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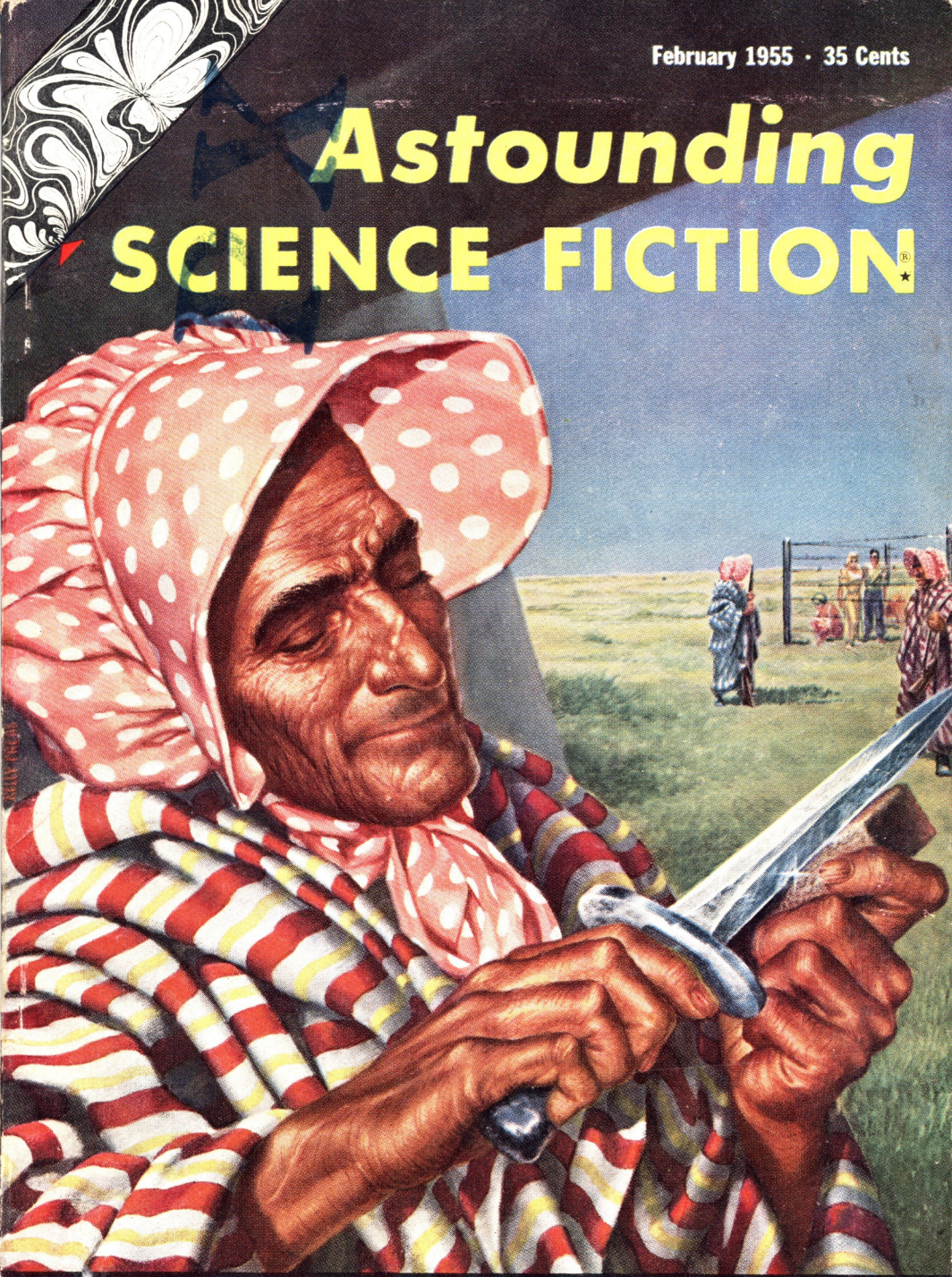

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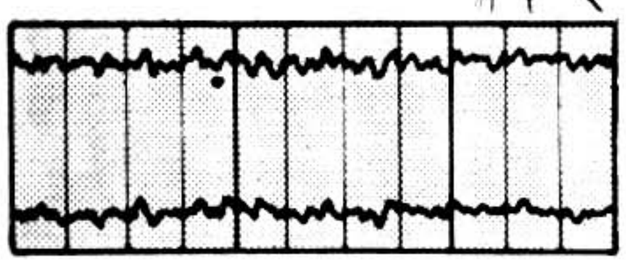

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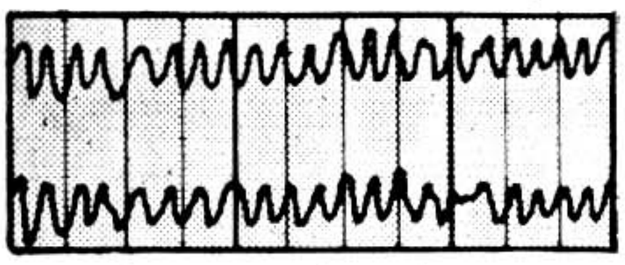

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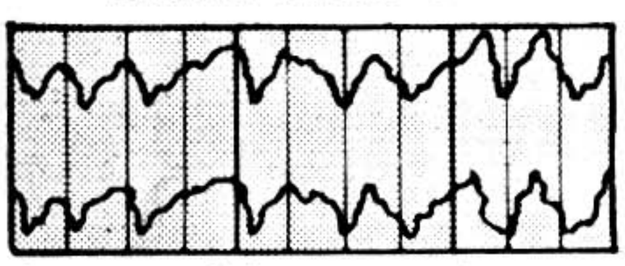

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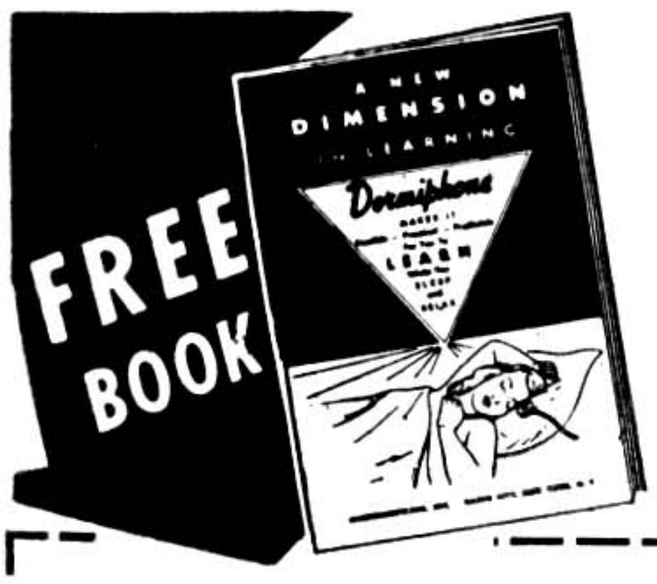

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EDITORIAL

SECOND-ORDER LOGIC?

At various times in these pages, we've kicked around the problem of logic and thinking—and that "we" isn't the editorial variety, either. See Brass Tacks—and join in the discussion if you've a mind to. The world's prize stupid oaf is the man who thinks he already has all the answers; so far, I don't qualify for that one.

Let's try a new tack on this problem of Aristotelian vs. Non-Aristotelian logic. The concept of A vs. Non-A logic is, of course, strictly Aristotelian in that anything that isn't A-logic must be Non-A—which makes it somewhat easy for the Non-A advocates. They do fine by defining in the negative; they need only tell you what they do *not* mean to be left an infinity of possible meanings. I can with the most complete assurance make the statement: "This magazine is not an apple." Whether that helps you to understand what it is or not . . . well, that's a different problem, I suppose. But my statement is unquestionably correct; no one can challenge me on that.

Such statements are safe, to be sure —but are they useful?

It is useful to recognize that Aristotelian logic is not adequate—that it's necessary but not sufficient. But that statement is itself necessary, but not sufficient; if A-type logic is not sufficient, then what is? Define *positively*, not negatively, the Non-A logic that *will* do the required job.

All right—let's make a try at it.

It's long been held that truly logical thinking about a problem requires an objective viewpoint; you must remove your own feelings and biases about the problem from consideration, and think about the problem as though you were not involved in it. Don't let the problem influence your feelings, or

your feelings influence the problem.

You know, that works fine in mechanical engineering. It works fine in chemistry, too. But when you reach the level of atomic phenomena, it breaks down. It also breaks down badly in astronomical work. The atomic level is made unmanageable by the fact that the act of observing changes the situation observed. Watching an electric motor operate doesn't disturb it; the mere act of looking at an electron sends it high-tailing somewhere else. You never see where it is—just get an idea of where it was.

On the other extreme, using Earth as an observation post to watch the motions of the planets causes trouble. We need Earth to retain the atmosphere we use for living, but unfortunately the presence of Earth upsets the motions of the other planets we're trying to observe.

The interesting result of that is that since our logical system seems to require an "objective" view of things —the viewpoint that viewing the system has no influence on the system —it works properly *only* for mechanical-level things! It works just dandy in science—until you hit the atomic level that is. Stick to pendulums, gears, and masses of a few million atoms minimum and it does a fine job.

But our logic-mathematics system has never been able to handle the problem of the motions of the planets decently; it's necessary to fiddle around taking two at a time, and making a series of approximations. Since each correction causes a correction in all the other orbital calculations, it's evidently an infinite series approximation. No matter how hard you try, you won't have the right answer, and you're going to have to try a long, long time.

Now let's consider a human problem situation. Bill Blow and his wife, we'll say, have an argument. If our friend Bill tries figuring out how his dear Mary would feel if he weren't there disturbing the situation, he may get an answer, but it won't have anything to do with the problem he's trying to solve. The "objective viewpoint" makes nonsense. Grade A, in a human problem. To understand Mary's reactions, Bill's got to understand the following factors:

1. What Mary's actual nature is.
2. What Mary *thinks* her nature is.
3. What Bill's own actual nature is.
4. What he *thinks* his nature is.
5. What Mary thinks Bill's nature is.
6. What Bill *thinks* Mary's nature is.
7. The fact that no human being can ever act on the facts in the case, but solely on what he *believes* the facts to be.

The fact that 1 and 2 above are not identical means that Mary *thinks* she will have reaction R to Bill's doing X, but actually she'll have reaction R′, which is quite different.

Now, if Bill is impatient, he'll say

Continued on page 161

TIME CRIME

BY H. BEAM PIPER

First of Two Parts. The Paratime Police had a real headache this time! Tracing one man in a population of millions is easy compared to finding one gang hiding out on one of billions of probability lines!

Illustrated by Freas

Kiro Soran, the guard captain, stood in the shadow of the veranda roof, his white cloak thrown back to display the scarlet lining. He rubbed his palm reflectively on the checkered butt of his revolver and watched the four men at the table.

"And ten tens are a hundred," one of the clerks in blue jackets said, adding another stack to the pile of gold coins.

"Nineteen hundreds," one of the pair in dirty striped robes agreed, taking a stone from the box in front of him and throwing it away. Only one stone remained. "One more hundred to pay."

One of the blue-jacketed plantation clerks made a tally mark; his companion counted out coins, ten and ten and ten.

Dosu Golan, the plantation manager, tapped impatiently on his polished boot leg with a thin riding whip.

"I don't like this," he said, in another and entirely different language. "I know, chattel slavery's an established custom on this sector, and we have to conform to local usages, but it sickens me to have to haggle with

these swine over the price of human beings. On the Zarkantha Sector, we used nothing but free wage-labor."

"Migratory workers," the guard captain said. "Humanitarian considerations aside, I can think of a lot better ways of meeting the labor problem on a fruit plantation than by buying slaves you need for three months a year and have to feed and quarter and clothe and doctor the whole twelve."

"Twenty hundreds of *obus*," the clerk who had been counting the money said. "That is the payment, is it not, Coru-hin-Irigod?"

"That is the payment," the slave dealer replied.

The clerk swept up the remaining coins, and his companion took them over and put them in an iron-bound chest, snapping the padlock. The two guards who had been loitering at one side slung their rifles and picked up the chest, carrying it into the plantation house. The slave dealer and his companion arose, putting their money into a leather bag; Coru-hin-Irigod turned and bowed to the two men in white cloaks.

"The slaves are yours, noble lords," he said.

Across the plantation yard, six more men in striped robes, with carbines slung across their backs, approached; with them came another man in a hooded white cloak, and two guards in blue jackets and red caps, with bayoneted rifles. The man in white and his armed attendants came toward the house; the six Calera slavers continued across the yard to where their horses were picketed.

"If I do not offend the noble lords, then," Coru-hin-Irigod said, "I beg their sufferance to depart. I and my men have far to ride if we would reach Careba by nightfall. The Lord, the Great Lord, the Lord God Safar watch between us until we meet again."

Urado Alatana, the labor foreman, came up onto the porch as the two slavers went down.

"Have a good look at them, Radd?" the guard captain asked.

"You think I'm crazy enough to let those bandits out of here with two thousand *obus*—forty thousand Paratemporal Exchange Units—of the Company's money without knowing what we're getting?" the other parried. "They're all right—nice, clean, healthy-looking lot. I did everything but take them apart and inspect the pieces while they were being unshackled at the stockade. I'd like to know where this Coru-hin-Whatshisname got them, though. They're not local stuff. Lot darker, and they're jabbering among themselves in some lingo I never heard before. A few are wearing some rags of clothing, and they have odd-looking sandals. I noticed that most of them showed marks of recent whipping. That may mean they're troublesome, or it may just mean that these Caleras are a lot of sadistic brutes."

"Poor devils!" The man called Dosu

Golan was evidently hoping that he'd never catch himself talking about fellow humans like that. The guard captain turned to him.

"Coming to have a look at them, Doth?" he asked.

"You go, Kirv; I'll see them later."

"Still not able to look the Company's property in the face?" the captain asked gently. "You'll not get used to it any sooner than now."

"I suppose you're right." For a moment Dosu Golan watched Coru-hin-Irigod and his followers canter out of the yard and break into a gallop on the road beyond. Then he tucked his whip under his arm. "All right, then. Let's go see them."

The labor foreman went into the house; the manager and the guard captain went down the steps and set out across the yard. A big slat-sided wagon, drawn by four horses, driven by an old slave in a blue smock and a thing like a sunbonnet, rumbled past, loaded with newly-picked oranges. Blue woodsmoke was beginning to rise from the stoves at the open kitchen and a couple of slaves were noisily chopping wood. Then they came to the stockade of close-set pointed poles. A guard sergeant in a red-trimmed blue jacket, armed with a revolver, met them with a salute which Kiro Soran returned; he unfastened the gate and motioned four or five riflemen into positions from which they could fire in between the poles in case the slaves turned on their new owners.

There seemed little danger of that, though Kiro Soran kept his hand close to the butt of his revolver. The slaves, an even hundred of them, squatted under awnings out of the sun, or stood in line to drink at the water-butt. They furtively watched the two men who had entered among them, as though expecting blows or kicks; when none were forthcoming, they relaxed slightly. As the labor foreman had said, they were clean and looked healthy. They were all nearly naked; there were about as many women as men, but no children or old people.

"Radd's right," the captain told the new manager. "They're not local. Much darker skins, and different facestructure; faces wedge-shaped instead of oval, and differently shaped noses, and brown eyes instead of black. I've seen people like that, somewhere, but—"

He fell silent. A suspicion, utterly fantastic, had begun to form in his mind, and he stepped closer to a group of a dozen-odd, the manager following him. One or two had been unmercifully lashed, not long ago, and all bore a few lash-marks. Odd sort of marks, more like burn-blisters than welts. He'd have to have the Company doctor look at them. Then he caught their speech, and the suspicion was converted to certainty.

"These are not like the others; they wear fine garments, and walk

proudly. They look stern, but not cruel. They are the real masters here; the others are but servants."

He grasped the manager's arm and drew him aside.

"You know that language?" he asked. When the man called Dosu Golan shook his head, he continued: "That's Kharanda; it's a dialect spoken by a people in the Ganges Valley, in India, on the Kholghoor Sector of the Fourth Level."

Dosu Golan blinked, and his face went blank for a moment.

"You mean they're from outtime?" he demanded. "Are you sure?"

"I did two years on Fourth Level Kholghoor with the Paratime Police, before I took this job," the man called Kiro Soran replied. "And another thing. Those lash-marks were made with some kind of an electric whip. Not these rawhide quirts the Caleras use."

It took the plantation manager all of five seconds to add that up. The answer frightened him.

"Kirv, this is going to make a simply hideous uproar, all the way up to Home Time Line main office," he said. "I don't know what I'm going to do—"

"Well, I know what I have to do." The captain raised his voice, using the local language: "Sergeant! Run to the guardhouse, and tell Sergeant Adarada to mount up twenty of his men and take off after those Caleras who sold us these slaves. They're headed down the road toward the river. Tell him to bring them all back, and especially their chief, Coru-hin-Irigod, and him I want alive and able to answer questions. And then get the white-cloak lord Urado Alatena, and come back here."

"Yes, captain." The guards were all Yarana people; they disliked Caleras intensely. The sergeant threw a salute, turned, and ran.

"Next, we'll have to isolate these slaves," Kiro Soran said. "You'd better make a full report to the Company as soon as possible. I'm going to transpose to Police Terminal Time Line and make my report to the Sector-Regional Subchief. Then—"

"Now wait a moment, Kirv," Dosu Golan protested. "After all, I'm the manager, even if I am new here. It's up to me to make the decisions—"

Kiro Soran shook his head. "Sorry, Doth. Not this one," he said. "You know the terms under which I was hired by the Company. I'm still a field agent of the Paratime Police, and I'm reporting back on duty as soon as I can transpose to Police Terminal. Look; here are a hundred men and women who have been shifted from one time-line, on one paratemporal sector of probability, to another. Why, the world from which these people came doesn't even exist in this space-time continuum. There's only one way they could have gotten here, and that's the way we did—in a Ghaldron-

Hesthor paratemporal transposition field. You can carry it on from there as far as you like, but the only thing it adds up to is a case for the Paratime Police. You had better include in your report mention that I've reverted to police status; my Company pay ought to be stopped as of now. And until somebody who outranks me is sent here, I'm in complete charge. Paratime Transposition Code, Section XVII, Article 238."

The plantation manager nodded. Kiro Soran knew how he must feel; he laid a hand gently on the younger man's shoulder.

"You understand how it is, Doth; this is the only thing I can do."

"I understand, Kirv. Count on me for absolutely anything." He looked at the brown-skinned slaves, and lines of horror and loathing appeared around his mouth. "To think that some of our own people would do a thing like this! I hope you can catch the devils! Are you transposing out, now?"

"In a few minutes. While I'm gone, have the doctor look at those whip-injuries. Those things could get infected. Fortunately, he's one of our own people."

"Yes, of course. And I'll have these slaves isolated, and if Adarada brings back Coru-hin-Irigod and his gang before you get back, I'll have them locked up and waiting for you. I suppose you want to narco-hypnotize and question the whole lot, slaves and slavers?"

The labor foreman, known locally as Urado Alatena, entered the stockade.

"What's wrong, Kirv?" he asked.

The Paratime Police agent told him, briefly. The labor foreman whistled, threw a quick glance at the nearest slaves, and nodded.

"I knew there was something funny about them," he said. "Doth, what a simply beastly thing to happen, two days after you take charge here!"

"Not his fault," the Paratime Police agent said. "I'm the one the Company'll be sore at, but I'd rather have them down on me rather than old Tortha Karf. Well, sit on the lid till I get back," he told both of them. "We'll need some kind of a story for the locals. Let's see— Explain to the guards, in the hearing of some of the more talkative slaves, that these slaves are from the Asian mainland, that they are of a people friendly to our people, and that they were kidnaped by pirates, our enemies. That ought to explain everything satisfactorily."

On his way back to the plantation house, he saw a clump of local slaves staring curiously at the stockade, and noticed that the guards had unslung their rifles and fixed their bayonets. None of them had any idea, of course, of what had happened, but they all seemed to know, by some sort of ESP, that something was seriously wrong. It was going to get worse, too, when strangers began arriving, ap-

parently from nowhere, at the plantation.

Verkan Vall waited until the small, dark-eyed woman across the circular table had helped herself from one of the bowls on the revolving disk in the middle, then rotated it to bring the platter of cold boar-ham around to himself.

"Want some of this, Dalla?" he asked, transferring a slice of ham and a spoonful of wine sauce to his plate.

"No, I'll have some of the venison," the black-haired girl beside him said. "And some of the pickled beans. We'll be getting our fill of pork, for the next month."

"I thought the Dwarma Sector people were vegetarians," Jandar Jard, the theatrical designer, said. "Most nonviolent peoples are, aren't they?"

"Well, the Dwarma people haven't any specific taboo against taking life," Bronnath Zara, the dark-eyed woman in the brightly colored gown, told him. "They're just utterly noncombative, nonaggressive. When I was on the Dwarma Sector, there was a horrible scandal at the village where I was staying. It seems that a farmer and a meat butcher fought over the price of a pig. They actually raised their voices and shouted contradictions at each other. That happened two years before, and people were still talking about it."

"I didn't think they had any money, either," Verkan Vall's wife, Hadron Dalla, said.

"They don't," Zara said. "It's all barter and trade. What are you and Vall going to use for a visible means of support, while you're there?"

"Oh, I have my mandolin, and I've learned all the traditional Dwarma songs by hypno-mech," Dalla said. "And Transtime Tours is fitting Vall out with a bag of tools; he's going to do repair work and carpentry."

"Oh, good; you'll be welcome anywhere," Zara, the sculptress, said. "They're always glad to entertain a singer, and for people who do the fine decorative work they do, they're the most incompetent practical mechanics I've ever seen or heard of. You're going to travel from village to village?"

"Yes. The cover-story is that we're lovers who have left our village in order not to make Vall's former wife unhappy by our presence," Dalla said.

"Oh, good! That's entirely in the Dwarma romantic tradition," Bronnath Zara approved. "Ordinarily, you know, they don't like to travel. They have a saying: 'Happy are the trees, they abide in their own place; sad are the winds, forever they wander.' But that'll be a fine explanation."

Thalvan Dras, the big man with the black beard and the long red coat and cloth-of-gold sash who lounged in the host's seat, laughed.

"I can just see Vall mending pots, and Dalla playing that mandolin and singing," he said. "At least, you'll be getting away from police work. I don't

suppose they have anything like police on the Dwarma Sector?"

"Oh, no; they don't even have any such concept," Bronnath Zara said. "When somebody does something wrong, his neighbors all come and talk to him about it till he gets ashamed, then they all forgive him and have a feast. They're lovely people, so kind and gentle. But you'll get awfully tired of them in about a month. They have absolutely no respect for anybody'sprivacy. In fact, it seems slightly indecent to them for anybody to want privacy."

One of Thalvan Dras' human servants came into the room, coughed apologetically, and said:

"A visiphone-call for His Valor, the Mavrad of Nerros."

Vall went on nibbling ham and wine sauce; the servant repeated the announcement a trifle more loudly.

"Vall, you're being paged!" Thalvan Dras told him, with a touch of impatience.

Verkan Vall looked blank for an instant, then grinned. It had been so long since he had even bothered to think about that antiquated title of nobility—

"Vall's probably forgotten that he has a title," a girl across the table, wearing an almost transparent gown and nothing else, laughed.

"That's something the Mavrad of Mnirna and Thalvabar never forgets," Jandar Jard drawled, with what, in a woman, would have been cattishness.

Thalvan Dras gave him a hastily repressed look of venomous anger, then said something, more to Verken Vall than to Jandar Jard, about titles of nobility being the marks of social position and responsibility which their

bearers should never forget. That jab, Vall thought, following the servant out of the room, had been a mistake on Jard's part. A music-drama, for which he had designed the settings, was due to open here in Dhergabar in another ten days. Thalvan Dras would cherish spite, and a word from the Mavrad of Mnirna and Thalvabar would set a dozen critics to disparaging Jandar's work. On the other hand, maybe it had been smart of Jandar Jard to antagonize Thalvan Dras; for every critic who bowed slavishly to the wealthy nobleman, there were at least two more who detested him unutterably, and they would rush to Jandar Jard's defense, and in the ensuing uproar, the settings would get more publicity than the drama itself.

In the visiphone booth, Vall found a girl in a green blouse, with the Paratime Police insigne on her shoulder, looking out of the screen. The wall behind her was pale green striped in gold and black.

"Hello, Eldra," he greeted her.

"Hello, Chief's Assistant; I'm sorry to bother you, but the Chief wants to talk to you. Just a moment, please."

The screen exploded into a kaleidoscopic flash of lights and colors, then cleared again. This time, a man looked out of it. He was well into middle age; close to his three hundredth year. His hair, a uniform iron-gray, was beginning to thin in front, and he was acquiring the beginnings of a double chin. His name was Tortha Karf, and he was Chief of Paratime Police, and Verkan Vall's superior.

"Hello, Vall. Glad I was able to locate you. When are you and Dalla leaving?"

"As soon as we can get away from this luncheon, here. Oh, say an hour. We're taking a rocket to Zarabar, and transposing from there to Passenger Terminal Sixteen, and from there to the Dwarma Sector."

"Well, Vall, I hate to bother you like this," Tortha Karf said, "but I wish you'd stop by Headquarters on your way to the rocketport. Something's come up—it may be a very nasty business—and I'd like to talk to you about it."

"Well, Chief, let me remind you that this vacation, which I've had to postpone four times already, has been overdue for four years," Vall said.

"Yes, Vall, I know. You've been working very hard, and you and Dalla are entitled to a little time together. I just want you to look into something, before you leave."

"It'll have to take some fast looking. Our rocket blasts off in two hours."

"It may take a little longer; if it does, you and Dalla can transpose to Police Terminal and take a rocket for Zarabar Equivalent, and transpose from there to Passenger Sixteen. It would save time if you brought Dalla with you to Headquarters."

"Dalla won't like this," Vall under-

stated.

"No. I'm afraid not." Tortha Karf looked around apprehensively, as though estimating the damage an enraged Hadron Dalla could do to his office furnishings. "Well, try to get here as soon as you can."

Thalvan Dras was holding forth, when Vall returned, on one of his favorite preoccupations.

