifle range. I saw some large bird circling overhead without any concern for the noise below. The canals in back of the rifle range teem with fish as they're not used or fished. To my mind the proper use of recreational firearms usually involves asking the local police about an approved location before shooting.

One friend, in South Jersey, discourages poaching by turning on a large siren from a switch by his bed. When he hears the first shot he turns on the siren—and it works!

I suppose my adult bicycling puts me in the "nice guy" camp but part of me belongs to the bad old gun lobby. I go to great pains not to be a pest or a menace and I resent arbitrary firearms laws. If Mrs. Harpling is wronged she should have recourse to vigorous local police and judiciary. However, haha, if you ever try to summon the local police you'll find that they're very easy-going and casual about native poachers and snowmobilers.

Mrs. Harpling implies that shooters have contributed to the demise of the songbirds (?) of which she speaks. In order to do that slaughter they'd have to be out by the thousands and the sky would have to be darkened with missiles! I'd say the birds fell quantitative victim to automobile pollutants. Speaking of automobiles, for every small animal shot there must be twenty squashed on the highway by well-meaning folk.

What Mrs. Harpling is doing is taking a particularly odious incident out of context. I offer, as one solution, more interest in local government, more efficient local government, horsepower-restricted personal vehicles or a punitive tax based on weight and horsepower and a philosophical withdrawal from utilitarianism gone mad. That's for starters.

ARNE C. EASTMAN
P.O. Box 321
Staten Island, New York 10301

When you get right down to it, "ecological impact" means "the way I *see it."*

Dear Mr. Bova:

In your editorial in the February '72 issue, you suggested opposition to the SST was mainly for faddish ecological reasons. I was opposed to the SST, and ecology had nothing to do with it. The reason I was opposed? Noise! For years since World War II, desirable neighborhoods have been blighted and turned into aerial slums by the noise of jet aircraft. More, there is no real relief at law. The SST promised more of the same and noisier.

MICHAEL N. TIERSTEIN
1577 East 37th Street
Brooklyn, New York 11234

Really? There were claims that the SST would be no noisier than subsonic jets during landings and takeoffs. But nobody measured *the problem; the voting was done by emotion, not reason!*

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sition in world affairs. They just never had the cohesion or outright power to influence the two supernations, even though today these poor Southern Hemisphere nations are called the Third World.

Through these years of the 1950's, it became increasingly clear that the United Nations could not become the world government that the United World Federalists and others had sought. The UN became little more than a debating society and propaganda sounding board—politically. But most people never realized that it's the UN's technical agencies that are binding the world together, in a very different way. Organizations such as UNESCO, UNICEF, WHO et al are diffusing western technological know-how throughout the underdeveloped world. By bringing these nations into the twentieth century, these agencies are also making them dependent on modern technology—just as we are. In the long run, this kind of activity will be much more important than the political charades played out on Manhattan's East Side.

As the 1950's moved into the 1960's, no real third power showed up, in Europe, Asia, Africa or Outer Space. Russia and the United States continued to get stronger, despite the fact that England, France and eventually China joined the nuclear "club." Russia and the U.S. used their galloping technology to move further and further ahead of the rest of the world—and stay abreast of each other. The ICBM race of the late 1950's became the ABM race of the 1960's. There are other races under way now, in military technology.

But it was the Hungarian Revolution of 1956 that marked the emotional turning point of the religious war between Capitalism and Communism.

Up to that time, even though there were summit meetings and some rhapsodizing about thaws in the Cold War, the basic rhetoric of both Russian and American political discourse was still Them-or-Us. Russia was blatantly dedicated to spreading Communism over the whole Earth, and "burying" Capitalism. America was publicly committed, by the President and Secretary of State, to work toward the freedom of the "captive peoples of Eastern Europe."

The Hungarians, who pride themselves on being the craftiest people of all, took this propaganda seriously. They overthrew their puppet government, and when Russian tanks rumbled into Budapest, Hungarian teen-agers battled them with rocks and homemade Molotov cocktails. They waited hopefully, cheerfully, for us to come to their aid. They called to us from their liberated radio stations.

The Russians crushed them. We did nothing. For the first time, it be-

came clear to all the world that no nation is going to risk nuclear devastation if it can avoid it—even at the cost of backing down on its own promises. Six years later, the Russians caved in very much the same way over the Cuban Missile Crisis. What the two superpowers said to each other was this: I am not going to interfere with what goes on in your backyard, because it's not worth the risk of nuclear war between us.

Thus the two superpowers carefully backed away from nuclear confrontation, and even began to negotiate treaties that stopped the testing of nuclear bombs in the atmosphere, oceans, and space (a form of antipollution legislation!).