". . . Reason I'm taking such an especially active interest in this year's Arts Exhibitions; I've become disturbed at the extent to which so many of our artists have been content to derive their motifs, even their techniques, from outtime art." He was using his vocowriter, rather than his conversational, voice. "I yield to no one in my appreciation of outtime art—you all know how devotedly I collect objects of art from all over paratime—but our own artists should endeavor to express their artistic values in our own artistic idioms."

Vall bent over his wife's shoulder.

"We have to leave, right away," he whispered.

"But our rocket doesn't blast off for two hours—"

Thalvan Dras had stopped talking and was looking at them in annoyance.

"I have to go to Headquarters before we leave. It'll save time if you come along."

"Oh, no, Vall!" She looked at him in consternation. "Was that Tortha Karf, calling?" She replaced her plate on the table and got to her feet.

"I'm dreadfully sorry, Dras," he addressed their host. "I just had a call from Tortha Karf. A few minor details that must be cleared up, before I leave Home Time Line. If you'll accept our thanks for a wonderful luncheon—"

"Why, certainly, Vall. Brogoth, will you call—" He gave a slight chuckle. "I'm so used to having Brogoth Zaln at my elbow that I'd forgotten he wasn't here. Wait, I'll call one of the servants to have a car for you."

"Don't bother; we'll take an aircab," Vall told him.

"But you simply can't take a public cab!" The black-bearded nobleman was shocked at such an obscene idea. "I will have a car ready for you in a few minutes."

"Sorry, Dras; we have to hurry. We'll get a cab on the roof. Good-by, everybody; sorry to have to break away like this. See you all when we get back."

Hadron Dalla watched dejectedly as the green crags and escarpments of the Paratime Building loomed above the city in front of them, and began slipping under the aircab. She felt like a prisoner recaptured at the moment when attempted escape was about to succeed.

"I knew it," she said. "I knew he'd find something. He's trying to break things up between us, the way he

did twenty years ago."

Vall crushed out his cigarette and said nothing. That hadn't been true, and she knew it as well as he did. There had been many other factors involved in the disintegration of their previous marriage, most of them of her own contribution. But that had been twenty years ago, she told herself. This time it would be different, if only—

"Really, Vall, he's never liked me," she went on. "He's jealous of me, I think. You're to be his successor, when he retires, and he thinks I'm not a good influence—"

"Oh, rubbish, Dalla! The Chief has always liked you," Vall replied. "If he didn't, do you think he'd always be inviting us to that farm of his, on Fifth Level Sicily? It's just that this job of ours has no end; something's always turning up, outtime."

The music that the cab had been playing died away. "Paratime Building, just below," it said, in a light feminine voice. "Which landing stage, please?" Vall leaned forward and punched at the buttons in front of him. Something in the cab's electronic brain gave a rapid series of clicks as it shifted from the general Paratime Building beam to the beam of the Paratime Police landing stage, then it said, "Thank you." The building below seemed to rotate upward toward them as it settled down. Then the antigrav-field snapped off, the cab door popped open, and the cab said: "Good-by, now. Ride with me again, sometime."

They crossed the landing stage, entered the antigrav shaft, and floated downward; at the end of a hallway, below, Vall opened the door of Tortha Karf's office and ushered her through ahead of him.

Tortha Karf, inside the semicircle of his desk, was speaking into a recording phone as they approached. He shut off the machine and waved, a cigarette in his hand.

"Come on back and sit down," he invited. "Be with you in a moment." Then he switched on the phone again and went on talking—something about prompter evaluation and transmission of reports and less reliance on robot equipment. "Sign that up, my personal order, and see it's transmitted to everybody down to and including Sector Regional Subchief level," he finished, then hung up the phone and turned to them.

"Sorry about this," he said. "Sit down, if you please. Cigarettes?"

She shook her head and sat down in one of the chairs behind the desk; she started to relax and then caught herself and sat erect, her hands on her lap.

"This won't interfere with your vacation, Vall," Tortha Karf was saying. "I just need a little help before you transpose out."

"We have to catch the rocket for Zarabar in an hour and a half," Dalla reminded him.

"Don't worry about that; if you miss the commercial rocket, our police rockets can give it an hour's start and pass it before it gets to Zarabar," Tortha Karf said. Then he turned to Vall.

"Here's what's happened," he said. "One of our field agents on detached duty as guard captain for Consolidated Outtime Foodstuffs on a fruit plantation in western North America, Third Level Esaron Sector, was looking over a lot of slaves who had been sold to the plantation by a local slave dealer. He heard them talking among themselves—in Kharanda."

Dalla caught the significance of that before Vall did. At first, she was puzzled; then, in spite of herself, she was horrified and angry. Tortha Karf was explaining to Vall just where and on what paratemporal sector Kharanda was spoken.

"No possibility that this agent, Skordran Kirv, could have been mistaken. He worked for a while on Kholghoor Sector, himself; knew the language by hypno-mech and by two years' use," Tortha Karf was saying. "So he ordered himself back on duty, had the slaves isolated and the slave dealers arrested, and then transposed to Police Terminal to report. The SecReg Subchief, old Vulthor Tharn, confirmed him in charge at this Esaron Sector plantation, and assigned him a couple of detectives and a psychist."

"When was this?" Vall asked.

"Yesterday. One-Five-Nine Day. About 1500 local time."

"Twenty-three hundred Dhergabar time," Vall commented.

"Yes. And I just found out about it. Came in in the late morning generalized report-digest; very inconspicuous item, no special urgency symbol or anything. Fortunately, one of the report editors spotted it and messaged Police Terminal for a copy of the original report."

"It's been a long time since we had anything like that," Vall said, studying the glowing tip of his cigarette, his face wearing the curiously withdrawn expression of a conscious memory recall. "Fifty years ago; the time that gang kidnaped some girls from Second Level Triplanetary Empire Sector and sold them into the harem of some Fourth Level Indo-Turanian sultan."

"Yes. That was your first independent case, Vall. That was when I began to think you'd really make a cop. One renegade First Level citizen and four or five ServSec Prole hoodlums, with a stolen fifty-foot conveyer. This looks like a rather more ambitious operation."

Dalla got one of her own cigarettes out and lit it. Vall and Tortha Karf were talking cop talk about method of operation and possible size of the gang involved, and why the slaves had been shipped all the way from India to the west coast of North America.

"Always ready sale for slaves on the Esaron Sector," Vall was saying. "And so many small independent states, and different languages, that outtimers wouldn't be particularly conspicuous."

"And with this barbarian invasion going on on the Kholghoor Sector, slaves could be picked up cheaply," Tortha Karf added.

In spite of her determination to boycott the conversation, curiosity began to get the better of her. She had spent a year and a half on the Kholghoor Sector, investigating alleged psychic powers of the local priests. There'd been nothing to it—the prophecies weren't precognition, they were shrewd inferences, and the miracles weren't psychokinesis, they were sleight-of-hand. She found herself asking:

"What barbarian invasion's this?"

"Oh, Central Asian nomadic people, the Croutha," Tortha Karf told her. "They came down through Khyber Pass about three months ago, turned east, and hit the headwaters of the Ganges. Without punching a lot of buttons to find out exactly, I'd say they're halfway to the delta country by now. Leader seems to be a chieftain called Llamh Droogh the Red. A lot of paratime trading companies are yelling for permits to introduce firearms in the Kholghoor Sector to protect their holdings there."

She nodded. The Fourth Level Kholghoor Sector belonged to what was known as Indus-Ganges-Irriwady Basic Sector-Grouping—probability of civilization having developed late on the Indian subcontinent, with the rest of the world, including Europe, in Stone Age savagery or early Bronze Age barbarism. The Kharandas, the people among whom she had once done field-research work, had developed a pre-mechanical, animal-power, handcraft, edge-weapon culture. She could imagine the roads jammed with fugitives from the barbarian invaders, the conveyer hidden among the trees, the lurking slavers—

Watch it, Dalla! Don't let the old scoundrel play on your feelings!

"Well, what do you want me to do, Chief?" Vall was asking.

"Well, I have to know just what this situation's likely to develop into, and I want to know why Vulthor Tharn's been sitting on this ever since Skordran Kirv reported it to him—"

"I can answer the second one now," Vall replied. "Vulthor Tharn is due to retire in a few years. He has a negatively good, undistinguished record. He's trying to play it safe."

Tortha Karf nodded. "That's what I thought. Look, Vall; suppose you and Dalla transpose from here to Police Terminal, and go to Novilan Equivalent, and give this a quick look-over and report to me, and then rocket to Zarabar Equivalent and go on with your trip to the Dwarma Sector. It may delay you eight or ten hours, but—"

"Closer twenty-four," Vall said. "I'd have to transpose to this plantation, on the Esaron Sector. How about it, Dalla? Would you want to do that?"

She hesitated for a moment, angry with him. He didn't want to refuse, and he was trying to make her do it for him.

"I know, it's a confounded imposition, Dalla," Tortha Karf told her. "But it's important that I get a prompt and full estimate of the situation. This may be something very serious. If it's an isolated incident, it can be handled in a routine manner, but I'm afraid it's not. It has all the marks of a large-scale operation, and if this is a matter of mass kidnapings from one sector and transpositions to another, you can see what a threat this is to the Paratime Secret."

"Moral considerations entirely aside," Vall said. "We don't need to discuss them; they're too obvious."

She nodded. For over twelve millennia, the people of her race and Vall's and Tortha Karf's had been existing as parasites on all the innumerable other worlds of alternate probability on the lateral dimension of time. Smart parasites never injure their hosts, and try never to reveal their existence.

"We could do that, couldn't we, Vall?" she asked, angry at herself now for giving in. "And if you want to question these slaves, I speak Kharanda, and I know how they think. And I'm a qualified and licensed narcohypnotic technician."

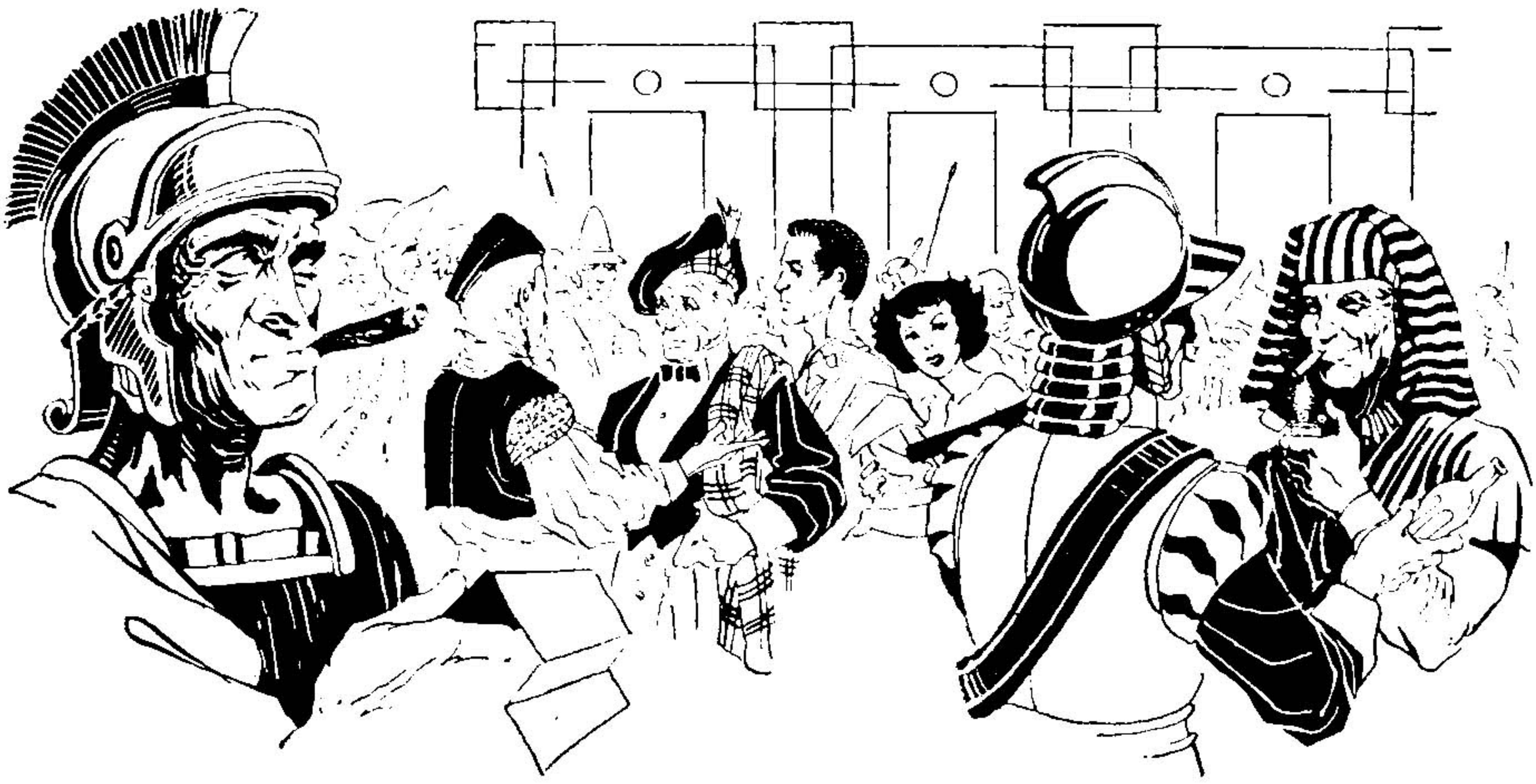
"Well, that's splendid, Dalla!" Tortha Karf enthused. "Wait a moment; I'll message Police Terminal to have a rocket ready for you."

"I'll need a hypno-mech for Kharanda, myself," Vall said. "Dalla, do you know Acalan?" When she shook her head, he turned back to Tortha Karf. "Look; it's about a four-hour rocket hop to Novilan Equivalent. Say we have the hypno-mech machines installed in the rocket; Dalla and I can take our language lessons on the way, and be ready to go to work as soon as we land."

"Good idea," Tortha Karf approved. "I'll order that done, right away. Now—"

Oddly enough, she wasn't feeling so angry, now that she had committed herself and Vall. Come to think of it, she had never been on Police Terminal Time Line; very few people, outside the Paratime Police, ever had. And, she had always wanted to learn more about Vall's work, and participate in it with him. And if she'd made him refuse, it would have been something ugly between them all the time they would be on the Dwarma Sector. But this way—

The big circular conveyer room was crowded, as it had been every minute of every day for the past ten thousand years. At the great circular desk in the center, departing or returning police officers were checking in or out with



the flat-topped cylindrical robot clerks, or talking to human attendants. Some were in the regulation green uniform; others, like himself, were in civilian clothes; more were in outtime costumes from all over paratime. Fringed robes and cloth-of-gold sashes and conical caps from the Second Level Khiftan Sector; Fourth Level Proto-Aryan mail and helmets; the short tunics and kilts of Fourth Level Alexandrian-Roman Sector; the Zarkantha loincloth and felt cap and daggers; there were priestly vestments stiff with gold, and military uniforms; there were trousers and jackboots and bare legs; blasters, and swords, and pistols, and bows and quivers, and spears. And the place was loud with a babel of voices and the clatter of teleprinters.

Dalla was looking about her in surprised delight; for her, the vacation had already begun. He was glad; for a while, he had been afraid that she would be unhappy about it. He guided her through the crowd to the desk, spoke for a while to one of the human attendants, and found out which was their conveyer. It was a fixed-destination shuttler, operative only between Home Time Line and Police Terminal, from which most of the Paratime Police operations were routed. He put Dall in through the sliding door, followed, and closed it behind him, locking it. Then, before he closed the starting switch, he drew a pistollike weapon and checked it.

In theory, the Ghaldron-Hesthor paratemporal transposition field was uninfluenced by material objects outside it. In practice, however, such objects occasionally intruded, and sometimes they were alive and hostile. The last time he had been in this conveyer room, he had seen a quartet of returning officers emerge from a conveyer dome

dragging a dead lion by the tail. The sigma-ray needler, which he carried, was the only weapon which could be used, under the circumstances. It had no effect whatever on any material structure and could be used inside an activated conveyer without deranging the conductor-mesh, as, say, a bullet or the vibration of an ultrasonic paralyzer would do, and it was instantly fatal to anything having a central nervous system. It was a good weapon to use outtime for that reason, also; even on the most civilized timeline, the most elaborate autopsy would reveal no specific cause of death.

"What's the Esaron Sector like?" Dalla asked, as the conveyer dome around them coruscated with shifting light and vanished.

"Third Level; probability of abortive attempt to colonize this planet from Mars about a hundred thousand years ago," he said. "A few survivors —a shipload or so—were left to shift for themselves while the parent civilization on Mars died out. They lost all vestiges of their original Martian culture, even memory of their extraterrestrial origin. About fifteen hundred to two thousand years ago, a reasonably high electrochemical civilization developed and they began working with nuclear energy and developed reaction-drive spaceships. But they'd concentrated so on the inorganic sciences, and so far neglected the biosciences, that when they launched their first ship for Venus they hadn't yet developed a germ theory of disease."

"What happened when they ran into the green-vomit fever?" Dalla asked.

"About what you could expect. The first—and only—ship to return brought it back to Terra. Of course, nobody knew what it was, and before the epidemic ended, it had almost depopulated this planet. Since the survivors knew nothing about germs, they blamed it on the anger of the gods—the old story of recourse to supernaturalism in the absence of a known explanation—and a fanatically anti-scientific cult got control. Of course, space travel was taboo; so was nuclear and even electric power. For some reason, steam power and gunpowder weren't offensive to the gods. They went back to a low-order steam-power, black-powder, culture, and haven't gotten beyond that to this day. The relatively civilized regions are on the east coast of Asia and the west coast of North America; civilized race more or less Caucasian. Political organization just barely above the tribal level —thousands of petty kingdoms and republics and principalities and feudal holdings and robbers' roosts. The principal industries are brigandage, piracy, slave-raiding, cattle-rustling and intercommunal warfare. They have a few ramshackle steam railways, and some steamboats on the rivers. We sell them coal and manufactured goods, mostly in exchange for foodstuffs and

tobacco. Consolidated Outtime Foodstuffs has the sector franchise. That's one of the companies Thalvan Dras gets his money from."

They had run down through the civilized Second and Third Levels and were leaving the Fourth behind and entering the Fifth, existing in the probability of a world without human population. Once in a while, around them, they caught brief flashes of buildings and rocketports and spaceports and landing stages, as the conveyer took them through narrow paratime belts on which their own civilization had established outposts—Fifth Level Commercial, Fifth Level Passenger, Industrial Sector, Service Sector.

Finally the conveyer dome around them shimmered into visibility and materialized; when they emerged, there were policemen in green uniforms who entered to search the dome with drawn needlers to make sure they had picked up nothing dangerous on the way. The room outside was similar to the one they had left on Home Time Line, even to the shifting, noisy crowd in incongruously-mixed costumes.

The rocketport was a ten minutes' trip by aircar from the conveyer head; when they boarded the stubby-winged strato-rocket, Vall saw that two of the passenger-seats had square metal cabinets bolted in place behind them and blue plastic helmets on swinging arms mounted above them.

"Everything's set up," the pilot told them. "Dr. Hadron, you sit on the left; that cabinet's loaded with language tape for Acalan. Yours is loaded with a tape of Kharanda; that's the Fourth Level Kholghoor language you wanted, Chief's Assistant. Shall I help you get fixed in your seats?"

"Yes, if you please. Here, Dalla, I'll fix that for you."

Dalla was already asleep when the pilot was adjusting his helmet and giving him his injection. He never felt the rocket tilt into firing position, and while he slept, the Kharands language, with all its vocabulary and grammar, became part of his subconscious knowledge, needing only the mental pronunciation of a trigger-symbol to bring it into consciousness. The pilot was already unfastening and raising his helmet when he opened his eyes. Dalla, beside him, was sipping a cup of spiced wine.

On the landing stage of the Sector-Regional Headquarters at Novilan Equivalent, four or five people were waiting for them. Vall recognized the subchief, Vulthor Tharn, who introduced another man, in riding boots and a white cloak, as Skordran Kirv. Vall clasped hands with him warmly.

"Good work, Agent Skordran. You got onto this promptly."

"I tried to, sir. Do you want the dope now? We have half an hour's flight to our spatial equivalent, and another half hour in transposition."

"Give it to me on the way," he said, and turned to Vulthor Tharn. "Our

Esaron costumes ready?"

"Yes. Over there in the control tower. We have a temporary conveyer head set up about two hundred miles south of here, which will take you straight through to the plantation."

"Suppose you change now, Dalla," he said. "Subchief, I'd like a word with you privately."

He and Vulthor Tharn excused themselves and walked over to the edge of the landing stage. The SecReg Subchief was outwardly composed, but Vall sensed that he was worried and embarrassed.

"Now, what's been done since you got Agent Skordran's report?" Vall asked.

"Well, sir, it seems that this is more serious than we had anticipated. Field Agent Skordran, who will give you the particulars, says that there is every indication that a large and well-organized gang of paratemporal criminals, our own people, are at work. He says that he's found evidence of activities on Fourth Level Kholghoor that don't agree with any information we have about conditions on that sector."

"Beside transmitting Agent Skordran's report to Dhergabar through the robot report-system, what have you done about it?"

"I confirmed Agent Skordran in charge of the local investigation, and gave him two detectives and a psychist, sir. As soon as we could furnish hypno-mech indoctrination in Kharanda to other psychists, I sent them along. He now has four of them, and eight detectives. By that time, we had a conveyer head right at this Consolidated Outtime Foodstuffs plantation."

"Why didn't you just borrow psychists from SecReg for Kholghoor, Eastern India?" Vall asked. "Subchief Ranthar would have loaned you a few."

"Oh, I couldn't call on another SecReg for men without higher-echelon authorization. Especially not from another Sector Organization, even another Level Authority," Vulthor Tharn said. "Beside, it would have taken longer to bring them here than hypno-mech our own personnel."

He was right about the second point, Vall agreed mentally; however, his real reason was procedural.

"Did you alert Ranthar Jard to what was going on in his SecReg?" he asked.

"Gracious, no!" Vulthor Tharn was scandalized. "I have no authority to tell people of equal echelon in other Sector and Level organizations what to do. I put my report through regular channels; it wasn't my place to go outside my own jurisdiction."

And his report had crawled through channels for fourteen hours, Vall thought.

"Well, on my authority, and in the name of Chief Tortha, you message Ranthar Jard at once; send him every scrap of information you have on the subject, and forward additional in-

formation as it comes in to you. I doubt he'll find anything on any time-line that's being exploited by any legitimate paratimers. This gang probably work exclusively on unpenetrated time-lines; this business Skordran Kirv came across was a bad blunder on some underling's part." He saw Dalla emerge from the control tower in breeches and boots and a white cloak, buckling on a heavy revolver. "I'll go change, now; you get busy calling Ranthar Jard. I'll see you when I get back."

"Are you taking over, Chief's Assistant?" Skordran Kirv asked, as the aircar lifted from the landing stage.

"Not at all. My wife and I are starting on our vacation, as soon as I find out what's been happening here, and report to Chief Tortha. Did your native troopers catch those slavers?"

"Yes, they got them yesterday afternoon; we've had them ever since. Do you want the whole thing just as it happened, Assistant Verkan, or just a condensation?"

"Give me what you think it indicates, remembering that you're probably trying to analyze a large situation from a very small sample."

"It's big, all right," Skordran Kirv said. "This gang can't number less than a hundred men, maybe several hundred. They must have at least two two-hundred-foot conveyers and several small ones, and bases on what sounds like some Fifth Level Time line, and at least one air freighter of around five thousand tons. They are operating on a number of Kholghoor and Esaron time lines."

Verkan Vall nodded. "I didn't think it was any petty larceny," he said.

"Wait till you hear the rest of it. On the Kholghoor Sector, this gang is known as the Wizard Traders; we've been using that as a convenience label. They pose as sorcerers—black robes and hood-masks covered with luminous symbols, voice-amplifiers, cold-light auras, energy-weapons, mechanical magic tricks, that sort of thing. They have all the Croutha scared witless. Their procedure is to establish camps in the forest near recently conquered Kharanda cities; then they appear to the Croutha, impress them with their magical powers, and trade manufactured goods for Kharanda captives. They mainly trade firearms, apparently some kind of flintlocks, and powder."

Then they were confining their operations to unpenetrated time lines; there had been no reports of firearms in the hands of the Croutha invaders.

"After they buy a batch of slaves," Skordran Kirv continued, "they transpose them to this presumably Fifth Level base, where they have concentration camps. The slaves we questioned had been airlifted to North America, where there's another concentration camp, and from there transposed to this Esaron Sector time line where I found them. They say that

there were at least two to three thousand slaves in this North American concentration camp and that they are being transposed out in small batches and replaced by others airlifted in from India. This lot was sold to a Calera named Nebu-hin-Abenoz, the chieftain of a hill town, Careba, about fifty miles southwest of the plantation. There were two hundred and fifty in this batch; this Coru-hin-Irigod only bought the batch he sold at the plantation."

The aircar lost speed and altitude; below, the countryside was dotted with conveyer heads, each spatially coexistent with some outtime police post or operation. There were a great many of them; the western coast of North America was a center of civilization on many paratemporal sectors, and while the conveyer heads of the commercial and passenger companies were scattered over hundreds of Fifth Level time lines, those of the Paratime Police were concentrated upon one. The antigrav-car circled around a three-hundred-foot steel tower that supported a conveyer head patially coexistent with one on a top floor of some outtime tall building, and let down in front of a low prefabricated steel shed. A man in police uniform came out to meet them. There was a fifty-foot conveyer dome inside, and a fifty-foot red-lined circle that marked the transposition point of an outtime conveyer. They all entered the dome, and the operator put on the transposition field.

"You haven't heard the worst of it yet," Skordran Kirv was saying. "On this time line, we have reason to think that the native, Nebu-hin-Abenoz, who bought the slaves, actually saw the slavers' conveyer. Maybe even saw it activated."

"If he did, we'll either have to capture him and give him a memory-obliteration, or kill him," Vall said. "What do you know about him?"

"Well, this Careba, the town he bosses, is a little walled town up in the hills. Everybody there is related to everybody else; this man we have, Coru-hin-Irigod, is the son of a sister of Nebu-hin-Abenoz's wife. They're all bandits and slavers and cattle rustlers and what have you. For the last ten years, Nebu-hin-Abenoz has been buying slaves from some secret source. Before the Kholghoor Sector people began coming in, they were mostly white, with a few brown people who might have been Polynesians. No Negroes—there's no black race on this sector, and I suppose the paratime slavers didn't want too many questions asked. Coru-hin-Irigod, under narco-hypnosis, said that they were all outlanders, speaking strange languages."

"Ten years! And this is the first hint we've had of it," Vall said. "That's not a bright mark for any of us. I'll bet the slave population on some of these Esaron time lines is an anthropologist's nightmare."

"Why, if this has been going on for ten years, there must have been millions upon millions of people dragged from their own time lines into slavery!" Dalla said in a shocked voice.

"Ten years may not be all of it," Vall said. "This Nebu-hin-Abenoz looks like the only tangible lead we have, at present. How does he operate?"

"About once every ten days, he'll take ten or fifteen men and go a day's ride—that may be as much as fifty miles; these Caleras have good horses and they're hard riders—into the hills. He'll take a big bag of money, all gold. After dark, when he has made camp, a couple of strangers in Calera dress will come in. He'll go off with them, and after about an hour, he'll come back with eight or ten of these strangers and a couple of hundred slaves, always chained in batches of ten. Nebu-hin-Abenoz pays for them, makes arrangements for the next meeting, and the next morning he and his party start marching the slaves to Careba. I might add that, until now, these slaves have been sold to the mines east of Careba; these are the first that have gotten into the coastal country."

"That's why this hasn't come to light before, then. The conveyer comes in every ten days, at about the same place?"

"Yes. I've been thinking of a way we might trap them," Skordran Kirv said. "I'll need more men, and equipment."

"Order them from Regional or General Reserve," Vall told him. "This thing's going to have overtop priority till it's cleared up."

He was mentally cursing Vulthor Tharn's procedure-bound timidity as the conveyer flickered and solidified around them and the overhead red light turned green.

They emerged into the interior of a long shed, adobe-walled and thatch-roofed, with small barred windows set high above the earth floor. It was cool and shadowy, and the air was heavy with the fragrance of citrus fruits. There were bins along the walls, some partly full of oranges, and piles of wicker baskets. Another conveyer dome stood beside the one in which they had arrived; two men in white cloaks and riding boots sat on the edge of one of the bins, smoking and talking.

Skordran Kirv introduced them—Gathon Dard and Krador Arv, special detectives—and asked if anything new had come up. Krador Arv shook his head.

"We still have about forty to go," he said. "Nothing new in their stories; still the same two time lines."

"These people," Skordran Kirv explained, "were all peons on the estate of a Kharanda noble just above the big bend of the Ganges. The Croutha hit their master's estate about a ten-days ago, elapsed time. In telling about their capture, most of them say that their master's wife killed herself with a dagger after the Croutha killed

her husband, but about one out of ten say that she was kidnaped by the Croutha. Two different time lines, of course. The ones who tell the suicide story saw no firearms among the Croutha; the ones who tell the kidnap story say that they all had some kind of muskets and pistols. We're making synthetic summaries of the two stories."

"We're having trouble with the locals about all these strangers coming in," Gathon Dard added. "They're getting curious."

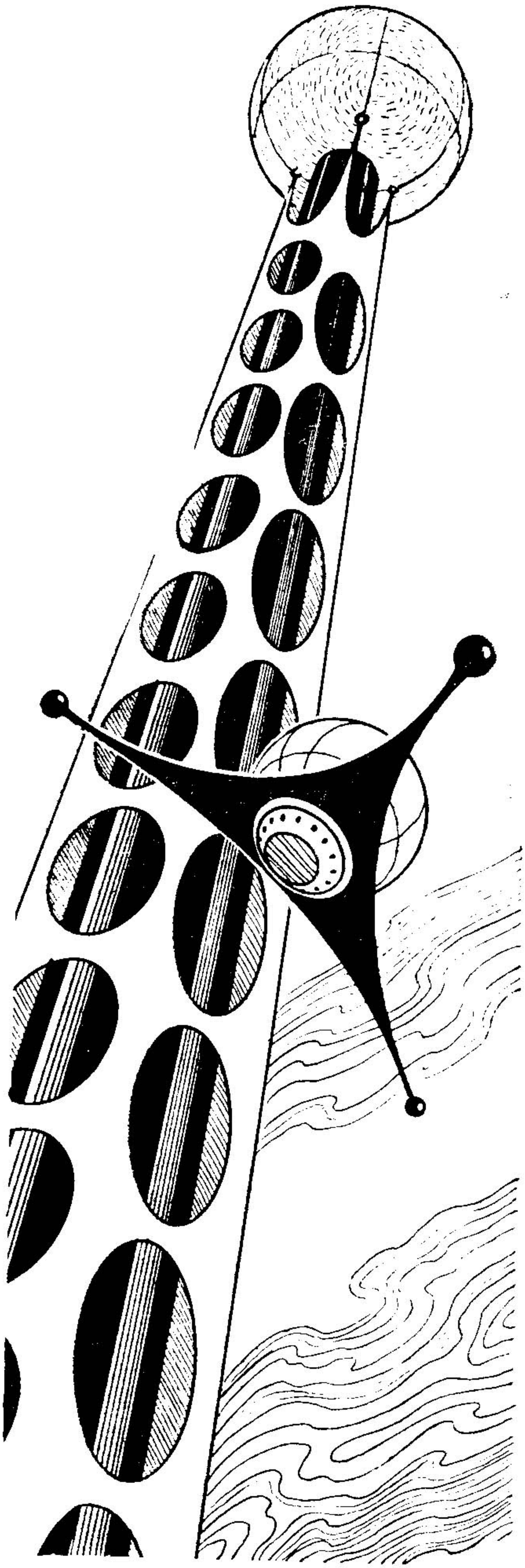
"We'll have to take a chance on that," Vall said. "Are the interrogations still going on? Then let's have a look-in at them."

The big double doors at the end of the shed were barred on the inside. Krador Arv unlocked a small side door, letting Vall, Dalla and Gathon Dard out. In the yard outside, a gang of slaves were unloading a big wagon of oranges and packing them into hampers; they were guarded by a couple of native riflemen who seemed mostly concerned with keeping them away from the shed, and a man in a white cloak was watching the guards for the same purpose. He walked over and introduced himself to Vall.

"Golzan Doth, local alias Dosu Golan. I'm Consolidated Outtime Foodstuffs' manager here."

"Nasty business for you people," Vall sympathized. "If it's any consolation, it's a bigger headache for us."

"Have you any idea what's going to



be done about these slaves?" Golzan Doth asked. "I have to remember that the Company has forty thousand Paratemporal Exchange Units invested in them. The top office was very specific in requesting information about that."

Vall shook his head. "That's over my echelon," he said. "Have to be decided by the Paratime Commission. I doubt if your company'll suffer. You bought them innocently, in conformity with local custom. Ever buy slaves from this Coru-hin-Irigod before?"

"I'm new, here. The man I'm replacing broke his neck when his horse put a foot in a gopher hole about two ten-days ago."

Beside him, Vall could see Dalla nod as though making a mental note. When she got back to Home Time Line, she'd put a crew of mediums to work trying to contact the discarnate former plantation manager; at Rhogom Institute, she had been working on the problem of return of a discarnate personality from outtime.

"A few times," Skordran Kirv said. "Nothing suspicious; all local stuff. We questioned Coru-hin-Irigod pretty closely on that point, and he says that this is the first time he ever brought a batch of Nebu-hin-Abenoz's outlanders this far west."

The interrogations were being conducted inside the plantation house, in the secret central rooms where the paratimers lived. Skordran Kirv used a door-activator to slide open a hidden door.

"I suppose I don't have to warn either of you that any positive statement made in the hearing of a narco-hypnotized subject—" he began.

". . . Has the effect of hypnotic suggestion—" Vall picked up after him.

". . . And should be avoided unless such suggestion is intended," Dalla finished.

Skordran Kirv laughed, opening another, inner door, and stood aside. In what had been the paratimers' recreation room, most of the furniture had been shoved into the corners. Four small tables had been set up, widely spaced and with screens between; across each of them, with an electric recorder between, an almost naked Kharanda slave faced a Paratime Police psychist. At a long table at the far side of the room, four men and two girls were working over stacks of cards and two big charts.

"Phrakor Vuln," the man who was working on the charts introduced himself. "Synthesist." He introduced the others.

Vall made a point of the fact that Dalla was his wife, in case any of the cops began to get ideas, and mentioned that she spoke Kharanda, had spent some time on the Fourth Level Kholghoor, and was a qualified psychist.

"What have you got, so far?" he asked.

"Two different time lines, and two

different gangs of Wizard Traders," Phrakor Vuln said. "We've established the latter from physical descriptions and because both batches were sold by the Croutha at equivalent periods of elapsed time."

Vall picked up one of the kidnap-story cards and glanced at it.

"I notice there's a fair verbal description of these firearms, and mention of electric whips," he said. "I'm curious about where they came from."

"Well, this is how we reconstructed them, Chief's Assistant," one of the girls said, handing him a couple of sheets of white drawing paper.

The sketches had been done with soft pencil; they bore repeated erasures and corrections. That of the whip showed a cylindrical handle, indicated as twelve inches in length and one in diameter, fitted with a thumb-switch.

"That's definitely Second Level Khiftan," Vall said, handing it back. "Made of braided copper or silver wire and powered with a little nuclear-conversion battery in the grip. They heat up to about two hundred centigrade; produce really painful burns."

"Why, that's beastly!" Dalla exclaimed.

"Anything on the Khiftan Sector is." Skordran Kirv looked at the four slaves at the tables. "We don't have a really bad case here, now. A few of these people were lash-burned horribly, though."

Vall was looking at the other sketches. One was a musket, with a wide butt and a band-fastened stock; the lock-mechanism, vaguely flintlock, had been dotted in tentatively. The other was a long pistol, similarly definite in outline and vague in mechanical detail; it was merely a knob-butted miniature of the musket.

"I've seen firearms like these; have a lot of them in my collection," he said, handing back the sketches. "Low-order mechanical or high-order pre-mechanical cultures. Fact is, things like those could have been made on the Kholghoor Sector, if the Kharandas had learned to combine sulfur, carbon and nitrates to make powder."

The interrogator at one of the tables had evidently heard all his subject could tell him. He rose, motioning the slave to stand.

"Now, go with that man," he said in Kharanda, motioning to one of the detectives in native guard uniform. "You will trust him; he is your friend and will not harm you. When you have left this room, you will forget everything that has happened here, except that you were kindly treated and that you were given wine to drink and your hurts were anointed. You will tell the others that we are their friends and that they have nothing to fear from us. And you will not try to remove the mark from the back of your left hand."

As the detective led the slave out a door at the other side of the room, the psychist came over to the long

table, handing over a card and lighting a cigarette.

"Suicide story," he said to one of the girls, who took the card.

"Anything new?"

"Some minor details about the sale to the Caleras on this time line. I think we've about scraped bottom."

"You can't say that," Phrakor Vuln objected. "The very last one may give us something nobody else had noticed."

Another subject was sent out. The interrogator came over to the table.

"One of the kidnap-story crowd," he said. "This one was right beside that Croutha who took the shot at the wild pig or whatever it was on the way to the Wizard Traders' camp. Best description of the guns we've gotten so far. No question that they're flintlocks." He saw Verkan Vall. "Oh, hello, Assistant Verkan. What do you make of them? You're an authority on outtime weapons, I understand."

"I'd have to see them. These people simply don't think mechanically enough to give a good description. A lot of peoples make flintlock firearms."

He started running over, in his mind, the paratemporal areas in which gunpowder but not the percussion-cap was known. Expanding cultures, which had progressed as far as the former but not the latter. Static cultures, in which an accidental discovery of gunpowder had never been followed up by further research. Post-debacle cultures, in which a few stray bits of ancient knowledge had survived.

Another interrogator came over, and then the fourth. For a while they sat and talked and drank coffee, and then the next quartet of slaves, two men and two women, were brought in. One of the women had been badly blistered by the electric whips of the Wizard Traders; in spite of reassurances, all were visibly apprehensive.

"We will not harm you," one of the psychists told them. "Here; here is medicine for your hurts. At first, it will sting, as good medicines will, but soon it will take away all pain. And here is wine for you to drink."

A couple of detectives approached, making a great show of pouring wine and applying ointment; under cover of the medication, they jabbed each slave with a hypodermic needle, and then guided them to seats at the four tables. Vall and Dalla went over and stood behind one of the psychists, who had a small flashlight in his hand.

"Now, rest for a while," the psychist was saying. "Rest and let the good medicine do its work. You are tired and sleepy. Look at this magic light, which brings comfort to the troubled. Look at the light. Look . . . at . . . the . . . light."

They moved to the next table.

"Did you have hand in the fighting?"

"No, lord. We were peasant folk, not fighting people. We had no weapons, nor weapon-skill. Those who fought were all killed; we held up empty hands, and were spared to be

captives of the Croutha."

"What happened to your master, the Lord Ghromdour, and to his lady?"

"One of the Croutha threw a hatchet and killed our master, and then his lady drew a dagger and killed herself."

The psychist made a red mark on the card in front of him, and circled the number on the back of the slave's hand with red indelible crayon. Vall and Dalla went to the third table.

"They had the common weapons of the Croutha, lord, and they also had the weapons of the Wizard Traders. Of these, they carried the long weapons slung across their backs, and the short weapons thrust through their bel's."

A blue mark on the card; a blue circle on the back of the slave's hand.

They listened to both versions of what had happened at the sack of the Lord Ghromdour's estate, and the march into the captured city of Jhirda, and the second march into the forest to the camp of the Wizard Traders.

"The servants of the Wizard Traders did not appear until after the Croutha had gone away; they wore different garb. They wore short jackets, and trousers, and short boots, and they carried small weapons on their belts—"

"They had whips of great cruelty that burned like fire; we were all lashed with these whips, as you may see, lord—"

"The Croutha had bound us two and two, with neck-yokes; these the servants of the Wizard Traders took off from us, and they chained us together by tens, with the chains we still wore when we came to this place—"

"They killed my child, my little Zhouzha!" the woman with the horribly blistered back was wailing. "They tore her out of my arms, and one of the servants of the Wizard Traders—may Khokhaat devour his soul forever!—dashed out her brains. And when I struggled to save her, I was thrown on the ground, and beaten with the fire-whips until I fainted. Then I was dragged into the forest, along with the others who were chained with me." She buried her head in her arms, sobbing bitterly.

Dalla stepped forward, taking the flashlight from the interrogator with one hand and lifting the woman's head with the other. She flashed the light quickly in the woman's eyes.

"You will grieve no more for your child," she said. "Already, you are forgetting what happened at the Wizard Traders' camp, and remembering only that your child is safe from harm. Soon you will remember her only as a dream of the child you hope to have, some day." She flashed the light again, then handed it back to the psychist. "Now, tell us what happened when you were taken into the forest; what did you see there?"

The psychist nodded approvingly,

made a note on the card, and listened while the woman spoke. She had stopped sobbing, now, and her voice was clear and cheerful.

Vall went over to the long table.

"Those slaves were still chained with the Wizard Traders' chains when they were delivered here. Where are the chains?" he asked Skordran Kirv.

"In the permanent conveyer room," Skordran Kirv said. "You can look at them there; we didn't want to bring them in here, for fear these poor devils would think we were going to chain them again. They're very light, very strong; some kind of alloy steel. Files and power saws only polish them; it takes fifteen seconds to cut a link with an atomic torch. One long chain, and short lengths, fifteen inches long, staggered, every three feet, with a single hinge-shackle for the ankle. The shackles were riveted with soft wrought-iron rivets, evidently made with some sort of a power riveting-machine. We cut them easily with a cold chisel."

"They ought to be sent to Dhergabar Equivalent, Police Terminal, for study of material and workmanship. Now, you mentioned some scheme you had for capturing this conveyer that brings in the slaves for Nebu-hin-Abenoz. What have you in mind?"

"We still have Coru-hin-Irigod and all his gang, under hypno. I'd thought of giving them hypnotic conditioning, and sending them back to Careba with orders to put out some kind of signal the next time Nebu-hin-Abenoz starts out on a buying trip. We could have a couple of men posted in the hills overlooking Careba, and they could send a message-ball through to Police Terminal. Then, a party could be sent with a mobile conveyer to ambush Nebu-hin-Abenoz on the way, and wipe out his party. Our people could take their horses and clothing and go on to take the conveyer by surprise."

"I'd suggest one change. Instead of relying on visual signals by the hypno-conditioned Coru-hin-Irigod, send a couple of our men to Careba with midget radios."

Skordran Kirv nodded. "Sure. We can condition Coru-hin-Irigod to accept them as friends and vouch for them at Careba. Our boys can be traders and slave buyers. Careba's a market town; traders are always welcome. They can have firearms to sell—revolvers and repeating rifles. Any Calera'll buy any firearm that's better than the one he's carrying; they'll always buy revolvers and repeaters. We can get what we want from Commercial Four-Oh-Seven; we can get riding and pack horses here."

Vall nodded. "And the post overlooking or in radio range of Careba on this time line, and another on Pol-Term. For the ambush of Nebu-hin-Abenoz's gang and the capture of the conveyer, use anything you want to—sleep-gas, paralyzers, energy-weapons, antigrav-equipment, anything. As far as regulations about using only equip-

ment appropriate to local culture-levels, forget them entirely. But take that conveyer intact. You can locate the base time line from the settings of the instrument panel, and that's what we want most of all."

Dalla and the police psychist, having finished with and dismissed their subject, came over to the long table.

". . . That poor creature," Dalla was saying. "What sort of fiends are they?"

"If that made you sick, remember we've been listening to things like that for the last eight hours. Some of the stories were even worse than that one."

"Well, I'd like to use a heat-gun on the whole lot of them, turned down to where it'd just fry them medium-rare," Dalla said. "And for whoever's back of this, take him to Second Level Khiftan and sell him to the priests of Fasif."

"Too bad you're not coming back from your vacation, instead of starting out, Chief's Assistant Verkan," Skordran Kirv said. "This is too big for me to handle alone, and I'd sooner work under you than anybody else Chief Tortha sends in."

"Vall!" Dalla cried in indignation. "You're not going to just report on this and then walk away from it, are you?"

"But, darling," Vall replied, in what he hoped was a convincing show of surprise. "You don't want our vacation postponed again, do you? If I get mixed up in this, there's no telling when I can get away, and by the time I'm free, something may come up at Rhogom Institute that you won't want to drop—"

"Vall, you know perfectly well that I wouldn't be happy for an instant on the Dwarma Sector, thinking about this—"

"All right, then; let's forget about the vacation. You want to stay on for a while and help me with this? It'll be a lot of hard work, but we'll be together."

"Yes, of course. I want to do something to smash those devils. Vall, if you'd heard some of the things they did to those poor people—"

"Well, I'll have to go back to Pol-Term, as soon as I'm reasonably well filled in on this, and report to Tortha Karf and tell him I've taken charge. You can stay here and help with these interrogations; I'll be back in about ten hours. Then, we can go to Kholghoor East India SecReg HQ to talk to Ranthar Jard. We may be able to get something that'll help us on that end—"

"You may be able to have your vacation before too long, Dr. Hadron," Skordran Kirv told her. "Once we capture one of their conveyers, the instrument panel'll tell us what time line they're working from, and then we'll have them."

"There's an Indo-Turanian Sector parable about a snake charmer who thought he was picking up his snake

and found that he had hold of an elephant's tail," Vall said. "That might be a good thing to bear in mind, till we find out just what we have picked up."

Coming down a hallway on the hundred and seventh floor of the Management wing of the Paratime Building, Yandar Yadd paused to admire, in the green mirror of the glassoid wall, the jaunty angle of his silver-feathered cap, the fit of his short jacket, and the way his weapon hung at his side. This last was not instantly recognizable as a weapon; it looked more like a portable radio, which indeed it was. It was, none the less, a potent weapon. One flick of his finger could connect that radio with one at Tri-Planet News Service, and within the hour anything he said into it would be heard by all Terra, Mars and Venus. In consequence, there existed around the Paratime Building a marked and understandable reluctance to antagonize Yandar Yadd.

He glanced at his watch. It was twenty minutes short of 1000, when he had an appointment with Baltan Vrath, the comptroller general. Glancing about, he saw that he was directly in front of the doorway of the Outtime Claims Bureau, and he strolled in, walking through the waiting room and into the claims-presentation office. At once, he stiffened like a bird dog at point.

Sphabron Larv, one of his young

legmen, was in altercation across the counter-desk with Varkar Klav, the Deputy Claims Agent on duty at the time. Varkar was trying to be icily dignified; Sphabron Larv's black hair was in disarray and his face was suffused with anger. He was pounding with his fist on the plastic counter-top.

"You have to!" he was yelling in the older man's face. "That's a public document, and I have a right to see it. You want me to go into Tribunes' Court and get an order? If I do, there'll be a Question in Council about why I had to, before the day's out!"

"What's the matter, Larv?" Yandar Yadd asked lazily. "He trying to hold something out on you?"

Sphabron Larv turned; his eyes lit happily when he saw his boss, and then his anger returned.

"I want to see a copy of an indemnity claim that was filed this morning," he said. "Varkar, here, won't show it to me. What does he think this is, a Fourth Level dictatorship?"

"What kind of a claim, now?" Yandar Yadd addressed Larv, ignoring Varkar Klav.

"Consolidated Outtime Foodstuffs — one of the Thalvan Interests companies — just claimed forty thousand P.E.U. for a hundred slaves bought by one of their plantation managers on Third Level Esaron from a local slave dealer. The Paratime Police impounded the slaves for narco-hypnotic interrogation, and then transposed the lot of them to Police Terminal."

Yandar Yadd still held his affectation of sleepy indolence.

"Now why would the Paracops do that, I wonder? Slavery's an established local practice on Esaron Sector; our people have to buy slaves if they want to run a plantation."

"I know that," Sphabron Larv replied. "That's what I want to find out. There must be something wrong, either with the slaves, or the treatment our people were giving them, or the Paratime Police, and I want to find out which."

"To tell the truth, Larv, so do I," Yandar Yadd said. He turned to the man behind the counter. "Varkar, do we see that claim, or do I make a story out of your refusal to show it?" he asked.

"The Paratime Police asked me to keep this confidential," Varkar Klav said. "Publicity would seriously hamper an important police investigation."

Yandar Yadd made an impolite noise. "How do I know that all it would do would be to reveal police incompetence?" he retorted. "Look, Varkar; you and the Paratime Police and the Paratime Commission and the Home Time Line Management are all hired employees of the Home Time Line public. The public has a right to know what its employees are doing, and ist' mybusiness to see that they're informed. Now, for the last time— will you show us a copy of that claim?"

"Well, let me explain, off the rec-

ord—" the official begged.

"Huh-uh! Huh-uh! I had that off-the-record gag worked on me when I was about Larv's age, fifty years ago. Anything I get, I put on the air or not at my own discretion."

"All right," Varkar Klav surrendered, pointing to a reading screen and twiddling a knob. "But when you read it, I hope you have enough discretion to keep quiet about it."

The screen lit, and Yandar Yadd automatically pressed a button for a photo-copy. The two newsmen stared for a moment, and then even Yandar Yadd's shell of drowsy negligence cracked and fell from him. His hand brushed the switch as he snatched the hand-phone from his belt.

"Marva!" he barked, before the girl at the news office could more than acknowledge. "Get this recorded for immediate telecast! . . . Ready? Beginning: The existence of a huge paratemporal slave trade came to light on the afternoon of One-Five-Nine Day, on a time line of the Third Level Esaron Sector, when Field Agent Skordran Kirv, Paratime Police, discovered, at an orange plantation of Consolidated Outtime Foodstuffs—"

Salgath Trod sat alone in his private office, his half-finished lunch growing cold on the desk in front of him as he watched the televiewscreen across the room, tuned to a pickup behind the Speaker's chair in the Executive Council Chamber ten stories below. The two thousand seats had been almost all empty at 1000, when Council had convened. Fifteen minutes later, the news had broken; now, at 1430, a good three quarters of the seats were occupied. He could see, in the aisles, the gold-plated robot pages gliding back and forth, receiving and delivering messages. One had just slid up to the seat of Councilman Hasthor Flan, and Hasthor was speaking urgently into the recorder mouthpiece. Another message for him, he supposed; he'd gotten at least a score such calls since the crisis had developed.

People were going to start wondering, he thought. This situation should have been perfect for his purposes; as leader of the Opposition he could easily make himself the next General Manager, if he exploited this scandal properly. He listened for a while to the Centrist-Management member who was speaking; he could rip that fellow's arguments to shreds in a hundred words—but he didn't dare. The Management was taking exactly the line Salgath Trod wanted the whole Council to take: treat this affair as an isolated and extraordinary occurrence, find a couple of convenient scapegoats, cobble up some explanation acceptable to the public, and forget it. He wondered what had happened to the imbecile who had transposed those Kholghoor Sector slaves onto an exploited time line. Ought to be shanghaied to the Khiftan Sector and sold to the priests of Fasif!

A buzzer sounded, and for an instant he thought it would be the message he had seen Hasthor Fan recording. Then he realized that it was the buzzer for the private door, which could only be operated by someone with a special identity sigil. He pressed a button and unlocked the door.

The young man in the loose wrap-around tunic who entered was a stranger. At least, his face and his voice were strange, but voices could be mechanically altered, and a skilled cosmetician could render any face unrecognizable. He looked like a student, or a minor commercial executive, or an engineer, or something like that. Of course, his tunic bulged slightly under the left armpit, but even the most respectable tunics showed occasional weapon-bulges.

"Good afternoon, councilman," the newcomer said, sitting down across the desk from Salgath Trod. "I was just talking to . . . somebody we both know."

Salgath Trod offered cigarettes, lighted his visitor's and then his own.

"What does Our Mutual Friend think about all this?" he asked, gesturing toward the screen.