But while World War III began to seem less imminent, the "little" wars took the center of the stage. The Communists call these guerrilla battles "wars of national liberation." We call them "Communist expansionist tactics." Whatever you call them, the central fact is that the Communists have consistently been on the "revolutionary" side, trying to upset the *status quo.* We have consistently been on the conservative side, fighting to maintain the *status quo,* to maintain the existing government in office, even when we often realize that the existing government is so corrupt and ineffectual that we wouldn't want it running one of our own cities.

In Vietnam, and earlier in Greece, Malaysia, Indonesia, Guatemala, Cuba and elsewhere we and our allies have been fighting these brushfire wars, where the large implications of Communist versus Capitalist boils down to a gaggle of peasants bushwhacking an army patrol. In *their* minds, the political issues are simple: land, bread, the poor against the rich.

The dread of nuclear devastation plus the disgust over the unresolved quagmire in Vietnam has caused a huge public reaction in the United States against war in general, and the military in particular. But other nations have found that war is still a viable—even profitable!—method for settling arguments with their neighbors.

Israel is a small nation surrounded by neighbors who have sworn to destroy her. Three times in the past quarter-century Israel has bloodied those neighbors. The Israelis claim that they're fighting to preserve their independence and their very existence. The Arab nations claim Israel is an aggressor. No matter which side you take, it's obvious that Israel has accomplished its objectives by going to war. Not a big, cataclysmic, Them-or-Us kind of war. But a limited, coldly effective war, short and sharp, that accomplishes a strictly defined political goal. In a way, the Arab-Israeli wars have had less of a religious overtone than our own Cold War against Communism. Moslem and Jew are fighting, not to convert each other or prove one way of life is better than the other. They

are fighting for very specific geopolitical reasons.

India has gone to war twice in the past decade, once against China and more recently against Pakistan. The brief war with China was a humiliating defeat for India, and ended India's pretensions as leader of a sort of international peace movement. The war against Pakistan was quite successful, "liberated" East Pakistan, and may have sounded the death knell for Pakistan as a viable national entity. Thus, in a few weeks of fighting, India may have accomplished what most Hindus have wanted since the subcontinent was politically divided, after World War II.

Through all these years since the late 1940's, mainland China has inexorably moved toward superpower status. And here may be the Third Force that people have been seeking since the Cold War began.

On the face of it, China is at best a mini-superpower. The Chinese don't have the missiles, the economic power, the technological base that America and Russia have. Compared to us strictly in terms of military might or gross national product, China has an enormous distance to cover before she becomes our equal. If ever. They have far too many people and too few resources. But they also have nuclear weapons, a large army, missionary fervor in their own particular brand of revolution, and the burning desire to establish themselves as THE leader of the world. After all, the Han have always considered themselves to be the only truly civilized people on Earth; everyone else is a barbarian.

Already China has parlayed a minimum of assets into a position of enormous influence in Asia. And American foreign policy, free of the McCarthy iceberg at last, seems to be set on helping Communist China to become even more influential. Why?

Take an ordinary playing card, or any fairly stiff sheet of paper or cardboard, and try to stand it on edge. Doesn't work too well, does it? Now fold it once and stand it up. A triangle is a *very* stable structure.

The Third Power, the counterbalancing force between the polarized U.S. and U.S.S.R. is going to be China. At least for the time being. China is Communist, but not the same Communist as Russia. China's propagandists have called America the enemy of the Chinese people since 1949. But China's armies are concentrated mainly along their 4000-mile-long frontier with Russia.

Psychologists figured out long ago that the optimum number of crewmen for a long, hazardous spaceflight is three (unless you can afford to send a large number of people). Three crewmen can work together, won't polarize, and won't be able to form "cliques." Maybe three's a good number for superpowers as this spaceship Earth continues its hazardous journey through the twentieth century. ■

THE EDITOR

I.O.U.

Because we owe you something more than $123.30 a month.

Because some of us can still remember what it was like when we were in your boots.

The mud. The bone-weariness. The rain running down the back of the neck. The four hours on and four hours off. We can't do anything about that. Because it's part of the job. It was then and it still is now.

But there is something we can do. We can support the USO. So you'll have some place to relax, write a letter home or just talk to people. It might make you forget the loneliness for a while.

The USO needs our help because it gets no government funds. It depends on people like us to give through the United Fund, Community Chest or local USO campaign.

So we'll give all we can. Because we know the USO's work isn't done as long as there's one serviceman away from home. **Put yourself in his boots.**

USO