"Our Mutual Friend isn't at all happy about it."

"You think, perhaps, that I'm bursting into wild huzzas?" Salgath Trod asked. "If I were to act as everybody expects me to, I'd be down there on the floor, now, clawing into the Management tooth and nail. All my adherents are wondering why I'm not. So are all my opponents, and before long one of them is going to guess the reason."

"Well, why not go down?" the stranger asked. "Our Mutual Friend thinks it would be an excellent idea. The leak couldn't be stopped, and it's gone so far already that the Management will never be able to play it down. So the next best thing is to try to exploit it."

Salgath Trod smiled mirthlessly. "So I am to get in front of it, and lead it in the right direction? Fine . . . as long as I don't stumble over something. If I do, it'll go over me like a Fifth Level bison-herd."

"Don't worry about that," the stranger laughed reassuringly. "There are others on the floor who are also friends of Our Mutual Friend. Here; what you'd better do is attack the Paratime Police, especially Tortha Karf and Verkan Vall. Accuse them of negligence and incompetence, and, by implication, of collusion, and demand a special committee to investigate. And try to get a motion for a confidence vote passed. A motion to censure the Management, say—"

Salgath Trod nodded. "It would delay things, at least. And if Our Mutual Friend can keep properly covered, I might be able to overturn the Management." He looked at the screen again. "That old fool of a Nanthav is just getting started; it'll be an hour before I could get recognized. Plenty of time to get a speech together. Some-

thing short and vicious—"

"You'll have to be careful. It won't do, with your political record, to try to play down these stories of a gigantic criminal conspiracy. That's too close to the Management line. And at the same time, you want to avoid saying anything that would get Verkan Vall and Tortha Karf started off on any new lines of investigation."

Salgath Trod nodded. "Just depend on me; I'll handle it."

After the stranger had gone, he shut off the sound reception, relying on visual dumb-show to keep him informed of what was going on on the Council floor. He didn't like the situation. It was too easy to say the wrong thing. If only he knew more about the shadowy figures whose messengers used his private door—

Coru-hin-Irigod held his aching head in both hands, as though he were afraid it would fall apart, and blinked in the sunlight from the window. Lord Safar, how much of that sweet brandy had he drunk, last night? He sat on the edge of the bed for a moment, trying to think. Then, suddenly apprehensive, he thrust his hand under his pillow. The heavy four-barreled pistols were there, all right, but—*The money!*

He rummaged frantically among the bedding, and among his clothes, piled on the floor, but the leather bag was nowhere to be found. Two thousand gold *obus*, the price of a hundred slaves. He snatched up one of the pistols, his headache forgotten. Then he laughed and tossed the pistol down again. Of course! He'd given the bag to the plantation manager, what was his outlandish name, Dosu Golan, to keep for him before the drinking bout had begun. It was safely waiting for him in the plantation strong box. Well, nothing like a good scare to make a man forget a brandy head, anyhow. And there was something else, something very nice—

Oh, yes, there it was, beside the bed. He picked up the beautiful gleaming repeater, pulled down the lever far enough to draw the cartridge halfway out of the chamber, and closed it again, lowering the hammer. Those two Jeseru traders from the North, what were their names? Ganadara and Atarazola. That was a stroke of luck, meeting them here. They'd given him this lovely rifle, and they were going to accompany him and his men back to Careba; they had a hundred such rifles, and two hundred six-shot revolvers, and they wanted to trade for slaves. The Lord Safar bless them both, wouldn't they be welcome at Careba!

He looked at the sunlight falling through the window on the still recumbent form of his companion, Faru-hin-Obaran. Outside, he could hear the sounds of the plantation coming to life— an ax thudding on wood, the clatter of pans from the kitchens. Crossing to Faru-hin-Obaran's bed, he grasped

the sleeper by the ankle, tugging.

"Waken, Faru!" he shouted. "Get up and clear the fumes from your head! We start back to Careba today!"

Faru swore groggily and pushed himself into a sitting position, fumbling on the floor for his trousers.

"What day's this?" he asked.

"The day after we went to bed, ninny!" Then Coru-hin-Irigod wrinkled his brow. He could remember, clearly enough, the sale of the slaves, but after that— Oh, well, he'd been drinking; it would all come back to him, after a while.

Verkan Vall rubbed his hand over his face wearily, started to light another cigarette, and threw it across the room in disgust. What he needed was a drink—a long drink of cool, tart white wine, laced with brandy—and then he needed to sleep.

"We're absolutely nowhere!" Ranthar Jard said. "Of course they're operating on time lines we've never penetrated. The fact that they're supplying the Croutha with guns proves that; there isn't a firearm on any of the time lines our people are legitimately exploiting. And there are only about three billion time lines on this belt of the Croutha invasion—"

"If we could think of a way to reduce it to some specific area of paratime—" one of Ranthar Jard's deputies began.

"That's precisely what we've been trying to do, Klav," Vall said. "We haven't done it."

Daila, who had withdrawn from the discussion and was on a couch at the side of the room, surrounded by reports and abstracts and summaries, looked up.

"I took hours and hours of hypnomech on Kholghoor Sector religions, before I went out on that wild-goose chase for psychokinesis and precognition data," she said. "About six or eight hundred years ago, there were religious wars and hersies and religious schisms all over the Kharanda country. No matter how uniform the Kholghoor Sector may be otherwise, there are dozens and dozens of small belts and subsectors of different religions or sects or god-cults."

"That's right," Ranthar Jard agreed, brightening. "We have hagiologists who know all that stuff; we'll have a couple of them interrogate those slaves. I don't know how much they can get out of them—lot of peasants, won't be up on the theological niceties—but a synthesis of what we get from the lot of them—"

"That's an idea," Vall agreed. "About the first idea we've had, here— Oh, how about politics, too? Check on who's the king, what the stories about the royal family are, that sort of thing."

Ranthar Jard looked at the map on the wall. "The Croutha have only gotten halfway to Nharkan, here. Say we transpose detectives in at night

on some of these time lines we think are promising, and check up at the tax-collection offices on a big landowner north of Jhirda named Ghromdour? That might get us something."

"Well, I don't want you to think we're trying to get out of work, Chief's Assistant," one of the deputies said, "but is there any real necessity for our trying to locate the Wizard Trader time lines? If you can get them from the Esaron Sector, it'll be the same, won't it?"

"Marv, in this business you never depend on just one lead," Ranthar Jard told him. "And beside, when Skordran Kirv's gang hits the base of operations in North America, there's no guarantee that they may not have time to send off a radio warning to the crowd at the base here in India. We have to hit both places at once."

"Well, that, too," Vall said. "But the main thing is to get these Wizard Trader camps on the Kholghoor Sector cleaned out. How are you fixed for men and equipment, for a big raid, Jard?"

Ranthar Jard shrugged. "I can get about five hundred men with conveyers, including a couple of two-hundred-footers to carry airboats," he said.

"Not enough. Skordran Kirv has one complete armored brigade, one airborne infantry brigade, and an air cavalry regiment, with Ghaldron-Hesthor equipment for a simultaneous transposition," Vall said.

"Where in blazes did he get them all?" Ranthar Jard demanded.

"They're guard troops, from Service Sector and Industrial Sector. We'll get you the same sort of a force. I only hope we don't have another Prole insurrection while they're away—"

"Well, don't think I'm trying to argue policy with you," Ranthar Jard said, "but that could raise a dreadful stink on Home Time Line. Especially on top of this news-break about the slave trade."

"We'll have to take a chance on that," Vall said. "If you're worried about what the book says, forget it. We're throwing the book away, on this operation. Do you realize that this thing is a threat to the whole Paratime Civilization?"

"Of course I do," Ranthar Jard said. "I know the doctrine of Paratime Security as well as you or anybody else. The question is, does the public realize it?"

A buzzer sounded. Ranthar Jard pressed a switch on the intercom-box in front of him and said: "Ranthar here. Well?"

"Visiphone call, top urgency, just came in for Chief's Assistant Verkan, from Novilan Equivalent. Where can I put it through, sir?"

"Here; booth seven." Ranthar Jard pointed across the room, nodding to Vall. "In just a moment."

Gathon Dard and Antrath Alv—temporary local aliases, Ganadara and Atarazola—sat relaxed in their sad-

dles, swaying to the motion of their horses. They wore the rust-brown hooded cloaks of the northern Jeseru people, in sober contrast to the red and yellow and blue striped robes and sun-bonnets of the Caleras in whose company they rode. They carried short repeating carbines in saddle scabbards, and heavy revolvers and long knives on their belts, and each led six heavily-laden pack-horses.

Coru-hin-Irigod, riding beside Ganadara, pointed up the trail ahead.

"From up there," he said, speaking in Acalan, the lingua franca of the North American West Coast on that sector, "we can see across the valley to Careba. It will be an hour, as we ride, with the pack-horses. Then we will rest, and drink wine, and feast."

Ganadara nodded. "It was the guidance of our gods—and yours, Coru-hin-Irigod— that we met. Such slaves as you sold at the outlanders' plantation would bring a fine price in the North. The men are strong, and have the look of good field-workers; the women are comely and well-formed. Though I fear that my wife would little relish it did I bring home such handmaidens."

Coru-hin-Irigod laughed. "For your wife, I will give you one of our riding whips." He leaned to the side, slashing at a cactus with his quirt. "We in Careba have no trouble with our wives, about handmaidens or anything else."

"By Safar, if you doubt your welcome at Careba, wait till you show your wares," another Calera said. "Rifles and revolvers like those come to our country seldom, and then old and battered, sold or stolen many times before we see them. Rifles that fire seven times without taking butt from shoulder!" He invoked the name of the Great Lord Safar again.

The trail widened and leveled; they all came up abreast, with the pack-horses strung out behind, and sat looking across the valley to the adobe walls of the town that perched on the opposite ridge. After a while, riders began dismounting and checking and tightening saddle-girths; a couple of Caleras helped Ganadara and Atarazola inspect their pack-horses. When they remounted, Atarazola bowed his head, lifting his left sleeve to cover his mouth, and muttered into it at some length. The Caleras looked at him curiously, and Coru-hin-Irigod inquired of Ganadara what he did.

"He prays," Ganadara said. "He thanks our gods that we have lived to see your town, and asks that we be spared to bring many more trains of rifles and ammunition up this trail."

The slaver nodded understandingly. The Caleras were a pious people, too, who believed in keeping on friendly terms with the gods.

"May Safar's hand work with the hands of your gods for it," he said, making what, to a non-Calera, would have been an extremely ribald sign.

"The gods watch over us," Atara-

zola said, lifting his head. "They are near us even now; they have spoken words of comfort in my ear."

Ganadara nodded. The gods to whom his partner prayed were a couple of paratime policemen, crouching over a radio a mile or so down the ridge.

"My brother," he told Coru-hin-Irigod, "is much favored by our gods. Many people come to him to pray for them."

"Yes. So you told me, now that I think on it." That detail had been included in the pseudo-memories he had been given under hypnosis. "I serve Safar, as do all Caleras, but I have heard that the Jeserus' gods are good gods, dealing honestly with their servants."

An hour later, under the walls of the town, Coru-hin-Irigod drew one of his pistols and fired all four barrels in rapid succession into the air, shouting, "Open! Open for Coru-hin-Irigod, and for the Jeseru traders, Ganadara and Atarazola, who are with him!"

A head, black-bearded and sun-bonneted, appeared between the brick merlons of the wall above the gate, shouted down a welcome, and then turned away to bawl orders. The gate slid aside, and, after the caravan had passed through, naked slaves pushed the massive thing shut again. Although they were familiar with the interior of the town from photographs taken with boomerang-balls—automatic-return transposition spheres like message-balls—they looked around curiously. The central square was thronged—Caleras in striped robes, people from the south and east in baggy trousers and embroidered shirts, mountaineers in deerskins. A slave market was in progress, and some hundred-odd items of human merchandise were assembled in little groups, guarded by their owners and inspected by prospective buyers. They seemed to be all natives of that geographic and paratemporal area.

"Don't even look at those," Coru-hin-Irigod advised. "They are culls; the market is almost over. We'll go to the house of Nebu-hin-Abenoz, where all the considerable men gather, and you will find those who will be able to trade slaves worthy of the goods you have with you. Meanwhile, let my people take your horses and packs to my house; you shall be my guests while you stay in Careba."

It was perfectly safe to trust Coru-hin-Irigod. He was a murderer and a brigand and a slaver, but he would never incur the scorn of men and the curse of the gods by dealing foully with a guest. The horses and packs were led away by his retainers; Ganadara and Atarazola pushed their horses after his and Faru-hin-Obaran's through the crowd.

The house of Nebu-hin-Abenoz, like every other building in Careba, was flat-roofed, adobe-walled and windowless except for narrow rifle-slits. The

wide double-gate stood open, and five or six heavily armed Caleras lounged just inside. They greeted Coru and Faru by name, and the strangers by their assumed nationality. The four rode through, into what appeared to be the stables, turning their horses over to slaves, who took them away. There were between fifty and sixty other horses in the place.

Divesting themselves of their weapons in an anteroom at the head of a flight of steps, they passed under an arch and into a wide, shady patio, where thirty or forty men stood about or squatted on piles of cushions, smoking cheroots, drinking from silver cups, talking in a continuous babel. Most of them were in Calera dress, though there were men of other communities and nations, in other garb. As they moved across the patio, Gathon Dard caught snatches of conversations about deals in slaves, and horse trades, about bandit raids and blood feuds, about women and horses and weapons.

An old man with a white beard and an unusually clean robe came over to intercept them.

"Ha, lord of my daughter, you're back at last. We had begun to fear for you," he said.

"Nothing to fear, father of my wife," Coru-hin-Irigod replied. "We sold the slaves for a good price, and tarried the night feasting in good company. Such good company that we brought some of it with us— Atarazola and Ganadara, men of the Jeseru;

Cavu-hin-Avoran, whose daughter mothered my sons." He took his father-in-law by the sleeve and pulled him aside, motioning Gathon Dard and Antrath Alv to follow.

"They brought weapons; they want outland slaves, of the sort I took to sell in the Big Valley country," he whispered. "The weapons are repeating rifles from across the ocean, and six-shot revolvers. They also have much ammunition."

"Oh, Safar bless you!" the white-bear dcried, his eyes brightening. "Name your own price; satisfy yourselves that we have dealt fairly with you; go, and return often again! Come, lord of my daughter; let us make them known to Nebu-hin-Abenoz. But not a word about the kind of weapons you have, strangers, until we can speak privately. Say only that you have rifles to trade."

Gathon Dard nodded. Evidently there was some sort of power-struggle going on in Careba; Coru-hin-Irigod and his wife's father were of the party of Nebu-hin-Abenoz, and wanted the repeaters and six-shooters for themselves.

Nebu-hin-Abenoz, swarthy, hook-nosed, with a square-cut graying beard, lounged in a low chair across the patio; near him four or five other Caleras sat or squatted or reclined, all smoking the rank black tobacco of the country and drinking wine or brandy. Their conversation ceased as Cavu-hin-Avoran and the others approached. The chief of Careba listened to the introduction, then heaved himself to his feet and clapped the newcomers on the shoulders.

"Good, good!" he said. "We know you Jeseru people; you're honest traders. You come this far into our mountains too seldom. We can trade with you. We need weapons. As for the sort of slaves you want, we have none too many now, but in eight days we will have plenty. If you stay with us that long—"

"Careba is a pleasant place to be," Ganadara said. "We can wait."

"What sort of weapons have you?" the chief asked.

"Pistols and rifles, lord of my father's sister," Coru-hin-Irigod answered for them. "The packs have been taken to my house, where our friends will stay. We can bring a few to show you, the hour after evening prayers."

Nebu-hin-Abenoz shot a keen glance at his brother-in-law's son and nodded. "Or, better, I will come to your house then; thus I can see the whole load. How will that be?"

"Better; I will be there, too," Cavu-hin-Avoran said, then turned to Gathon Dard and Antrath Alv. "You have been long on the road; come, let us drink cool wine, and then we will eat," he said. "Until this evening, Nebu-hin-Abenoz."

He led his son-in-law and the traders to one side, where several kegs

stood on trestles with cups and flagons beside them. They filled a flagon, took a cup apiece, and went over to a pile of cushions at one side.

As they did, three men came pushing through the crowd toward Nebu-hin-Abenoz's seat. They wore a costume unfamiliar to Gathon Dard—little round caps with red and green streamers behind, and long, wide-sleeved white gowns—and one of them had gold rings in his ears.

"Nebu-hin-Abenoz?" one of them said, bowing. "We are three men of the Usasu cities. We have gold *obus* to spend; we seek a beautiful girl, to be first concubine to our king's son, who is now come to the estate of manhood."

Nebu-hin-Abenoz picked up the silver-mounted pipe he had laid aside, and re-lighted it, frowning.

"Men of the Usasu, you have a heavy responsibility," he said. "You have the responsibility for the future of your kingdom, for a boy's character is more shaped by his first concubine than by his teachers. How old is the boy?"

"Sixteen, Nebu-hin-Abenoz; the age of manhood among us."

"Then you want a girl older, but not much older. She should be versed in the arts of love, but innocent of heart. She should be wise, but teachable; gentle and loving, but with a will of her own—"

The three men in white gowns were fidgeting. Then, suddenly, like three marionettes on a single string, they

put their right hands to their mouths and then plunged them into the left sleeves of their gowns, whipping out knives and then sprang as one upon Nebu-hin-Abenoz, slashing and stabbing.

Gathon Dard was on his feet at once; he hurled the wine flagon at the three murderers and leaped across the room. Antrath Alv went bounding after him, and by this time three or four of the group around Nebu-hin-Abenoz's chair had recovered their wits and jumped to their feet. One of the three assailants turned and slashed with his knife, almost disemboweling a Calera who had tried to grapple with him Before he could free the blade, another. Calera brought a brandy bottle down on his head. Gathon Dard sprang upon the back of a second assassin, hooking his left elbow under the fellow's chin and grabbing the wrist of his knife-hand with his right; the man struggled for an instant, then went limp and fell forward. The third of the trio of murderers was still slashing at the fallen chieftain when Antrath Alv chopped him along the side of the neck with the edge of his hand; he simply dropped and lay still.

Nebu-hin-Abenoz was dead. He had been slashed and cut and stabbed in twenty places; his throat had been cut at least three times, and he had almost been decapitated. The wounded Calera wasn't dead yet; however, even if he had been at the moment on the operating table of a First Level Home Time Line hospital, it was doubtful if he could have been saved, and under the circumstances, his life-expectancy could be measured in seconds. Some cushions were placed under his head, and women called to attend him, but he died before they arrived.

The three assassins were also dead. Except for a few cuts on the scalp of the one who had been felled with the bottle, there was not a mark on any of them. Cavu-hin-Avoran kicked one of them in the face and cursed.

"We killed the skunks too quickly!" he cried. "We should have overcome them alive, and then taken our time about dealing with them as they deserved." He went on to specify the nature of their deserts. "Such infamy!"

"Well, I'll swear I didn't think a little tap like I gave that one would kill him," the bottle-wielder excused himself. "Of course, I was thinking only of Nebu-hin-Abenoz, Safar receive him—"

Antrath Alv bent over the one he had hand-chopped.

"I didn't kill this one," he said. "The way I hit him, if I had, his neck would be broken, and it's not. See?" He twisted at the dead man's neck. "I think they took poison before they drew their knives."

"I saw all of them put their hands to their mouths!" a Calera exclaimed. "And look; see how their jaws are clenched." He picked up one of the

knives and used it to pry the dead man's jaws apart, sniffing at his lips and looking into his mouth. "Look, his teeth and his tongue are discolored; there is a strange smell, too."

Antrath Alv sniffed, then turned to his partner. "Halatane," he whispered. Gathon Dard nodded. That was a First Level poison; paratimers often carried halatane capsules on the more barbaric time-lines, as a last insurance against torture.

"But, Holy Name of Safar, what manner of men were these?" Coru-hin-Irigod demanded. "There are those I would risk my life to kill, but I would not throw it away thus."

"They came knowing that we would kill them, and took the poison that they might die quickly and without pain," a Calera said.

"Or that your tortures would not wring from them the names and nation of those who sent them," an elderly man in the dress of a rancher from the southeast added. "If I were you, I would try to find out who these enemies are, and the sooner the better."

Gathon Dard was examining one of the knives—a folding knife with a broad single-edged blade, locked open with a spring; the handle was of tortoise shell, bolstered with brass.

"In all my travels," he said, "I never saw a knife of this workmanship before. Tell me, Coru-hin-Irigod, do you know from what country these outland slaves of Nebu-hin-Abenoz's come?"

"You think that might have something to do with it?" the Calera asked.

"It could. I think that these people might not have been born slaves, but people taken captive. Suppose, at some time, there had been sold to Nebu-hin-Abenoz, and sold elsewhere by him, one who was a person of consequence—the son of a king, or the priest of some god," Gathon Dard suggested.

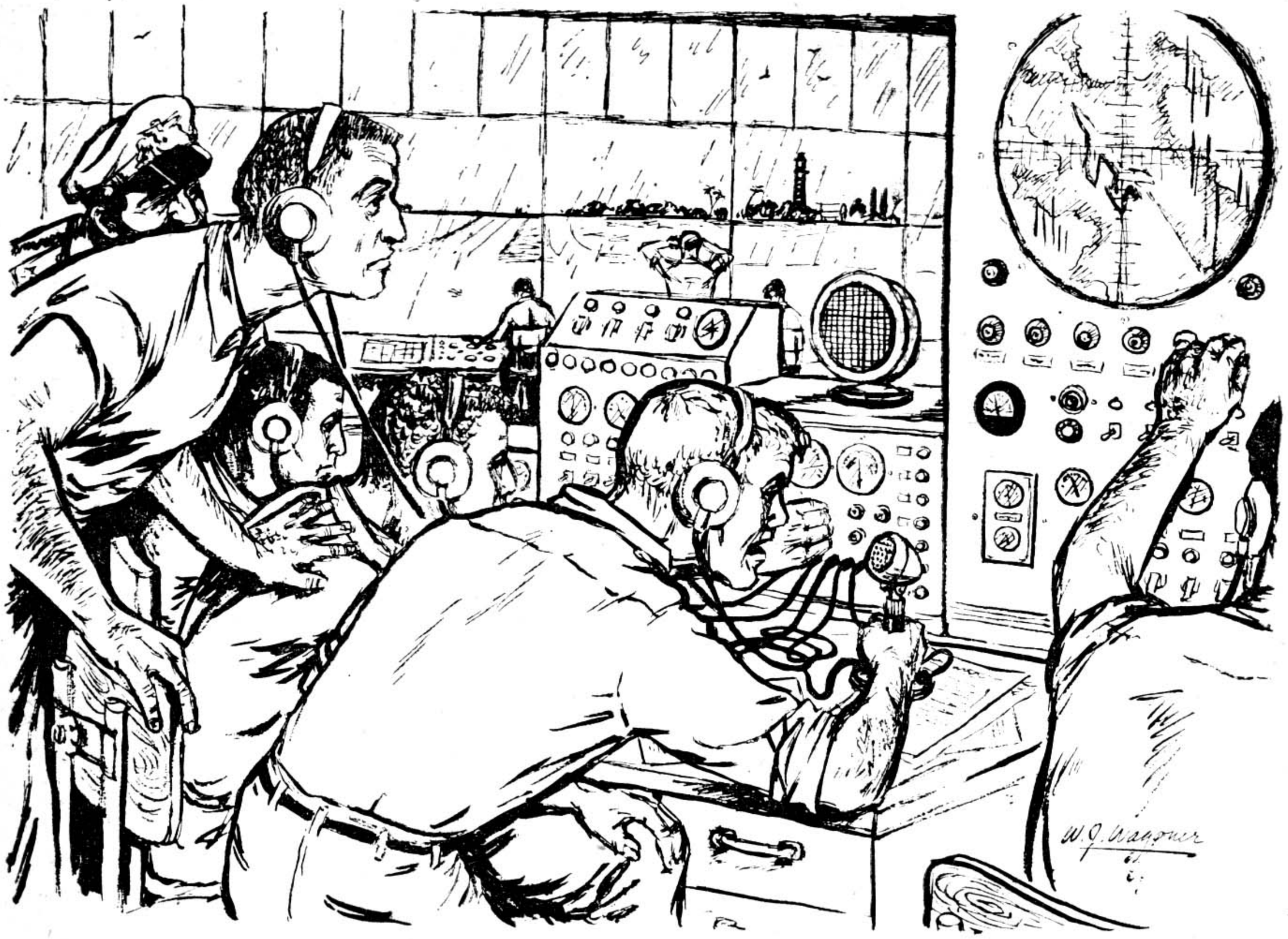
"By Safar, yes! And now that nation, wherever it is, is at blood-feud with us," Cavu-hin-Avoran said. "This must be thought about; it is an ill thing to have unknown enemies."

"Look!" a Calera who had begun to strip the three dead men cried. "These are not of the Usasu cities, or any other people of this land. See, they are uncircumcised!"

"Many of the slaves whom Nebu-hin-Abenoz brought to Careba from the hills have been uncircumcised," Cour-hin-Irigod said. "Jeseru, I think you have your sights on the heart of it." He frowned. "Now, think you, will those who had this done be satisfied, or will they carry on their hatred against all of us?"

"A hard question," Antrath Alv said. "You Caleras do not serve our gods, but you are our friends. Suffer me to go apart and pray; I would take counsel with the gods, that they may aid us all in this."

TO BE CONCLUDED



DESIGN FLAW

BY LEE CORREY

What's a test-pilot going to say when the crack-up of the magnificent new ship came because . . . **he went to sleep!**

Illustrated by Wagoner

The paint forming the word "EXPERIMENTAL" blistered from the hull as the ship screamed down out of the exosphere, its needle nose and sweeping wings glowing from the ram-compression heat.

Just as predicted decades earlier by Sänger and Tsien and calculated by engineers over their drawing boards, the flow of thin air over the wings caused lift, and the ship eased into a rib-cracking high-g turn as it started the first of the zooms which would carry it along the upper fringes of the atmosphere like a stone skipping across water.

But it didn't skip; that was not the

plan. Once the ship leveled out, Cal Justin fought his way up through the thick pressure of many g's and kept the nose level.

There wasn't much air at the altitude the KX-238 was at, but it was enough to sustain the transcontinental rocket in level flight and heat the hull to the point where it was ready to peel from the ship. In addition, the combination of the velocity of the ship, the heat of its hull, and the rarity of the air caused it to ionize a path over a mile wide through the ionosphere like a meteor.

Cal wasn't very comfortable with the heat and the deceleration due to drag, but he got his breath again and touched the mike switch on the control wheel. "Titwillow Base, this is Santa Claus. Re-entry successful. In level flight and on track. Over."

An impersonal voice just barely touched with a note of excitement sounded in his headphones, "Roger, Santa Claus from Titwillow Base. Your body-telemetering is out. No carrier on Channel Three; eighty-five microvolts on Channel Two. Can you see the antennas? Over."

Cal looked out through the double-paned ports over the glowing nose of the rocket, then turned and glanced back along the long, long hull to the swept wings and fins. "Titwillow Base, this is Santa Claus. It looks awful hot around those slot antennas. Over."

"Roger, Santa Claus. Blue Blazer Range reports they are picking you up on acquisition radar now. Are you ready to sync in with them for approach and landing? Over."

Concurring briefly, Cal leaned forward to adjust the vernier settings on the approach and landing instruments. Below him, the Ozarks were speeding past and fading into the distance over the curve of the Earth. The Mississippi River was crawling beneath him, and the Atlantic Ocean was just barely visible on the eastern horizon. But he didn't look; he didn't have time.

Someday, he told himself, *I'm going along as a passenger and rubberneck out the windows*. He'd never had a good look at what went on outside, not even during the runs with the *Super Skyrocket*, the X-12, and the Triple-X. He'd always had his hands full just flying the beasts.

The KX-238 was no exception. The transcontinental rocket was merely a protype, the pilot model for those which would come later, rolling off the assembly lines by the hundreds to arc over the continents and oceans. But she had to be proved first; she had bugs, and Cal had to ride her to find those bugs.

The ship was lower now, and a new voice came over his headset. "Santa Claus, this is Blue Blazer. We are locked on you. Ready to commence approach phase. Over."

"Santa Claus ready to commence approach." The ship was heading for a relatively tiny air base on the East Coast. At the speed the KX-238 was

traveling, Cal might miss the coast itself. A souped-up, improved, and purely experimental instrument-landing system would bring him in over the field for a landing.

"Blue Blazer commencing track and guide."

Little lights and green-glowing screens on the hooded panel before him came to life. Tensely and anxiously, he focused his attention on them to the exclusion of all else and tried to fly the ship by what they told him.

The terrain below began to show the works of men now, had he been able to watch. It was warm in the tiny cockpit, and the drag-induced deceleration kept him thrown forward against the webbing of his harness.

It might have been a combination of these things, he told himself, or the persistent drone of Blue Blazer's voice over the headphones. But whatever it was, he was getting very sleepy. Not even the vibration of the ship slowing through the transsonic region snapped him out of it.

Then Blue Blazer's voice became excited in his ears, but he didn't notice it. The panel began to show danger and warning, but he didn't notice that either. Instead, he fell slowly and surely to sleep.

It was like being at the bottom of a well filled with ink. As he slowly fought his way toward the surface, the voices came to him from beyond the thick, muddy blackness.

". . . Was very lucky . . . straps and harness saved him . . . that ship must have been stressed better than an ordinary plane—No, nothing a couple weeks here won't mend—"

The blackness got lighter and gave way to gray.

". . . Body telemetry was out, or else we'd have some indication of how many g's he took on impact . . . would certainly like to know that—"

The gray got lighter. Then it was pure-blinding white.

"Hold it! He's regaining consciousness—"

Now there was pain—pain in his arms and legs and a throbbing, searing hurt in his chest that made it difficult to breathe. Pressure told him he was on his back, and other tactile senses reported he was between linen sheets.

It was like waking from a dream, like waking from—

Only then did he remember: *I fell asleep! I cracked up the ship!*

He knew he was still alive, but now he wished that he'd died.

". . . Still shocky . . . be all right—"

Another voice, a familiar voice, came through the haze to him. "Cal . . . Cal, this is Don Karlter. Can you hear me, Cal?"

He didn't remember nodding.

"Good show, Cal! Beautiful landing in spite of the failure—"

Failure? No failure but mine!

"The boys are studying the wreck-

age now. Dwight says they've found the failure. It was mechanical. He says the elevons tore clean off their hinges because the servos—"

Mechanical failure? But I fell asleep! Or did I? It must have been mechanical failure! I couldn't have fallen asleep! I was too excited to fall asleep! Who'd ever believe I fell asleep?

But as he sank back down into that well of blackness, he knew that he *had* fallen asleep—because he couldn't remember having crashed. Illogical . . . impossible . . . but it had happened.

He felt uncomfortable sitting in the chair. The slings and casts on both arms made him feel helpless, and he was sweating under the elastic bandage wound around his rib cage. Don Karlter put a cigarette into his mouth and lit it for him.

And he had a hard time telling himself to keep quiet. There were serious faces gathered around Don Karlter's desk—engineers in their casual, open-collared shirts, and the military men in their all-alike, somber uniforms.

"How are you feeling now, Cal?" Don asked him after the group was seated.

Cal rolled the cigarette to the corner of his mouth and grinned. "Outside of the busted wings and a couple holes in my mouth where teeth ought to be, I'm feeling fine—like a duck without feathers!"

"You can consider yourself lucky to get off that easy," Don said with just the hint of a smile playing around the corners of his mouth. "Not very many guys have survived a smash-up like that. Somehow, you must have been completely relaxed when she hit." The rocket engineer turned to the group, his undershot lower jaw protruding from his long, thin face. He put on his horn-rimmed glasses, shoved his sparse, sandy hair out of his little eyes, and put his bony hands on the table. "Let's get do the business at hand, boys. Here's where we stand: mechanical failure in the wing structure and servo system. We don't know why. Anybody got an idea?"

"The same types of components rode the KX-238 that were in the *Griffon I*," Bill O'Brien, the controls man, remarked.

"But the *Griffon* was a box-kite compared to this one," Ed Alcott told him. "We flew a lot of new stuff this time."

"True, true," O'Brien mused. "But it was the same type of gear . . . basically. It should have worked fine—"

"But it didn't," Karlter pointed out. He drummed the desk top with his fingernails. "Boys, here at White Sands our toughest problem has always been reliability. It's difficult to get something to work the same way every time. Some engineering sciences have licked the reliability problem, but it looks like we're still stuck with it."

"Reilly's Law," Guy Barclay said cryptically.

"Huh?"

"Reilly's Law," Guy repeated. "It states that in any scientific or engineering endeavor, anything that can go wrong *will* go wrong."

"Very true in rocketry," Karlter admitted. "So we've got to put in components we know to be reliable to the *nth* degree."

"But it was a basic design flaw as well," Dwight Jacobs objected.

"That it was." Karlter was the project engineer, a man with long experience in rocketry. He knew what such a thing meant. "So we do something about it. Guy, freeze construction on Number Two. We go back to the drawing boards and labs for complete redesign."

"A major modification," O'Brien said with disgust. "We always think we have the problems licked . . . until the first one flies. Then we've got to go back and do it all over again! One of these days I'm going to quit engineering and start teaching."

Captain Quinn laid his stripe-laden cuffs on the desk, folded his big, competent hands, and spoke for the first time. "Justin, we've all studied your flight report, but I'd like to ask you a few questions—"

"I tried to put down everything," Cal said.

"I know," the Navy aero-medical man said quietly. "I don't question the fact that your report seems rather sketchy when the ship went out of control; we can't expect keen observation under stress conditions like that. But it just seems rather strange to me that everything went fine during the re-entry phase and then went haywire later on. Re-entry was the touch-and-go proposition both ship-wise and pilot-wise—or so we thought. What were your express feelings during the supersonic glide phase? How did the ship handle? What was your general attitude? Was there any question of failure in your mind?"

"No, after I got out of re-entry, I knew the rest would be fine. I don't recall too clearly just what I was thinking, but I wasn't worried," Cal told him. "The ship was a little touchy on the controls, but I expected it. The Triple-X was the same way at high Mach-numbers."

"Did control get touchier in the transsonic just before failure occurred?" O'Brien asked, rubbing his forehead with the eraser on his pencil.

"I . . . I don't know exactly," Cal replied carefully. "The last part of the flight is still a little confused—"

"I can understand that," Karlter put in. Don Karlter knew that if no one else in the room did. He had been the first man to ride the *Griffon I*, the original long-range manned rocket that was the prototype of the KX-238. "Cal, you won't be in shape to ride the next one, but I want you to monitor the re-design. You're Johnnie-on-

the-spot; you've actually ridden in the beast. Do you have any recommendations right now before we get into the re-design work?"

"Nothing right now. I don't know exactly what you plan to do. So you guys talk," he suggested, shifting in his chair to let cigarette ashes drop off onto the floor. "I'll put in my two-bits' worth where I can."

The conference dragged on for hours as the engineers tried to understand the failure and design it out of the next ship. It seemed illogical to some of them that the failure had happened the way it did. But they knew from the wreckage that it *had* happened, and they therefore attempted to find the logical reason for it.

They never questioned Cal Justin's report. He was an experienced test pilot. He knew his report was accurate, but he also realized it was incomplete. He felt very uncomfortable during the entire meeting.

Faced with having to do something, the engineers worked out an approach to the problem. They went back to their offices, and the modification and re-design of the KX-238 transcontinental rocket began.

In the ensuing months as the form of the KX-238A took shape in the hangar at White Sands, Cal kept busy doing what he could. As with any project, there were a hundred small "fires" to put out each day—endless trifling jobs and decisions which had to be made. Since his left arm had set improperly and had been reset, he found himself on ice as far as riding the A-model went and therefore spent many long hours checking-out the relief pilot, Ralph Simmons, on the operations involved in flying the KX-238A.

But he was not the same Cal Justin who had stepped through the hatch of the KX-238 that morning several months ago. His wife noticed the change before anybody else did, and she brought it up one evening at supper.

"You've been working terribly hard, haven't you, dear?" Diane asked as she noticed him toying with his food. This was unusual, for he normally had an appetite which would do credit to a wolf.

He looked up and managed a smile. "Work hard with a busted wing? Don't kid me, hon."

"Is it your arm that's bothering you then?"

"Some. I don't like being crippled-up, even though I know I was lucky to get off as easy as I did."

Diane knew by this time not to make any fuss about her husband's dangerous work and usually kept silent. Like many a test pilot's wife, she worried herself sick about him when he was aloft, but she didn't mention the fact once he was on the ground again. The two of them had learned early in their married life that such discussions definitely didn't strengthen

their marital relations, particularly when Cal's job meant their bread and butter. However, this time she plunged boldly ahead and remarked, "You didn't look very rested the morning you left to fly that ship, Cal. If it was due to that little argument we had the night before about going to dinner with the Ogilvy's—"

"No, but—"

"You looked tired when you left. I hope you weren't mad; I said I was sorry—"

"I know you did, hon . . . but I *was* a little bushed that morning. I wonder if—Well, never mind."

She got up and put her arms around his shoulders. "Cal, dear, what's been bothering you lately? You've been moody and quiet—not at all like yourself. Is it because you crashed the ship? Is that it?"

"Yes—" He put his napkin on the table.

"Because you didn't get enough sleep the night before?"

He got up suddenly, pulling away from her. "I don't know, Diane. I just don't know. The engineers say it was a mechanical failure . . . and that I'm not to blame."

She faced him and asked, "Then why are you worrying?"

"Because it *was* my fault! But I can't explain it—"

"What happened, dear?"

"I . . . I went to sleep at the controls."

"You . . . went . . . to sleep?" his wife asked incredulously. "But how?"

"Sounds impossible, doesn't it? I don't understand it myself."

"Have you told Don Karlter?"

"No—"

"But, why not?"

"Do *you* believe I really fell asleep?"

"I . . . I don't know," she said, taken aback. "How could you have gone to sleep flying a dangerous ship?"

"Well, you've just answered your question. I haven't told anybody but you, because who's going to believe me? I was all teed-up to a fair-thee-well flying that ship; I *had* to be! I was on edge, nervous, touchy, and under some rugged physical strain. So how could I have fallen asleep?" He sat down again and let her perch on his lap with her arms around him. "Now do you see? How can I tell them that without knowing *why* I fell asleep? I know what the boys would say: 'Old Cal took a pretty rough shaking-up in that crash, you know—and maybe he's not flying straight yet.' Well, maybe I'm not, but that's what happened."

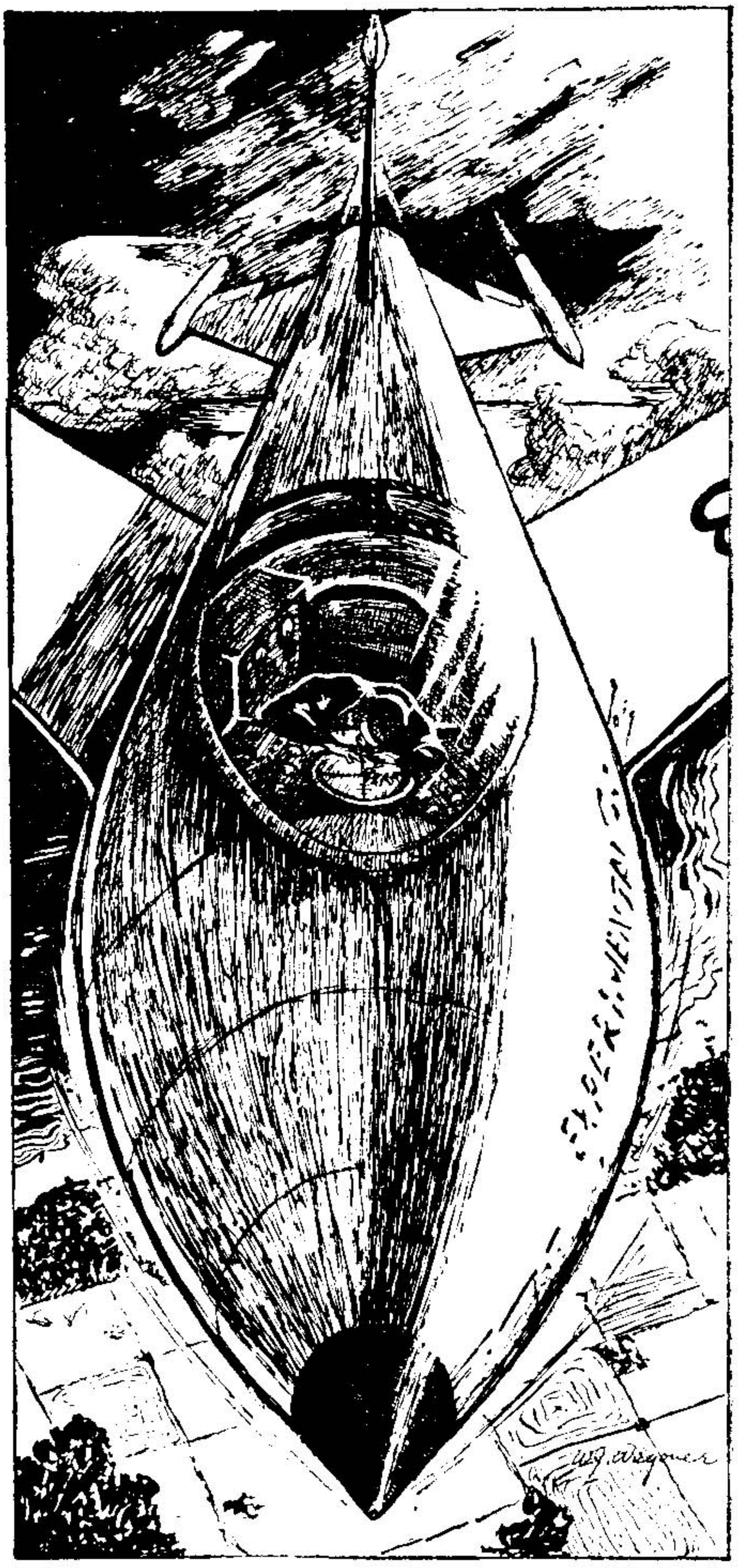
"But it might be something important, sweetheart," Diane suggested. "Maybe something they didn't know about before . . . something due to the high altitude or the speed—"

"Three previous flights were made without incident of this kind in the *Griffon* rockets," he said, shaking his head. "They've been making high-

altitude mammal flights all the time for the past couple decades. Nothing like this has ever shown up. There was no logical reason for it to happen at all." He paused while he got out cigarettes for both of them, then went on, "I guess I shouldn't worry. They've found a mechanical flaw in the design that may have been the real cause. So I'm not to blame for it. But I keep wondering about Ralph—" He shrugged. "I don't know; if Ralph does fine, we'll forget it. About the only thing I can do right now is to keep quiet or get tossed in the booby hatch for the head doctors to play with. Keep it under your lid, too, hon . . . if you believe it."

Somehow, he sensed that she didn't. After all, he had been through a serious crash, hadn't he? And couldn't this be part of the mind's protective mechanism blanking out memories of pain by conveniently forgetting the moments leading to the crash—and making him believe he'd fallen asleep?

He'd thought about that– but he still *knew* he had gone to sleep.



"Now after you horse it out of the dive, Ralph, don't forget to make sure Red Dog is tracking you from Florida. We don't want to search the Atlantic Ocean for you," he explained for the hundredth time as he knelt by the pilot's chair helping Simmons into his straps and telemetry gear.

The KX-238A was fueled and ready to go. Karlter and his boys weren't taking chances this time; they'd planned for a short hop from White Sands to Florida.

"Red Dog will lock on you, and from then on it's just like riding an ILS instrument landing," he went on. "Just watch the panel, and you can't miss the field. They'll have three F-200's to chase you in, but you'll be

guided by the landing radar. It checks and rechecks its solutions about thirteen times a second to keep you on the right course. The dope it gives you is the real stuff; trust it instead of the seat of your pants, and don't try to navigate by contact—"

"Nothing superstitious about this bunch, is there?" Ralph remarked with a grin as he checked the blood-oxygen pickup on his ear lobe.

"Huh?"

"Thirteen reports per second."

"Oh! That's just what the computer happens to be set up for. The landing system's still pretty much in the development stage, making old equipment do new things, you know. It has something to do with the rate of their radar antenna sweep and track frequency, or something." He felt of the straps, then slapped Simmons on the shoulder. "Good luck, chum. We'll be waiting for that post card from Miami Beach!"

Simmons gave him the thumbs-up.

The take-off went smoothly. Cal watched from the roof of the White Sands "C" Control Center as the KX-238A drove for the sky, her boosters separating clean and on schedule. When the call for cut-off came over the speakers, and the tiny star in the sky winked out, he went downstairs to the radar plot room.

There was an air of quiet, orderly confusion around the plotting boards as men leaned over them, marking the thin pen traces with timing notations. He went over to the Z-plot—the vertical trajectory presentation—where Don Karlter was watching the trace with a nervous expression on his long face.

Simmons got it through the re-entry pull-out without trouble. His voice came over a loud-speaker on the wall, "Hello, Chloroform Base, this is Fragrant Annie! Re-entry normal! Standing by to ride Red Dog. Approach! Over!"

Cal watched the radar plot anxiously as Red Dog radar picked up the ship. The pen on the plot board was racing along now. On the horizontal chart, it was whizzing across the outlined map with amazing speed.

"This is Fragrant Annie! Riding Red Dog now! Some heating around vital spots, but not bad. She's flying smooth."

Thirty seconds dragged by, then it happened. The pen wiggled. Don Karlter grabbed for the microphone and shouted, "Fragrant Annie, this is Chloroform! You're all over the sky! What's going on? Over!"

The silence that came back fell like a thunderclap among the men. Karlter pushed the mike button again. "Fragrant Annie, acknowledge Chloroform! Acknowledge! What's the matter? Over!"

"Don!" Bill O'Brien called out from his position by the telemetry recorder. "Something's happened to him!"

Captain Quinn's voice boomed out

"His body telemetry indicates he's unconscious!"

"What? why?"

"I don't know! Respiration down, pulse retarded—He's out like a light!"

The teletype against the wall linking them with the Florida radar stations began to rattle insistently. Dwight Jacobs stepped over and read it aloud as it was being printed.

"RDX TO CHLO BASE. URGENT URGENT. FRAGRANT ANNIE NO COMMUNICATION. CHASE PLANES REPORT FRAGRANT ANNIE LOSES CONTROL IN DIVE. ADVISE. ADVISE. DE RDX BY 3320 0957."

"Ralph! Ralph! Answer me!" Karlter yelled over the mike.

The radar plotting pen described a series of erratic maneuvers and came to rest suddenly. The teletype started up again.

"RDX TO CHLO BASE. FRAGRANT ANNIE IMPACT REPORTED BY CHASE PLANES TWO HUNDRED MILES NNW. WASHOUT. REPEAT TOTAL WASHOUT. RECOVERY PARTY UNDER WAY. DE RDX 3320 0959."

Don Karlter put down the mike and turned slowly from the plotting board. "Number Two down," he said in a hoarse whisper. "Why? What caused it? What knocked him out? Why? WHY?"

O'Brien was removing the film canister from the telemetry recorder. "We'll have the film this afternoon," he said as he started for the door.

"I want to see that film in one hour flat!" Don suddenly snapped. "Captain, get the Air Force aero-med boys in on this one as well. I want to find out what happened—"

Cal Justin knew what had happened. Simmons had fallen asleep.

But he didn't say anything. He was too sick to say anything. Instead, he stood stonily by the plotting board, frozen with his thoughts.

Because he hadn't spoken up, Ralph Simmons had died. The report confirming that was being quietly read aloud by Dwight at the teletype.

Because he hadn't spoken up! *But also because he could not speak up!*

He went home. He couldn't bear to stay around for the post-mortem over the telemetry films showing how a man died.

"Pilot error?" Karlter snorted, pacing back and forth behind his desk. He tripped over the telephone cord, swore, then glared at each man gathered in the room. It was the same group as before. "I'd call it pilot *failure*! Quinn, what's your opinion?"

The Navy flight surgeon shook his head as though he were in a daze. "I don't understand it. I just don't understand it at all. He wasn't under excessive acceleration. The cabin temperature was tolerable with the suit he was wearing. There was absolutely no indication of anoxia or explosive decompression at all. The records look

like he fainted! His pulse and respiration took a jump as though he were suddenly frightened, and then he went unconscious! It doesn't make sense, Karlter. He lived through more than 10g on re-entry pull-out, then passed out cold in level flight heading in for a landing. In all my experience with naval aviation—"

"How's his wife, Cal?" Bill O'Brien suddenly asked.

"Pretty bad," the test pilot said sadly. "The final jolt is always rough, although both she and Diane know something like this may happen and are forced to live with it."

"Does she want his body shipped back here—what's left of it, I mean?"

Cal shook his head slowly. "She believes that shipping dead bodies around and having funerals is barbaric. She merely asks us to throw his ashes into the jet stream from an F-200."

Karlter was still pacing, ignoring the conversation. He suddenly burst forth in exasperation, "Two ships! Two ships--and one pilot!" He took a deep breath and set his long jaw. "But we're not giving up. We'll take one more flier at it. O'Brien, how soon can you make arrangements for us to get access to the NBS flight simulator?"

"I'll call Washington right now," Bill replied, reaching for the phone.

"Never mind; after this meeting," Karlter waved him off. "Dwight . . . Tex . . . Sam . . . Irv . . . all of you! Sit down over the plans and specs for the 238A and study them like they've never been studied before."

"What should we look for?" Dwight asked.

"You decide! You're the engineers on this project! You saw the flight records! Try to find out what happened! Cal, does this strike a bell with you? How does your interpretation of the records jibe with what you recall from your flight?"

"It looked normal . . . until the last. I can't tell you what happened before I crashed; it's confused. Things happened so fast that—" Cal tried to explain.

"O.K., O.K.! Captain, I'd like to have a palaver with the boys at Patuxent . . . day after tomorrow. Can you leave tonight and arrange for it?"

"What's the purpose?" Quinn asked quietly.

"Cal's going with me. He's riding the next ship. We should put him through his paces in the aero-med flight simulators and centrifuges to find his tolerances, limits, reactions, and other pertinent data so we can have something to go on in case he doesn't make the grade."

"Can do. I'll be out of here this evening."

Karlter turned to the test pilot. "Cal, better get ready to leave tomorrow. You're the only man who's ridden a 238 and lived. You've suddenly become very important to this project!"

Cal's face remained impassive.

The flight to Maryland was rough. One jet engine had a flame-out at thirty-five thousand feet while they were trying to clear some frontal weather over Tennessee, and the remainder of the flight was made under conditions of anxiety. Cal didn't get much sleep. He kept thinking about his crash—and Simmons. And he wondered whether or not the jetliner would have another flame-out. It would be rather ironic for him, a test pilot of hot aircraft and rockets, to expire in the crash of a scheduled commercial airliner.

At Patuxent, Cal was immediately thrown into an intensive series of medical checks. He failed most of them miserably. In the centrifuges where he was whirled at high-g with little instruments strapped to his body, he passed out cold at 2.15 g, far below normal tolerance. During the several seconds of free-fall in a supersonic jet flying a ballistic trajectory, he completely lost his orientation and became violently sick. He didn't get a chance to endure explosive decompression, extreme heat, and the rest of the hair-raising experiments he was scheduled for. The aero-medical men gave him a flat thumbs-down as far as riding anything hotter than a private plane.

Alone in his temporary quarters the night following his down-check, he smoked chain cigarettes and paced the floor. But by eight o'clock, he was so dead-tired that he fell asleep on the bed with his wrinkled clothing still on.

Don woke him later to tell him that they were going back to New Mexico in the morning, but Cal was too tired to remark.

At three o'clock in the cold hours of the morning, however, he woke up sweating. Sleep was suddenly useless. Without turning on the light, he went to the small window and started to chain-smoke again. The sky was beginning to gray in the east, but a clammy fog was rolling in from the Atlantic Ocean, shrouding the buildings in a hazy cloak. The winking red lights of the control tower and radio antennas jabbed upward into the murk, and from the direction of the flight line came the unmistakable muted thunder and whine of a high-thrust turbojet getting under way. Below the window, lonely street lights shone back from the glossy-wet pavement.

What could he say? How could he go to Don Karlter and tell him what had to be told? He stood there berating himself.

"I'm a coward," he told himself in a hoarse whisper. "A weakling. I can't tell them the 238 put me to sleep. They'd think I was weak—like the tests just showed. But I've *got* to tell them . . . and make them believe it. Otherwise they're going to go on killing pilots. Ralph was killed because I didn't have the guts to tell them. Ralph died because of something I didn't let them know."

He *had* to break silence; he couldn't

go on living this way. But how?

The time was coming when another pilot—not he any more—would have to face that looming, unknown specter, that ghost of Morpheus which had already claimed two ships and the life of a man.

"I'm not going to let them kill another one!" he said to himself. "I've *got* to find out what happened! I've got to find out why I went to sleep!"

The next morning, after a very restless night, Cal discovered himself at loose ends. Don was suddenly called into a high-level conference with some brass that had come from Washington. Possessed of a visitor's badge which gave him clearance to the technical areas, Cal decided to lose a few hours in the technical library. He was feeling absolutely miserable, and needed the several hours' relaxation of the common spare-time duty of a specialist: keeping up with progress in allied fields.

He spent a good half-hour rummaging through the unclassified commercial magazines and finally signed into the classified area. Digging out a few of the late flight reports on the Quad-X and X-17 research planes, he settled himself at one of the long tables.

The young lieutenant commander across from him was evidently one of the aero-medical men from the Patuxent center, for he wore the insigne of a naval flight surgeon. A stack of reports and journals covering various phases of aviation medicine was piled in front of him.

Cal went over the first report on the Quad-X, becoming engrossed in it to the exclusion of all else. His troubled mind found relaxation in the precise language and the tightly logical equations. He was about to go on to the second report when he noticed the title on the cover of a journal lying in front of the boyish commander.

"Pardon me, commander, may I have a look at that journal when you've finished with it?" he asked in a whisper.

The naval surgeon looked up and glanced at Cal's civilian suit. "Of course," he remarked, handing it across the table. "It's unclassified—one of the new journals on physio-psychological research. A bunch of promising work, even if some of their theories are a bit wild."

Cal studied the index printed sternly on the brown cover and opened it to the article he was interested in.

The title was, as is sometimes common, quite long:

"*A Report of Some Theoretical Investigations Into Neurological Feedback by Aural and Visual Senses, Including Preliminary Reports of Studies of Infra-Sonics, Flicker, Narcolepsy, and Fatigue*, by Elmer T. Worthington, Ph.D., *et al*, University of Colorado."

He opened and started to read the introduction. An hour later, he was plowing his way through paragraphs of unfamiliar terminology, but the article held him. He was still studying

it when he felt a tap on his shoulder.

It was Don Karlter. "Plane leaves in thirty minutes. Let's go."

He returned the journal and left the library in a daze.

Cal had just found out *why* he had gone to sleep at the controls of the KX-238.

As usual, he was very uncomfortable riding in the airliner. He was used to flying a plane, not riding it. He missed the instrument dials in front of him, the song of the radio range in his ears, and the indications of the radar and omnirange. He kept trying to guess their altitude and airspeed until it got dark. They were somewhere over southern Missouri, he guessed.

Quinn drowsed off in his seat across the aisle. But Don Karlter kept right on studing the reports in front of him. The lights in the jetliner were low now, the only illumination in the cabin being a halo of light around the stewardesses' area and the slender beam of light on the table in front of Don and Cal. The heavy breathing of people was all around them. Through the cabin wall, they could barely hear the muffled swish and thunder of the jets pushing them through the stratosphere.

"I feel whipped," Don said disgustedly, sliding the papers back into his brief case.

Cal shook his head sadly. Don Karlter's life was and always had been the dream of space flight. He had believed so strongly in it that he had taken the Rocket Division of the Karlter Ship & Drydock Corporation and built it into the biggest rocket concern in the world. He had risked his life to ride the first of the old *Griffon* rockets, and his heart and soul were tied up in the KX-238. The transcontinental rocket was a step nearer to space flight, and he was pushing it for all it was worth. Of course, Washington knew that such a long-range manned rocket would be invaluable both as a bomber and a reconnaissance ship. But commercial firms were interested in it, too, because the rocket was becoming fast transportation.

Before the *Griffon* rockets, guided missiles had had only military uses; the Pact of Berlin had almost sounded the death knell of rocketry until Karlter succeeded in putting a man in a rocket and giving it commercial possibilities. A budding new industry was rising from the heap of old swords that had been military rocketry, and another failure at this point could set it back for decades.

Therefore, the puzzling problem of the pilot failure of the second 238 rocket had hit Don Karlter hard. Cal knew it; he could sense it in the man's actions. He had known Don for a long time, and shared with him most of his beliefs and dreams of the future of rocketry.

"Cal," Karlter went on, lighting a cigarette for himself and the test pilot,

"the two failures were not connected in the slightest. Those two in a row were probably just circumstance. The third one will probably go O.K. But *it's got to go!* A third failure in a row, regardless of reason, will send us all back to selling apples on street corners and replacing burned out bulbs in the engineering offices of Great Western Aircraft. But we've got to take the risk. We licked the mechanical failure of the first ship. Now we've got to lick the pilot failure! Cal, that's going to be up to you. You can't ride it, but you can train the next pilot. And I want you to *train* him. It all rests with the pilot now. The ship is good; as usual, the engineering product is about a hundred times better than nature's. It's the man now, Cal. I wish we could improve him, but we're stuck with only one model; no new ones are going to come along for a while! So we've got to put up with a lousy, unpredictable, weak, and fallible hunk of human being. Only this time we've got to get a pilot that won't conk out on us. We can always figure out some reason why a machine fails on us, Cal. Human beings . . . no. As the old saying goes: some people got it, some people ain't. We've got to get somebody who's got it."

You won't find him, Cal thought. *But I've got to prove it to you—and myself.*

Don lapsed into silence thereafter. Cal thought surely he would have something to say about the medical checks, but he didn't. Karlter knew what a bad crash could do to a pilot; Don had flown once.

One evening about a week after they'd returned, Cal came home, ate dinner, and told Diane, "Sweetheart, I'm going into the study for a little bit. I don't want to be disturbed. O.K.?"

She nodded and reminded him, "Please try to get to bed at a decent hour tonight, dear. I don't even remember you coming to bed last night."

"I'm a night owl by trade," he kidded her. "I never get going good until my second cup of coffee in the morning. *You're* the bright and early one around here, you know. I sometimes wonder why I didn't marry someone with the same metabolic cycle."

"Beast!" she chided him. "What are you up to now? Don't read until two A.M. It's bad for your eyes to read when you're tired."

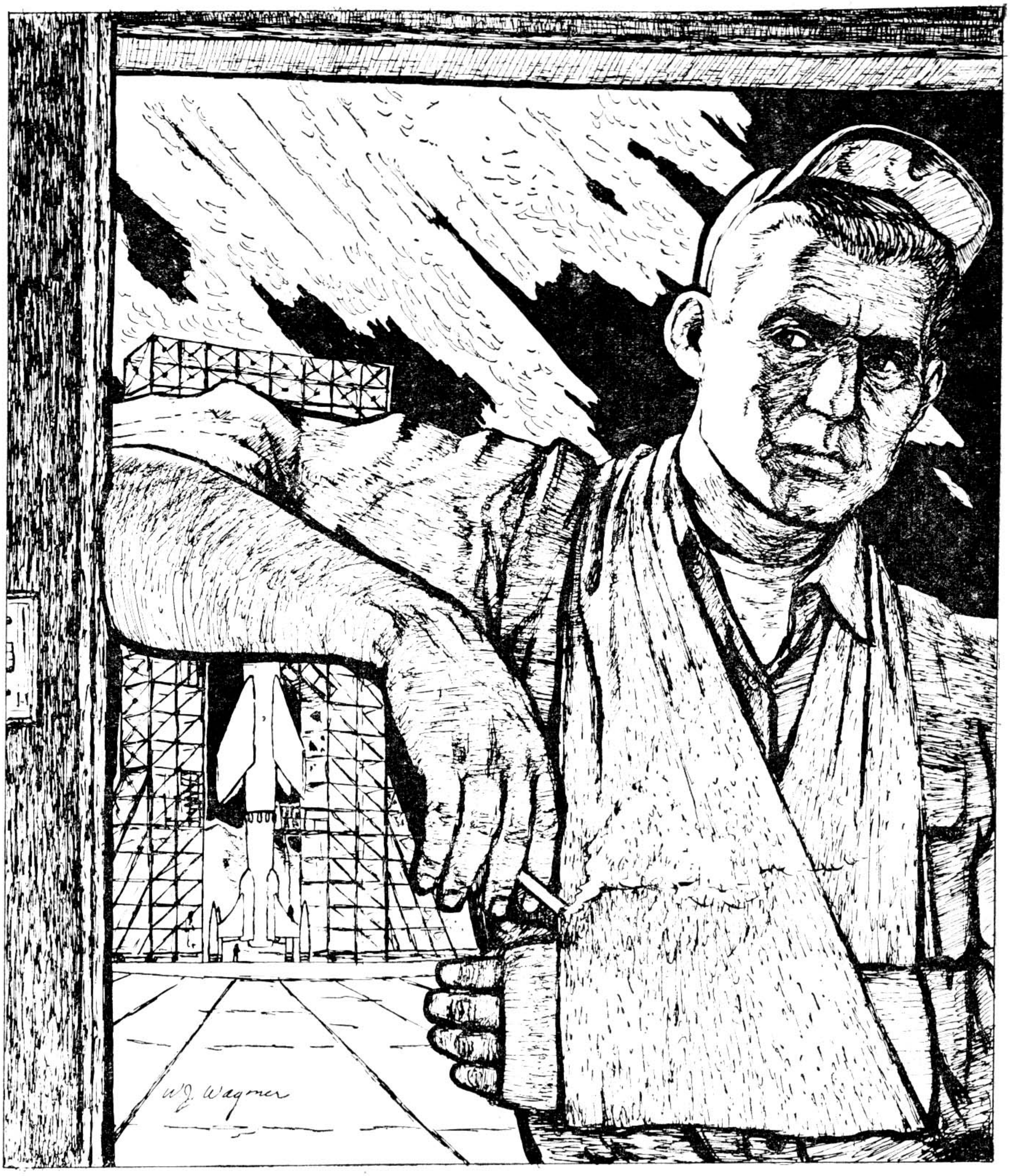
"I'm just going to do a little experimenting," he told her, getting up from the table. "It's not dangerous, but I want you to follow my instructions."

Her face suddenly got serious at the mention of danger. "What are you going to do, Cal?"

"I'm going to prove that the ship put me to sleep."

"The ship put you—Cal, are you all right?"

"I am. I think I have the problem



solved, but I've got to try it. If it works, it'll prove that the KX-238 forced me to go to sleep."

His wife looked at him strangely. "But—"

"I've got to solve it once and for all, dear. It's a hanging problem. I went to sleep; Ralph went to sleep; the next pilot will go to sleep. They'll keep on killing pilots and losing ships unless I can step in and show them just *how* the ship caused a human failure as

surely as if it clubbed him, or tossed him against the canopy, or blacked him out in a turn. I've got to show that the pilot failure is beyond the control of the pilot. Now, if I don't come out of the study in one hour—say, by eight o'clock—I want you to call Don Karlter. Have him come right over and bring Captain Quinn with him. That's all. Understand?"

Diane didn't like it, but she didn't try to stop him. She knew she couldn't. Instead of arguing further, she made up her mind what she would do as soon as Cal retired to the study. Don and Captain Quinn would know how to handle him. After all, hadn't he been acting strangely since the crash, and hadn't he persisted in this silly notion of the ship putting him to sleep?

Secluding himself in the study, Cal shut the door tightly behind him and placed an easy-chair in front of the high-fidelity record player. From a carton on the desk he took a small black box containing a large point-source of light. He dug in his pocket, hands shaking, and took out a small device he'd had made up in the White Sands' optical shop: a small glass prism with a hole along its axis and ten equal, silvered faces. This he placed over the center pin of the record turntable and fixed the light source so that it was pointing toward the prism. Setting the turntable speed at 78 r.p.m., he stepped back and put his hand on the light switch.

He knew what he was getting into. Subconsciously, his mind rebelled. With streams of sweat running down his face, he forced himself to turn off the light and sit down in the chair.

The turntable in front of him was spinning the prismatic cylinder set on its center pin. As it turned, its ten silvered sides reflected the spot of light into his eyes.

It took will power to focus his attention on it. He watched it intently for nearly thirty seconds. Then it hit him.

A terrific wave of pure, cold fear came over him, making him want to scream aloud and run. But he grabbed the chair and stayed put; after all, he kept yelling at himself, what is there to fear? Then there was pain in his arms and chest and a screaming, roaring noise in his ears. He was suddenly no longer in his den, but sitting in the cockpit of the KX-238.

Flicker, flicker, flicker—Each of the ten sides of the prism reflected light in turn to his eyes, but at a carefully predetermined frequency.

Then it began to blur, to become a glow instead of a flicker. The flashing spot of light grew in his vision until he could see nothing else. Wave after wave of drowsiness was washing over him. *I'm right! I've got it! I've found it!* he thought as he hovered on the edge of consciousness.

But even as he thought this, he was already so far gone that he didn't hear the door open, nor his wife scream.

And he didn't feel Don Karlter and Quinn trying to bring him to.

The demonstration for Karlter and Quinn later that night was also a success.

"Holy Smoke! Turn on the lights! Turn on the lights!" Don yelled. Cal flashed the overhead light on again and stopped the turntable. Karlter wiped his hand over his face. "*Wow!* It does, doesn't it?"

"Believe me now?" Cal asked.

"Hell, yes! Give me a cigarette."

Quinn was still sitting there, looking very unmilitary in an old pair of paint-smeared dungarees. He still had sawdust in his hair from his home workshop. Violently, he shook his head and rubbed his mustache, nodding slowly. "Narcolepsy. It fits," he mumbled. "Quite an effective demonstration, Cal."

"But *why* didn't you say something about it before?" Karlter wondered, indictment in his voice. "*Why?* A man rode to his death because of your silence! Why didn't you speak up?"

"Look, Don, don't act like both judge and jury. What would you have done if I had told you? Don't answer; I know. I would have been called all sorts of nasty names, and the problem would not have been solved. You'd have assigned the cause of failure to that lousy, no-good pilot and wept like mad over the loss of that perfect ship, destroyed by that lousy pilot.

"As it was, there happened to be some kind of a mechanical failure as well. Might have happened before or after the crash. But you had the trouble pinned on that mechanical flaw and would have thought I was just punchy from the crackup, so you would have ignored it. I couldn't give you a good reason because I had no data to back me up. I could have yelled to the head doctors, or charged at windmills. It might have been noble of me, but certainly not effective. I'd have already lost your respect. So I kept my mouth shut."

Karlter nodded. "Go on. You're making sense."

"You were happy about it then until Simmons cracked up . . . as I knew he would. But by that time I almost had myself talked into believing that falling asleep was nonsense. But then we were all stuck; the telemetry information—which was lacking on my crack-up—said Ralph fell asleep, which he did. Except that it was natural to assume that he'd been knocked out." He drew deeply on his cigarette and expelled smoke in a long cloud. "Boy, if you think you had a tough problem then, how about *me*? I knew I had to tell you, but I couldn't. Man, I was a coward, a weakling, a general no-good-nick! It was only after I got hold of that report," he went on, indicating the copy of the paper he'd sent for and which Captian Quinn was now reading with rapt attention, "that I *knew* what caused the failures. But, to be absolutely sure I was on the

right track, I had to rig a gimmick and demonstrate it which I just did and which has just given me a corker of a headache. Then I had to prove to both of you that a man can undergo human failure for reasons that are beyond his control and tie it down to something that could be measured so that I wouldn't be accused of merely a character failure. Me and every pilot that flew that ship. The math was perfect; the ship was perfect; the trouble was that the pilot was no good. *Ergo*, the pilot is the trouble. That's the reasoning; I remember you saying that. That *wasn't* the trouble, Don."

He walked over and sat down on the couch; his hands were still shaking, and his words were tumbling out. "I did a lot of thinking about this whole mess after we got back from Patuxent, Don. You see, we have trouble admitting that a person can be compelled. If a human being falls short, it's because of any reason except compulsion—cowardice, weakness, anything. We don't like to admit that forces external to ourselves can compel us to *want* to do something. But the psychiatrists are doing it! And remember the Communist brain-washing techniques? Man, I was up against it! Really up against it!"

Quinn lowered the book and picked up the prism from the turntable. Rolling it over in his hand, he looked at it. "Low frequencies play funny tricks with the human brain. We've known this for quite some time, Don. A fourteen-cycle audio note, for example, if presented at a level above eighty decibels, will drive a subject almost insane with fear. Physical vibration has the same effect. We just completely overlooked another aspect of it on the KX-238: *light!*"

"We sure did!" Cal cut in. "Don, this little prism on the turntable was reflecting that light source into our eyes at a thirteen-cycle-per-second rate. What is the rep-rate of the approach and landing radar guidance on the 238's panel?"

Don looked up suddenly. "Thirteen cycles-per-second!"

"Right! There's the culprit! The thirteen-per-second flicker of the screens on that panel does the same thing as that little prism. Maybe Quinn can tell you exactly what it does physiologically, but I went to sleep concentrating on that panel – and so did Ralph Simmons!"

"Actually," Quinn came in as though he were almost on cue, "the psychophysiology men are coming up with a lot of stuff that's been guesswork and rule-of-thumb until recently. According to this article—which I am going to read most thoroughly, by the way—that particular flicker frequency constitutes some sort of feedback within the brain. E.E.G. records from the occipital and parietal lobes show the alpha rhythm to be about thirteen cycles-per-second on the average. With my meager knowledge of elec-

tronics, I would say that the experts would call it positive feedback or perhaps even phase distortion. However, it's now evident that it knocks the viewer into narcolepsy. There's a lot of work to be done on it yet."

"But we can modify the landing system for the 238!" Don said with a grin.

"Sure, now that we know about it and accept the fact that it has some masty effects on the pilot," Cal put in. "I have a hunch, Don, that it's just one of the nasty little things lying around that have been overlooked and that we'll design into the ships in pure innocence. And we'll go on killing pilots because of this design flaw. I'll probably be one of them, but it's stupid to think that we can do what we intend to do without killing a few people with mistakes. Look at aviation, for example."

"You're right," Don reflected quietly. "It'll be expensive—and not only in terms of cash. But everything we've done that's been worth while has carried a payment. What really hurts is not the design flaws in our ships; they can be fixed. It's the design flaws in our culture—"

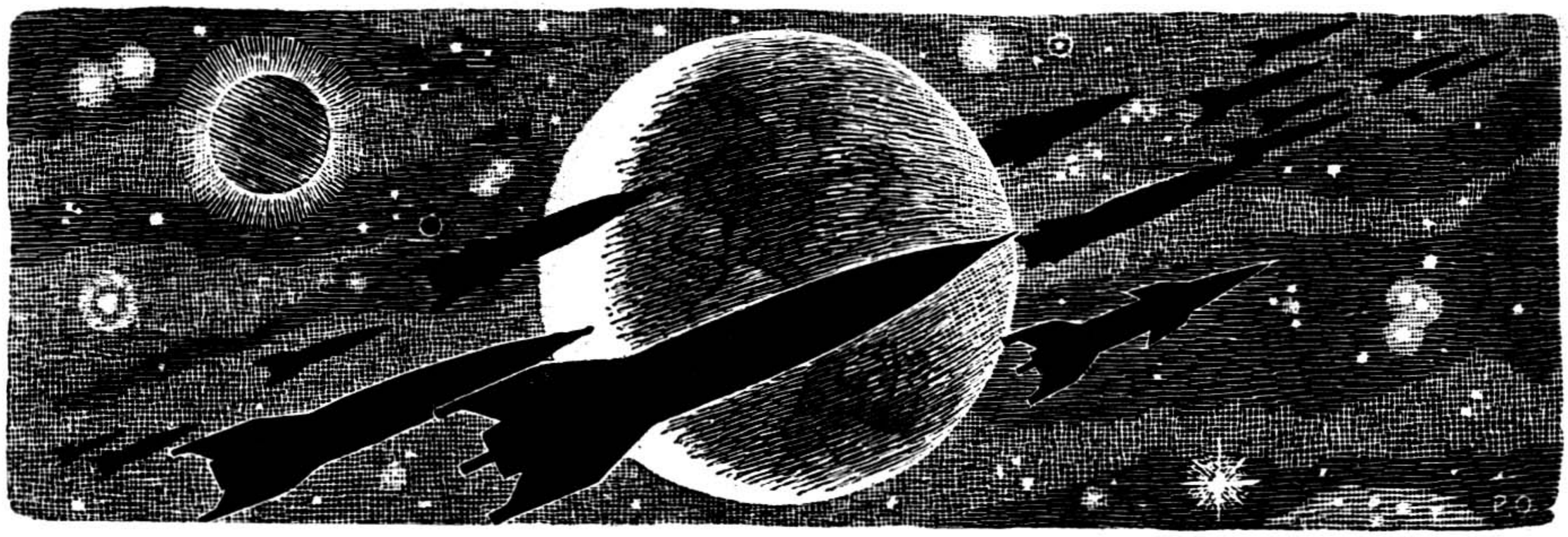
"Yeah, like the one which kept me from coming to you and saying, 'Don, Ralph died because I didn't tell you this before, but the KX-238 transcontinental rockets have a sleep-compeller built into them!'"

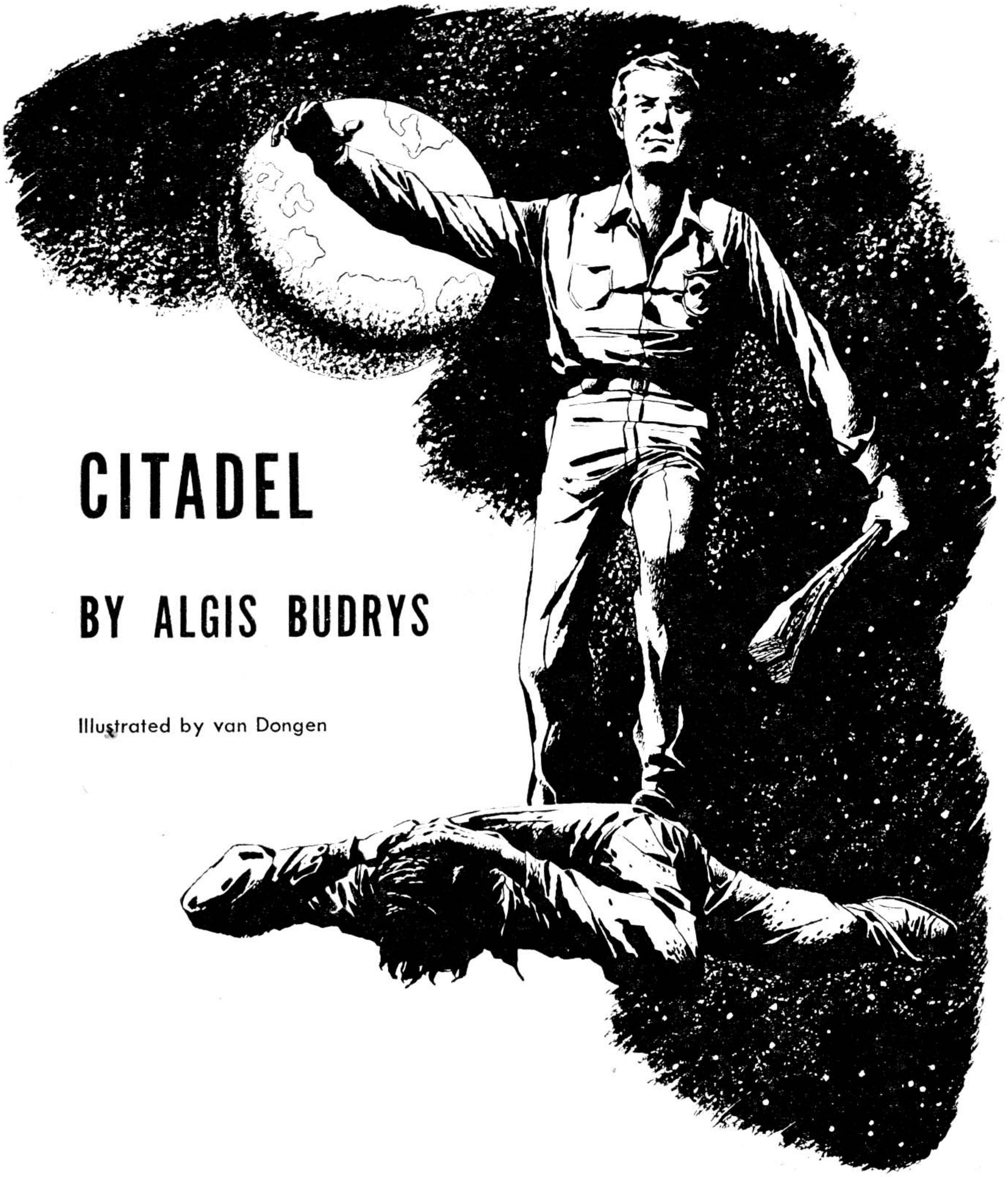
"Or like the one that would have made me tell you that you were nuts!" Don got to his feet and pointed at Cal. "But forget flying them, chum. You're on the design staff from now on, especially after those tests at Patuxent."

Cal looked up at him. "We'll see how I react now, and if Quinn thinks it might have been psychosomatic. I went through holy physical hell right here under the flicker, and I'd almost be willing to bet I get through with flying colors now. At any rate, I don't intend to stay on the ground and let some other guys beat me out now. Want to place a bet on that, Don?"

Don did. He lost.

THE END





CITADEL

BY ALGIS BUDRYS

Illustrated by van Dongen

He was looking for a privacy his strange personality needed. And — never quite seemed to achieve it. All his efforts were, somehow — great triumphs of the race, and great failures for him!

I.

The aging man was sweating profusely, and he darted sidelong glances at the windowless walls of the outer office. By turns, he sat stiffly in a corner chair or paced uneasily, his head swiveling constantly.

His hand was clammy when Mead shook it.

"Hello, Mr. Mead," he said in a husky, hesitant voice, his eyes never quite still, never long on Mead's face, but darting hither and yon, his glance rebounding at every turn from the walls, the floor, the ceiling, the closed outer door.

Christopher Mead, Assistant Undersecretary for External Affairs, returned the handshake, smiling. "Please come into my office," he said quickly. "It's much more spacious."

"Thank you," the aging man said gratefully and hurried into the next room. Mead rapidly opened the windows, and some of the man's nervousness left him. He sank down into the visitor's chair in front of Mead's desk, his eyes drinking in the distances beyond the windows. "Thank you," he repeated.

Mead sat down behind the desk, leaned back, and waited for the man's breathing to slow. Finally he said, "It's good to see you again, Mr. Holliday. What can I do for you?"

Martin Holliday tore his glance away from the window long enough to raise his eyes to Mead's face and then drop them to the hands he had folded too deliberately in his lap.

"I'd—" His voice husked into unintelligibility, and he had to begin again. "I'd like to take an option on a new planet," he finally said.

Mead nodded. "I don't see why not." He gestured expressively at the star chart papered over one wall of his office. "We've certainly got plenty of them. But what happened with your first one?"

"It d-d-duh—"

"Mr. Holliday, I certainly won't be offended if you'd prefer to look out the window," Mead said quickly.

"Thank you." After a moment, he began again. "It didn't work out," he said, his glance flickering back to Mead for an instant before he had to look out the window again.

"I don't know where my figuring went wrong. It *didn't* go wrong. It was just . . . just *things*. I thought I could sell enough subdivisions to cover the payments and still keep most of it for myself, but it didn't work out."

He looked quickly at Mead with a flash of groundless guilt in his eyes. "First I had to sell more than I'd intended, because I had to lower the original price. Somebody'd optioned another planet in the same system, and I hadn't counted on the competition. Then, even after I'd covered the option and posted surety on the payments, there were all kinds of expenses. Then I couldn't lease the mineral rights—" He looked at Mead

again, as though he had to justify himself. "I don't know how that deal fell through. The company just . . . just *withdrew*, all of a sudden."

"Do you think there might have been anything peculiar about that?" Mead asked. "I mean—could the company have made a deal with the colonists for a lower price after you'd been forced out?"

Holliday shook his head quickly. "Oh, no—nothing like that. The colonists and I got along fine. It wasn't as though I hadn't put the best land up for sale, or tried to make myself rich. Why, after I'd had to sell some of the remaining land, and I knew it wasn't worth staying, any more, some of them offered to lend me enough money to keep fifty thousand square miles for myself." He smiled warmly, his eyes blank while he focused on memory.

"But that wasn't it, of course," he went on. "I had my original investment back. But I couldn't tell them why I couldn't stay. It was *people*—even if I never saw them, it was the thought of people, with aircraft and rockets and roads—"

"I understand, Mr. Holliday," Mead said in an effort to spare him embarrassment.

Holliday looked at him helplessly. "I couldn't tell them that, could I, Mr. Mead? They were good, friendly people who wanted to help me. I couldn't tell them it was people, could I?"

He wet his dry lips and locked his eyes on the view outside the window. "All I want, Mr. Mead, is half a planet to myself," he said softly.

He shook his head. "Well, it'll work out this time. This time, I won't have to sell so much, and I'll have a place to spend what time I've got left in peace, without this . . . this—" He gestured helplessly in an effort to convey his tortured consciousness of his own fear.

Mead nodded quickly as he saw his features knot convulsively. "Of course, Mr. Holliday. We'll get you an option on a new planet as quickly as we can."

"Thank you," Holliday said again. "Can we . . . can we handle it today? I've had my credit transferred to a local bank."

"Certainly, Mr. Holliday. We won't keep you on Earth a moment longer than absolutely necessary." He took a standard form out of a desk drawer and passed it to Holliday for his signature.

"I'll be smarter this time," the aging man said, trying to convince himself, as he uncapped his pen. "This time, it'll work out."

"I'm sure it will, Mr. Holliday," Mead said.

II.

Marlowe was obese. He sat behind his desk like a tuskless sea lion crouched behind a rock, and his cheeks merged into jowls and obliterated his neck.

His desk was built specially, so that he could get his thighs under it. His office chair was heavier and wider by far than any standard size, its casters rolling on a special composition base that had been laid down over the carpeting, for Marlowe's weight would have cut any ordinary rug to shreds. His jacket stretched like pliofilm to enclose the bulk of his stooped shoulders, and his eyes surveyed his world behind the battlemented heaviness of the puffing flesh that filled their sockets.

A bulb flickered on his interphone set, and Marlowe shot a glance at the switch beneath it.

"Secretary, quite contrary," he muttered inaudibly. He flicked the switch. "Yes, Mary?" His voice rumbled out of the flabby cavern of his chest.

"Mr. Mead has just filed a report on Martin Holliday, Mr. Secretary. Would you like to see it?"

"Just give me a summary, Mary."

Under his breath he whispered, "Summary that mummery, Mary," and a thin smile fell about his lips while he listened. "Gave him Karlshaven IV, eh?" he observed when his secretary'd finished. "O.K. Thanks, Mary."

He switched off and sat thinking. Somewhere in the bowels of the Body Administrative, he knew, notations were being made and cross-filed. The addition of Karlshaven IV to the list of planets under colonization would be made, and Holliday's asking prices for land would be posted with Emigration, together with a prospectus abstracted from the General Galactic Survey.

He switched the interphone on again.

"Uh . . . Mary? Supply me with a copy of the GenSurv on the entire Karlshaven system. Tell Mr. Mead I'll expect him in my office sometime this afternoon—you schedule it—and we'll go into it further."

"Yes, Mr. Secretary. Will fifteen-fifteen be all right?"

"Fifteen-fifteen's fine, uh . . . Mary," Marlowe said gently.

"Yes, sir," his secretary replied, abashed. "I keep forgetting about proper nomenclature."

"So do I, Mary, so do I," Marlowe sighed. "Anything come up that wasn't scheduled for today?"

It was a routine question, born of futile hope. There was always something to spoil the carefully planned daily schedules.

"Yes and no, sir."

Marlowe cocked an eyebrow at the interphone.

"Well, that's a slight change, anyway. What is it?"

"There's a political science observer from Dovenil—that's Moore II on our maps, sir—who's requested permission to talk to you. He's here on the usual exchange program, and he's within his privileges in asking, of course. I assume it's the ordinary thing—what's our

foreign policy, how do you apply it, can you give specific instances, and the like."

Precisely, Marlowe thought. For ordinary questions there were standard answers, and Mary had been his secretary for so long that she could supply them as well as he could.

Dovenil. Moore II, eh? Obviously, there was something special about the situation, and Mary was leaving the decision to him. He scanned through his memorized star catalogues, trying to find the correlation.

"Mr. Secretary?"

Marlowe grunted. "Still here. Just thinking. Isn't Dovenil that nation we just sent Harrison to?"

"Yes, sir. On the same exchange program."

Marlowe chuckled. "Well, if we've got *Harrison* down there, it's only fair to let their fellow learn something in exchange, isn't it? What's his name?"

"Dalish ud Klavan, sir."

Marlowe muttered to himself: "Dalish ud Klavan, Irish, corn beef and cabbage." His mind filed it away together with a primary-color picture of Jiggs and Maggie.

"All right, Mary, I'll talk to him, if you can find room in the schedule somewhere. Tell you what—let him in at fifteen-thirty. Mead and I can furnish a working example for him. Does that check all right with your book?"

"Yes, sir. There'll be time if we carry over on the Ceroii incidents."

"Ceroii's waited six years, four months, and twenty-three days. They'll wait another day. Let's do that, then, uh . . . Mary."

"Yes, sir."

Marlowe switched off and picked up a report which he began to read by the page-block system, his eyes almost unblinking between pages. "Harrison, eh?" he muttered once, stopping to look quizzically at his desktop. He chuckled.

III.

At fifteen-fifteen, the light on his interphone blinked twice, and Marlowe hastily initialed a directive with his right hand while touching the switch with his left.

"Yes, Mary?"

"Mr. Mead, sir."

"O.K." He switched off, pushed the directive into his OUT box, and pulled the GenSurv and the folder on Martin Holliday out of the HOLD tray. "Come in, Chris," he said as Mead knocked on the door.

"How are you today, Mr. Marlowe?" Mead asked as he sat down.

"Four ounces heavier," Marlowe answered dryly. "I presume you're not. Cigarette, Chris?"

Apparently, the use of the first name finally caught Mead's notice. He looked thoughtful for a moment, then took a cigarette and lit it. "Thanks—Dave."

"Well, I'm glad that's settled,"

Marlowe chuckled, his eyes almost disappearing in crinkles of flesh. "How's Mary?"

Mead grinned crookedly. "*Miss Folsom* is in fine fettle today, thank you."

Marlowe rumbled a laugh. Mead had once made the mistake of addressing the woman as "Mary," under the natural assumption that if Marlowe could do it, everyone could.

"Mary, I fear," Marlowe observed, "lives in more stately times than these. She'll tolerate informality from me because I'm in direct authority over her, and direct authority, of course, is Law. But you, Mead, are a young whipper-snapper."

"But that's totally unrealistic!" Mead protested. "I don't respect her less by using her first name . . . it's just . . . just friendliness, that's all."

"Look," Marlowe said, "it makes sense, but it ain't logical—not on her terms. Mary Folsom was raised by a big, tough, tight-lipped authoritarian of a father who believed in bringing kids up by the book. By the time she got tumbled out into the world, all big men were unquestionable authority and all young men were callow whipper-snappers. Sure, she's unhappy about it, inside. But it makes her a perfect secretary, for me, and she does her job well. We play by her rules on the little things, and by the world's rules on the big ones. Kapish?"

"Sure, Dave, but—"

Marlowe picked up the folder on Holliday and gave Mead one weighty but understanding look before he opened it.

"Your trouble, Chris, is that your viewpoint is fundamentally sane," he said. "Now, about Holliday, Martin, options 062–26–8729, 063–108–1004. I didn't get time to read the GenSurv on the Karlshaven planets, so I'll ask you to brief me."

"Yes, sir."

"What's IV like?"

"Good, arable land. A little mountainous in spots, but that's good. Loaded with minerals—industrial stuff, like silver. Some tin, but not enough to depress the monetary standard. Lots of copper. Coal beds, petroleum basins, the works. Self-supporting practically from the start, a real asset to the Union in fifty-six years."

Marlowe nodded. "Good. Nice picking, Chris. Now—got a decoy?"

"Yes, sir. Karlshaven II's a False-E. I've got a dummy option on it in the works, and we'll be able to undercut Holliday's prices for his land by about twenty per cent."

"False-E, huh? How long do you figure until the colony can't stick on it any longer?"

"A fair-sized one, with lots of financial backing, might even make it permanently. But we won't be able to dig up that many loafers, and, naturally, we can't give them that big a subsidy. Eventually, we'll have to ferry them all out—in about eight years, say. But that'll give us time

enough to break Holliday."

Marlowe nodded again. "Sounds good."

"Something else," Mead said. "II's mineral-poor. It's near to being solid metal. That's what makes it impossible to really live on, but I figure we can switch the mineral companies right onto it and off IV."

Marlowe grinned approvingly. "You been saving this one for Holliday?"

"Yes, sir," Mead said, nodding slowly. He looked hesitantly at Marlowe.

"What's up, Boy?"

"Well, sir—" Mead began, then stopped. "Nothing important, really."

Marlowe gave him a surprising look full of sadness and brooding understanding.

"You're thinking he's an old, frightened man, and why don't we leave him alone?"

"Why . . . yes, sir."

"Dave."

"Yes, Dave."

"You're quite right. Why don't we?"

"We can't, sir. I know that. But it doesn't seem fair—"

"Exactly, Chris. It ain't right, but it's correct."

The light on Marlowe's interphone blinked once. Marlowe looked at it in momentary surprise. Then his features cleared, and he muttered "Cabbage." He reached out toward the switch.

"We've got a visitor, Chris. Follow my lead." He reviewed his information on Dovenilid titular systems while he touched the switch. "Ask ud Klavan to come in, uh . . . Mary."

IV.

Dalish ud Klavan was almost a twin for the pictured typical Dovenilid in Marlowe's library. Since the pictures were usually idealized, it followed that Klavan was an above-average specimen of his people. He stood a full eight feet from fetters to crest, and had not yet begun to thicken his shoes in compensation for the stoop that marked advancing middle age for his race.

Marlowe, looking at him, smiled inwardly. No Dovenilid could be so obviously superior and still only a lowly student. Well, considering Harrison's qualifications, it might still not be tit for tat.

Mead began to get to his feet, and Marlowe hastily planted a foot atop his nearest shoe. The assistant winced and twitched his lips, but at least he stayed down.

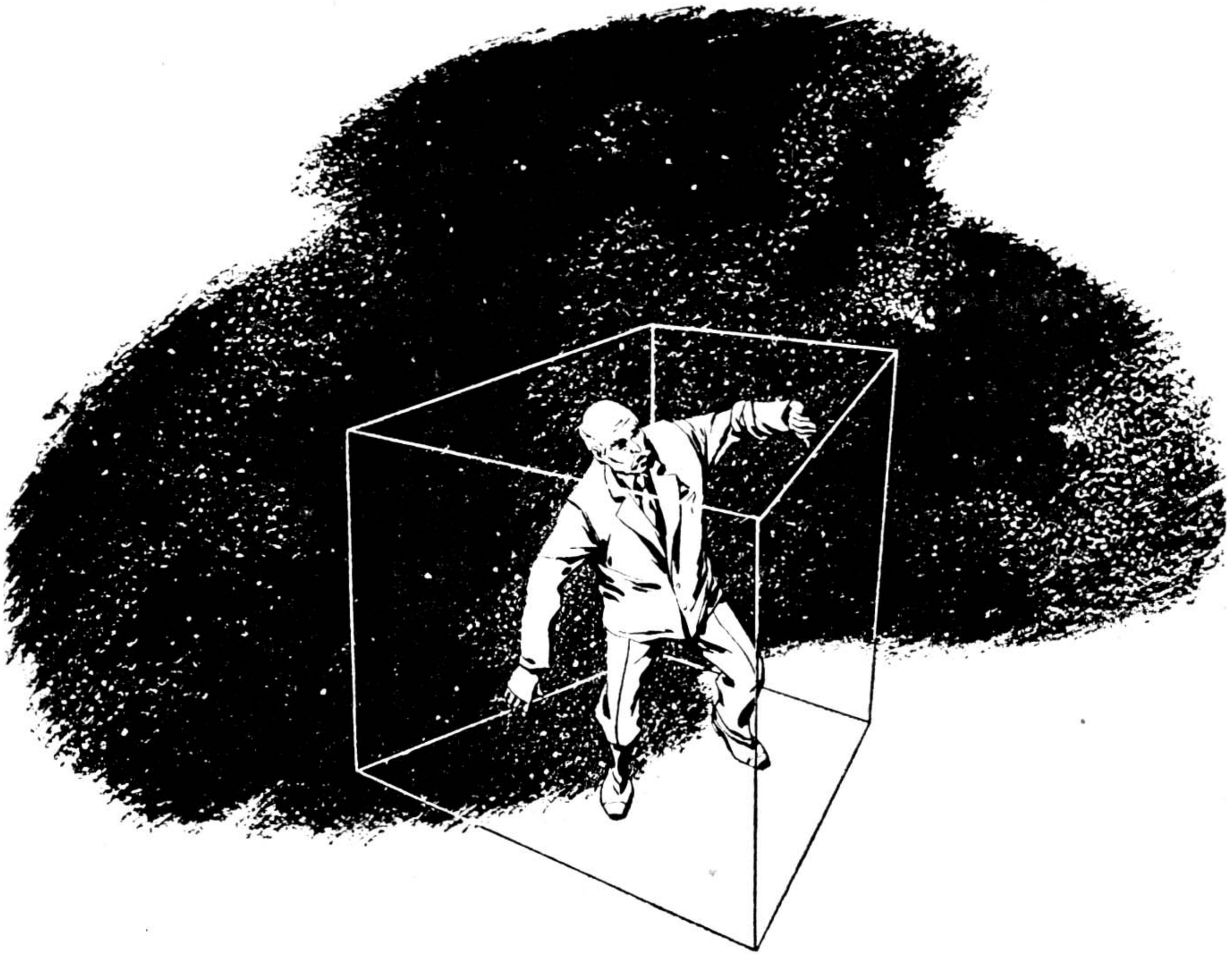
"Dalish ud Klavan," the Dovenilid pronounced, in good English.

"David Marlowe, Secretary for External Affairs, Solar Union," Marlowe replied.

Ud Klavan looked expectantly at Mead.

"Christopher Mead, Assistant Undersecretary for External Affairs," the assistant said, orientating himself.

"If you would do us the honor of permitting us to stand—" Marlowe asked politely.



"On the contrary, Marlowe. If you would do me the honor of permitting me to sit, I should consider it a privilege."

"Please do so. Mr. Mead, if you would bring our visitor a chair—"

They lost themselves in formalities for a few minutes, Marlowe being urbanely correct, Mead following after as best he could through the maze of Dovenilid morés. Finally they were able to get down to the business at hand, ud Klavan sitting with considerable comfort in the carefully designed chair which could be snapped into almost any shape, Marlowe bulking behind his desk, Mead sitting somewhat nervously beside him.

"Now, as I understand it, ud Klavan," Marlowe began, "you'd like to learn something of our policies and methods."

"That is correct, Marlowe and Mead." The Dovenilid extracted a block of opaque material from the flat wallet at his side and steadied it on his knee. "I have your permission to take notes?"

"Please do. Now, as it happens, Mr. Mead and I are currently considering a case which perfectly illustrates our policies."

Ud Klavan immediately traced a series of ideographs on the note block,

and Marlowe wondered if he was actually going to take their conversation down verbatim. He shrugged mentally. He'd have to ask him, at some later date, whether he'd missed anything. Undoubtedly, there'd be a spare recording of the tape he himself was making.

"To begin: As you know, our government is founded upon principles of extreme personal freedom. There are no arbitrary laws governing expression, worship, the possession of personal weapons, or the rights of personal property. The state is construed to be a mechanism of public service, operated by the Body Politic, and the actual regulation and regimentation of society is accomplished by natural socio-economic laws which, of course, are both universal and unavoidable.

"We pride ourselves on the high status of the individual in comparison to the barely-tolerable existence of the state. We do, naturally, have ordinances and injunctions governing crimes, but even these are usually superseded by civil action at the personal level."

Marlowe leaned forward a trifle. "Forgetting exact principles for a moment, ud Klavan, you realize that the actuality will sometimes stray from the ideal. Our citizens, for example, do not habitually carry weapons except under extraordinary conditions. But that is a civil taboo, rather than a fixed ammendation of our constitution. I have no doubt that some future generation, morés having shifted, will, for example, revive the *code duello*."

Ud Klavan nodded. "Quite understood, thank you, Marlowe."

"Good. Now, to proceed:

"Under conditions such as those, the state and its agencies *cannot* lay down a fixed policy of any sort, and expect it to be in the least permanent. The people will not tolerate such regulation, and with each new shift in social morés—and the institution of any policy is itself sufficient to produce such a shift within a short time—successive policies are repudiated by the Body Politic, and new ones must be instituted."

Marlowe leaned back and spread his hands. "Therefore," he said with a rueful smile, "it can fairly be said that we *have* no foreign policy, effectively speaking. We pursue the expedient, ud Klavan, and hope for the best. The case which Mr. Mead and I are currently considering is typical.

"The Union, as you know, maintains a General Survey Corps whose task it is to map the galaxy, surveying such planets as harbor alien races or seem suitable for human colonization. Such a survey team, for example, first established contact between your people and ours. Exchange observation rights are worked out, and representatives of both races are given the opportunity to acquaint themselves with the society of the other.

"In the case of unoccupied, habitable planets, however, the state's function ceases with the filing of a complete and definitive survey at the Under-Ministry for Emigration. The state, as a state, sponsors no colonies and makes no establishments escept for the few staging bases which are maintained for the use of the Survey Corps. We have not yet found any need for the institution of an offensive service analogous to a planetary army, nor do we expect to. War in space is possible only under extraordinary conditions, and we foresee no such contingency.

"All our colonization is carried out by private citizens who apply to Mr. Mead, here, for options on suitable unoccupied planets. Mr. Mead's function is to act as a consultant in these cases. He maintains a roster of surveyed human-habitable planets, and either simply assigns the requested planet or recommends one to fit specified conditions. The cost of the option is sufficient to cover the administrative effort involved, together with sufficient profit to the government to finance further surveys.

"The individual holding the option is then referred to Emigration, which provides copies of a prospectus taken from the General Survey report, and advertises the option holder's asking prices on subdivisions. Again, there is a reasonable fee of a nature similar to ours, devoted to the same purposes.

"The state then ceases to have any voice in the projected colonization whatsoever. It is a totally private enterprise—a simple real estate operation, if you will, with the state acting only as an advertising agency, and, occasionally, as the lessor of suitable transportation from Earth to the new planet. The colonists, of course, are under our protection, maintaining full citizenship unless they request independence, which is freely granted.

"If you would like to see it for purposes of clarification, you're welcome to examine our file on Martin Holliday, a citizen who is fairly typical of these real estate operators, and who has just filed an option on his second planet." Smiling, Marlowe extended the folder.

"Thank you, I should like to," ud Klavan said, and took the file from Marlowe. He leafed through it rapidly, pausing, after asking Marlowe's leave, to make notes on some of the information, and then handed it back.

"Most interesting," ud Klavan observed. "However, if you'll enlighten me—This man, Martin Holliday; wouldn't there seem to be very little incentive for him, considering his age, even if there is the expectation of a high monetary return? Particularly since his first attempt, while not a failure, was not an outstanding financial success?"

Marlowe shrugged helplessly. "I tend to agree with you thoroughly, ud Klavan, but—" he smiled, "you'll agree, I'm sure, that one Earthman's

boredom is another's incentive? We are not a rigorously logical race, ud Klavan."

"Quite," the Dovenilid replied.

V.

Marlowe stared at his irrevocable clock. His interphone light flickered, and he touched the switch absently.

"Yes, Mary?"

"Will there be anything else, Mr. Secretary?"

"No, thank you, Mary. Good night."

"Good night, sir."

There was no appeal. The day was over, and he had to go home.

He stared helplessly at his empty office, his mind automatically counting the pairs of departing footsteps that sounded momentarily as clerks and stenographers crossed the walk below his partly-open window. Finally he rolled his chair back and pushed himself to his feet. Disconsolate, he moved irresolutely to the window and watched the people leave.

Washington—aging, crowded Washington, mazed by narrow streets, carrying the burden of the severe, unimaginative past on its grimy architecture—respired heavily under the sinking sun.

The capital ought to be moved, he thought as he'd thought every night at this time. Nearer the heart of the empire. Out of this steamy bog. Out of this warren.

His heavy lips moved into an ironical comment on his own thoughts. No one was ever going to move the empire's traditional seat. There was too much nostalgia concentrated here, along with the humidity. Some day, when the Union was contiguous with the entire galaxy, men would still call Washington, on old, out-of-the-way Earth, their capital. Man was not a rigorously logical race, as a race.

The thought of going home broke out afresh, insidiously avoiding the barriers of bemusement which he had tried to erect, and he turned abruptly away from the window, moving decisively so as to be able to move at all. He yanked open a desk drawer and stuffed his jacket pockets with candy bars, ripping the film from one and chewing on its end while he put papers in his brief case.

Finally, he could not delay any longer. Everyone else was out of the building, and the robots were taking over. Metal treads spun along the corridors, bearing brooms, and the robot switchboards guarded the communications of the Ministry. Soon the char-robots would be bustling into this very office. He sighed and walked slowly out, down the empty halls where no human eye could see him waddling.

He stepped into his car, and as he opened the door the automatic recording said "Home, please," in his own voice. The car waited until he was settled and then accelerated gently,

pointing for his apartment.

The recording had been an unavoidable but vicious measure of his own. He'd had to resort to it, for the temptation to drive to a terminal, to an airport, or rocket field, or railroad station—*anywhere*—had become excruciating.

The car stopped for a pedestrian light, and a sports model bounced jauntily to a stop beside it. The driver cocked an eyebrow at Marlowe and chuckled. "Say, Fatso, which one of you's the Buick?" Then the light changed, the car spurted away, and left Marlowe cringing.

He would not get an official car and protect himself with its license number. He would not be a coward. He *would* not!

His fingers shaking, he tore the film from another candy bar.

Marlowe huddled in his chair, the notebook clamped on one broad thigh by his heavy hand, his lips mumbling nervously while his pencil-point checked off meter.

"Dwell in aching discontent," he muttered. "No. Not that." He stared down at the floor, his eyes distant.

"Bitter discontent," he whispered. He grunted softly with breath that had to force its way past the constricting weight of his hunched chest. "Bitter dwell." He crossed out the third line, substituted the new one, and began to read the first two verses to himself.

"We are born of Humankind—
This our destiny:
To bitter dwell in discontent
Wherever we may be.

"To strangle with the burden
Of that which heels us on.
To stake our fresh beginnings
When frailer breeds have done."

He smiled briefly, content. It still wasn't perfect, but it was getting closer. He continued:

"To pile upon the ashes
Of races in decease
Such citadels of our kind's own
As fortify no—"

"What are you doing, David?" his wife asked over his shoulder.

Flinching, he pulled the notebook closer into his lap, bending forward in an instinctive effort to protect it.

The warm, loving, sawing voice went on. "Are you writing another poem, David? Why, I thought you'd given that up!"

"It's . . . it's nothing, really, uh . . . Leonora. Nothing much. Just a . . . a thing I've had running around my head. Wanted to get rid of it."

His wife leaned over and kissed his cheek clumsily. "Why, you old big dear! I'll bet it's for me. Isn't it, David? Isn't it for me?"

He shook his head in almost desperate regret. "I'm . . . I'm afraid not, uh—" Snorer. "It's about something else, Leonora."

"Oh." She came around the chair, and he furtively wiped his cheek with

a hasty hand. She sat down facing him, smiling with entreaty. "Would you read it to me anyway, David? Please, dear?"

"Well, it's not . . . not finished yet—not right."

"You don't have to, David. It's not important. Not really." She sighed deeply.

He picked up the notebook, his breath cold in his constricted throat. "All right," he said, the words coming out huskily, "I'll read it. But it's not finished yet."

"If you don't want to—"

He began to read hurriedly, his eyes locked on the notebook, his voice a suppressed hoarse, spasmodic whisper.

"*Such citadels of our kind's own*
As fortify no peace.

"*No wall can offer sheller,*
No roof can shield from pain.
We cannot rest; we are the damned;
We must go forth again.

"*Unnumbered we must—*"

"David, are you sure about those last lines?" She smiled apologetically. "I know I'm old-fashioned, but couldn't you change that? It seems so . . . so harsh. And I think you may have unconsciously borrowed it from someone else. I can't help thinking I've heard it before, somewhere? Don't you think so?"

"I don't know, dear. You may be right about that word, but it doesn't really matter, does it? I mean, I'm not going to try to get it published, or anything."

"*I* know, dear, but still—"

He was looking at her desperately.

"I'm sorry, dear!" she said contritely. "Please go on. Don't pay any attention to my stupid comments."

"They're not stupid—"

"Please, dear. Go on."

His fingers clamped on the edge of the notebook.

"*Unnumbered we must wander,*
Break, and bleed, and die.
Implacable as ocean,
Our tide must drown the sky.

"*What is our expiation,*
For what primeval crime,
That we must go on marching
Until the crash of time?

"*What hand has shaped so cruelly?*
What whim has cast such fate?
Where is, in our creation,
The botch that makes us great?"

"Oh, that's good, darling! That's very good. I'm proud of you, David."

"I think it stinks," he said evenly, "but, anyway, there are two more verses."

"*David!*"

Grimly, he spat out the last eight lines.

"*Why are we ever gimleted*
By empire's irony?
Is discontent the cancered price
Of Earthman's galaxy?"

Leonora, recoiling from his cold fury, was a shaking pair of shoulders and a mass of lank hair supported by her hands on her face while she sobbed.

"*Are our souls so much perverted?*
Can we not relent?
Or are the stars the madman's cost
For his inborn discontent?

"Good night, Leonora."

VI.

The light flickered on Marlowe's interphone.

"Good morning, Mr. Secretary."

"Good morning, Mary. What's up?"

"Harrison's being deported from Dovenil, sir. There's a civil crime charged against him. Quite a serious one."

Marlowe's eyebrows went up. "How much have we got on it?"

"Not too much, sir. Harrison's report hasn't come in yet. But the story's on the news broadcasts now, sir. We haven't been asked to comment yet, but Emigration has been called by several news outlets, and the Ministry for Education just called here and inquired whether it would be all right to publish a general statement of their exchange students' careful instructions against violating local customs."

Marlowe's glance brooded down on the mass of papers piled in the tray of his IN box. "Give me a tape of a typical broadcast," he said at last. "Hold everything else. Present explanation to all news outlets: None now, statement forthcoming after preliminary investigation later in the day. The Ministry regrets this incident deeply, and will try to settle matters as soon and as amicably as possible, et cetera, et cetera. O.K.?"

"Yes, sir."

He swung his chair around to face the screen let into a side wall, and colors began to flicker and run in the field almost immediately. They steadied and sharpened, and the broadcast tape began to roll.

Dateline: Dovenil, Sector Three, Day 183, 2417 GST. Your Topical News reporter on this small planet at the Union's rim was unable today to locate for comment any of the high officials of this alien civilization directly concerned with the order for the deportation of exchange student-observer Hubert Harrison, charged with theft and violent assult on the person of a Dovenilid citizen. Union citizen Harrison was unavailable for comment at this time, but Topical News will present his views and such other clues when more ensues.

Marlowe grunted. Journalese was getting out of hand again. That last rhyming sentence was sure to stick in the audience's brains. It might be only another advertising gimmick, but if

they started doing it with the body of the news itself, it might be well to feed Topical enough false leads to destroy what little reputation for comprehensibility they had left.

He touched his interphone switch.

"Uh . . . Mary, what was the hooper on that broadcast?"

"Under one per cent, sir."

Which meant that, so far, the Body Politic hadn't reacted.

"Thank you. Is there anything else coming in?"

"Not at the moment, sir."

"What's—" Cabbage. "What's Dalish ud Klavan doing?"

"His residence is the Solar Hostel, sir. The management reports that he is still in his room, and has not reserved space on any form of long-distance transportation. He has not contacted us, either, and there is a strong probability that he may still be unaware of what's happened."

"How many calls did he make yesterday, either before or after he was here, and to whom?"

"I can get you a list in ten minutes, sir."

"Do that, Mary."

He switched off, sat slapping the edge of his desk with his hand, and switched on again.

"Mary, I want the GenSurvs on the Dovenil area to a depth of ten cubic lights."

"Yes, sir."

"And get me Mr. Mead on the phone, please."

"Yes, sir."

Marlowe's lips pulled back from his teeth as he switched off. He snatched a candy bar out of his drawer, tore the film part way off, then threw it back in the drawer as his desk phone chimed.

"Here, Chris."

"Here, Mr. Marlowe."

"Look, Chris—has Holliday left Earth yet?"

"Yes, sir. Yes, Dave."

"Where is he?"

"Luna, en route to Karlshaven. He was lucky enough to have me arrange for his accidentally getting a ride on a GenSurv ship that happened to be going out that way, if you follow me." Mead grinned.

"Get him back."

The smile blanked out. "I can't do that, Mr. Marlowe! He'd never be able to take it. You should have seen him when I put him on the shuttle. We doped him up with EasyRest, and even then his subconscious could *feel* the

bulkheads around him, even in his sleep. Those shuttles are small, and they don't have ports."

"We can't help that. We need him, and I've got to talk to him first. Personally."

Mead bit his lip. "Yes, sir."

"Dave."

"Yes . . . Dave."

VII.

Dalish ud Klavan sat easily in his chair opposite Marlowe. He rested one digit on his notebook and waited.

"Ud Klavan," Marlowe said amiably, "you're undoubtedly aware by now that your opposite number on Dovenil has been charged with a civil crime and deported."

The Dovenilid nodded. "An unfortunate incident. One that I regret personally, and which I am sure my own people would much rather not have had happen."

"Naturally." Marlowe smiled. "I simply wanted to reassure you that this incident does not reflect on your own status in any way. We are investigating our representative, and will take appropriate action, but it seems quite clear that the fault is not with your people. We have already forwarded reparations and a note of apology to your government. As further reparation, I wish to assure you personally that we will coöperate with your personal observations in every possible way. If there is anything at all you wish to know—even what might, under ordinary conditions, be considered restricted information—just call on us."

Ud Klavan's crest stirred a fraction of an inch, and Marlowe chuckled inwardly. Well, even a brilliant spy might be forgiven an outward display of surprise under these circumstances.

The Dovenilid gave him a piercing look, but Marlowe presented a featureless facade of bulk.

The secretary chuckled in his mind once more. He doubted if ud Klavan could accept the hypothesis that Marlowe did not know he was a spy. But the Dovenilid must be a sorely confused being at this point.

"Thank you, Marlowe," he said finally. "I am most grateful, and I am sure my people will construe it as yet another sign of the Union's friendship."

"I hope so, ud Klavan," Marlowe replied. Having exchanged this last friendly lie, they went through the customary Dovenilid formula of leave-taking.

Marlowe slapped his interphone switch as soon as the alien was gone. "Uh . . . Mary, what's the latest on Holliday?"

"His shuttle lands at Idlewild in half an hour, sir."

"All right, get Mr. Mead. Have him meet me out front, and get an official car to take us to the field. I'll want somebody from Emigration to go with us. Call Idlewild and have

them set up a desk and chairs for four out in the middle of the field. Call the Ministry for Traffic and make sure that field stays clear until we're through with it. My Ministerial prerogative, and no back-talk. I want that car in ten minutes."

"Yes, sir."

Mary's voice was perfectly even, without the slightest hint that there was anything unusual happening. Marlowe switched off and twisted his mouth.

He picked up the GenSurv on the Dovenil area and began skimming it rapidly.

He kept his eyes carefully front as he walked out of his office, past the battery of clerks in the outer office, and down the hall. He kept them rigidly fixed on the door of his personal elevator which, during the day, was human-operated under the provisions of the Human Employment Act of 2302. He met Mead in front of the building and did not look into the eyes of Bussard, the man from Emigration, as they shook hands. He followed them down the walk in a sweating agony of obliviousness, and climbed into the car with carefully normal lack of haste.

He sat sweating, chewing a candy bar, for several minutes before he spoke. Then, slowly, he felt his battered defenses reassert themselves, and he could actually look at Bussard, before he turned to Mead.

"Now, then," he rapped out a shade too abruptly before he caught himself. "Here's the GenSurv on the Dovenil area, Chris. Anything in it you don't know already?"

"I don't think so, sir."

"O.K., dig me up a habitable planet —even a long-term False E will do— close to Dovenil, but not actually in their system. If it's at all possible, I want that world in a system without any rich planets. And I don't want any rich systems anywhere near it. If you can't do that, arrange for the outright sale of all mineral and other resource rights to suitable companies. I want that planet to be habitable, but I want it to be impossible for any people on it to get at enough resources to achieve a technological culture. Can do?"

Mead shook his head. "I don't know."

"You've got about fifteen minutes to find out. I'm going to start talking to Holliday, and when I tell him I've got another planet for him, I'll be depending on you to furnish one. Sorry to pile it on like this, but must be."

Mead nodded. "Right, Mr. Marlowe. That's why I draw pay."

"Good boy. Now, uh—" Rabbit. "Bussard. I want you to be ready to lay out a complete advertising and prospectus program. Straight routine work, but about four times normal speed. The toughest part of it will be following the lead that Chris and I set.

Don't be surprised at anything, and act like it happens every day."

"Yes, Mr. Marlowe."

"Right."

Bussard looked uncomfortable. "Ah . . . Mr. Marlowe?"

"Yes?"

"About this man, Harrison. I presume all this is the result of what happened to him on Dovenil. Do you think there's any foundation in truth for what they say he did? Or do you think it's just an excuse to get him off their world?"

Marlowe looked at him coldly. "Don't be an ass," he snorted.

VIII.

Martin Holliday climbed slowly out of the shuttle's lock and moved fumblingly down the stairs, leaning on the attendant's arm. His face was a mottled gray, and his hands shook uncontrollably. He stepped down to the tarmac and his head turned from side to side as his eyes gulped the field's distances.

Marlowe sat behind the desk that had been put down in the middle of this emptiness, his eyes brooding as he looked at Holliday. Bussard stood beside him, trying nervously to appear noncommittal, while Mead went up to the shaking old man, grasped his hand, and brought him over to the desk.

Marlowe shifted uncomfortably. The desk was standard size, and he had to sit far away from it. He could not feel at ease in such a position.

His thick fingers went into the side pocket of his jacket and peeled the film off a candy bar, and he began to eat it, holding it in his left hand, as Mead introduced Holliday.

"How do you do, Mr. Holliday?" Marlowe said, his voice higher than he would have liked it, while he shook the man's hand.

"I'm . . . I'm pleased to meet you, Mr. Secretary," Holliday replied. His eyes were darting past Marlowe's head.

"This is Mr. Bussard, of Emigration, and you know Mr. Mead, of course. Now, I think we can all sit down."

Mead's chair was next to Holliday's, and Bussard's was to one side of the desk, so that only Marlowe, unavoidably, blocked his complete view of the stretching tarmac.

"First of all, Mr. Holliday, I'd like to thank you for coming back. Please believe me when I say we would not have made such a request if it were not urgently necessary."

"It's all right," Holliday said in a low, apologetic voice. "I don't mind."

Marlowe winced, but he had to go on.

"Have you seen a news broadcast recently, Mr. Holliday?"

The man shook his head in embarrassment. "No, sir. I've been . . . asleep most of the time."

"I understand, Mr. Holliday. I didn't really expect you had under the

circumstances. The situation is this:

"Some time ago, our survey ships, working out in their usual expanding pattern, encountered an alien civilization on a world designated Moore II on our maps, and which the natives call Dovenil. It was largely a routine matter, no different from any other alien contact which we've had. They had a relatively high technology, embracing the beginnings of interplanetary flight, and our contact teams were soon able to work out a diplomatic status mutually satisfactory to both.

"Social observers were exchanged, in accordance with the usual practice, and everything seemed to be going well."

Holliday nodded out of painful politeness, not seeing the connection with himself. Some of his nervousness was beginning to fade, but it was impossible for him to be really at ease with so many people near him, with all of Earth's billions lurking at the edge of the tarmac.

"However," Marlowe went on as quickly as he could, "today, our representative was deported on a trumped-up charge. Undoubtedly, this is only the first move in some complicated scheme directed against the Union. What it is, we do not yet know, but further observation of the actions of their own representative on this planet has convinced us that they are a clever, ruthless people, living in a society which would have put Machiavelli to shame. They are single-minded of purpose, and welded into a tight group whose major purpose in life is the service of the state in its major purpose, which, by all indications, is that of eventually dominating the universe.

"You know our libertarian society. You know that the Union government is almost powerless, and that the Union itself is nothing but a loose federation composed of a large number of independent nations tied together by very little more than the fact that we are all Earthmen.

"We are almost helpless in the face of such a nation as the Dovenilids. They have already outmaneuvered us once, despite our best efforts. There is no sign that they will not be able to do so again, at will.

"We must, somehow, discover what the Dovenilids intend to do next. For this reason, I earnestly request that you accept our offer of another planet than the one you have optioned, closer to the Dovenilid system. We are willing, under these extraordinary circumstances, to consider your credit sufficient for the outright purchase of half the planet, and Mr. Bussard, here, will do his utmost to get you suitable colonists for the other half as rapidly as it can be done. Will you help us, Mr. Holliday?"

Marlowe sank back in his chair. He became conscious of a messy feeling in his left hand, and looked down to

discover the half-eaten candy bar had melted. He tried furtively to wipe his hand clean on the underside of the desk, but he knew Bussard had noticed, and he cringed and cursed himself.

Holliday's face twisted nervously.

"I . . . I don't know—"

"Please don't misunderstand us, Mr. Holliday," Marlowe said. "We do not intend to ask you to spy for us, nor are we acting with the intention of now establishing a base of any sort on the planet. We simply would like to have a Union world near the Dovenilid system. Whatever Dovenil does will not have gathered significant momentum by the end of your life. You will be free to end your days exactly as you have always wished, and the precautions we have outlined will ensure that there will be no encroachments on your personal property during that time. We are planning for the next generation, when Dovenil will be initiating its program of expansion. It is then that we will need an established outpost near their borders."

"Yes," Holliday said hesitantly, "I can understand that. I . . . I don't know," he repeated. "It seems all right. And, as you say, it won't matter, during my lifetime, and it's more than I had really hoped for." He looked nervously at Mead. "What do you think, Mr. Mead? You've always done your best for me."

Mead shot one quick glance at Marlowe. "I think Mr. Marlowe's doing his best for the Union," he said finally, "and I know he is fully aware of your personal interests. I think what he's doing is reasonable under the circumstances, and I think his proposition to you, as he's outlined it, is something which you cannot afford to not consider. The final decision is up to you, of course."

Holliday nodded slowly, staring down at his hands. "Yes, yes, I think you're right, Mr. Mead." He looked up at Marlowe. "I'll be glad to help. And I'm grateful for the consideration you've shown me."

"Not at all, Mr. Holliday. The Union is in your debt."

Marlowe wiped his hand on the underside of the desk again, but he only made matters worse, for his fingers picked up some of the chocolate he had removed before.

"Mr. Mead, will you give Mr. Holliday the details on the new planet?" he said, trying to get his handkerchief out without smearing his suit. He could almost hear Bussard snickering.

Holliday signed the new option contract and shook Marlowe's hand. "I'd like to thank you again, sir. Looking at it from my point of view, it's something for nothing—at least, while I'm alive. And it's a very nice planet, too, from the way Mr. Mead described it. Even better than Karlshaven."

"Nevertheless, Mr. Holliday," Mar-

lowe said, "you have done the Union a great service. We would consider it an honor if you allowed us to enter your plant in our records under the name of Holliday."

He kept his eyes away from Mead.

Martin Holliday's eyes were shining. "Thank you, Mr. Marlowe," he said huskily.

Marlowe could think of no reply. Finally, he simply nodded. "It's been a pleasure meeting you, Mr. Holliday. We've arranged transportation, and your shuttle will be taking off very shortly."

Holliday's face began to bead with fresh perspiration at the thought of bulkheads enclosing him once more, but he managed to smile, and then ask, hesitantly: "May I . . . may I wait for the shuttle out here, sir?"

"Certainly. We'll arrange for that. Well, good-by, Mr. Holliday."

"Good-by, Mr. Marlowe. Good-by, Mr. Bussard. And good-by, Mr. Mead. I don't suppose you'll be seeing me again."

"Good luck, Mr. Holliday," Mead said.

Marlowe twisted awkwardly on the car's back seat, wiping futilely at the long smear of chocolate on his trouser pocket.

Well, he thought, at least he'd given the old man his name on the star maps until Earthmen stopped roving.

At least he'd given him that.

Mead was looking at him. "I don't suppose we've got time to let him die in peace, have we?" he asked.

Marlowe shook his head.

"I suppose we'll have to start breaking him immediately, won't we?"

Marlowe nodded.

"I'll get at it right away, sir."

Dave! Does everyone have to hate me? Can't anyone understand? Even you, uh—Creed. Even you, Mead?

IX.

Dalish ud Klavan, stooped and withered, sat hopelessly, opposite Marlowe, who sat behind his desk like a grizzled polar bear, his thinning mane of white hair unkempt and straggling.

"Marlowe, my people are strangling," the old Dovenilid said.

Marlowe looked at him silently.

"The Holliday Republic has signed treaty after treaty with us, and still their citizens raid our mining planets, driving away our own people, stealing the resources we must have if we are to live."

Marlowe sighed. "There's nothing I can do."

"We have gone to the Holliday government repeatedly," ud Klavan pleaded. "They tell us the raiders are criminals, that they are doing their best to stop them. But they still buy the metal the raiders bring them."

"They have to," Marlowe said. "There are no available resources

anywhere within practicable distances. If they're to have any civilization at all, they've *got* to buy from the outlaws."

"But they are members of the Union!" ud Klavan protested. "*Why* won't you do anything to stop them?"

"We can't," Marlowe said again. "They're members of the Union, yes, but they're also a free republic. We have no administrative jurisdiction over them, and if we attempted to establish one our citizens would rise in protest all over our territory."

"Then we're finished. Dovenil is a dead world."

Marlowe nodded slowly. "I am very sorry. If there is anything I can do, or that the Ministry can do, we will do it. But we cannot save the Dovenilid state."

Ud Klavan looked at him bitterly. "Thank you," he said. "Thank you for your generous offer of a gracious funeral.

"I don't understand you!" he burst out suddenly. "I don't understand you people! Diplomatic lies, yes. Expediency, yes! But this . . . this madness, this fanatical, illogical devotion of the state in the cause of a people who will tolerate no state! This . . . no, this I cannot understand."

Marlowe looked at him, his yes full of years.

"Ud Klavan," he said, "you are quite right. We are a race of maniacs. And that is why Earthmen rule the galaxy. For our treaties are not binding, and our promises are worthless. Our government does *not* represent our people. It represents our people as they once were. The delay in the democratic process is such that the treaty signed today fulfills the promise of yesterday—but today the Body Politic has formed a new opinion, is following a new logic which is completely at variance with that of yesterday. An Earthman's promise—expressed in words or deeds—is good *only at the instant he makes it.* A second later, new factors have entered into the total circumstances, and a new chain of logic has formed in his head—to be altered again, a few seconds later."

He thought, suddenly, of that poor claustrophobic devil, Holliday, harried from planet to planet, never given a moment's rest—and civilizing, civilizing, spreading the race of humankind wherever he was driven. Civilizing with a fervor no hired dummy could have accomplished, driven by his fear to sell with all the real estate agent's talent that had been born in him, selling for the sake of money with which to buy that land he needed for his peace—and always being forced to sell a little too much.

Ud Klavan rose from his chair. "You are also right, Marlowe. You are a race of maniacs, gibbering across the stars. And know, Marlowe, that the other races of the universe hate you."

Marlowe with a tremendous effort

heaved himself out of his chair.

"Hate us?" He lumbered around the desk and advanced on the frightened Dovenilid, who was retreating backwards before his path.

"Can't you see it? Don't you understand that, if we are to pursue any course of action over a long time—if we are ever going to achieve a galaxy in which an Earthman can some day live at peace with himself—we must each day violate all the moral codes and creeds which we held inviolate the day before? That we must fight against every ideal, every principle which our fathers taught us, because they no longer apply to our new logic?

"*You* hate us!" He thrust his fat hand, its nails bitten down to the quick and beyond, in front of the cringing alien's eyes.

"You poor, weak, single-minded, ineffectual thing! We hate ourselves!"

THE END

THE ANALYTICAL LABORATORY

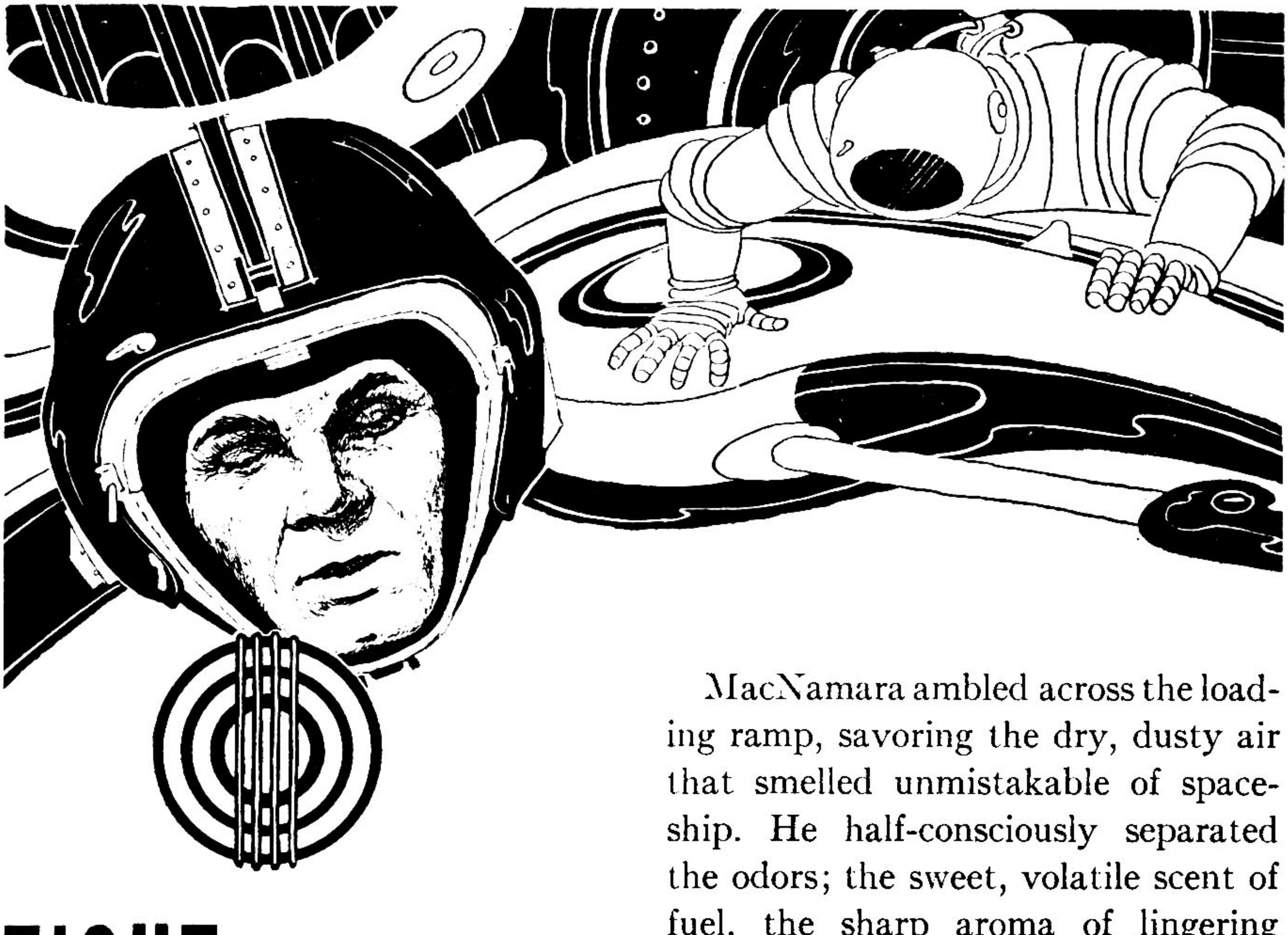
On some issues, I have a pretty good idea which yarns will get voted into the bonus spots; on others, I genuinely don't know how it will work out. Those, naturally, are the issues most interesting to me — and those are the ones on which I have a chance to learn more about what you want.

That business is itself none too easy, incidentally; a man likes what he's used to. But what he's used to can also be the boringly familiar! How much of the "familiar and pleasing" effect, and how much of the "familiarity breeds contempt" effect exists? Try, for the fun of it, making out two An Lab lists this month — one to send in, representing *what you like*, and a second representing *what you think the readers' vote will be*. Keep that second one, and check when the An Lab report is published!

For the November 1954 issue, it went this way:

Place	*Story*	*Author*	*Points*
1.	They'd Rather Be Right (Conclusion)	Mark Clifton and Frank Riley	2.17
2.	Pilot's License	William T. Powers	2.30
3.	The End of Summer	Algis Budrys	2.75
4.	A Matter of Monsters	Manly Banister	3.70
5.	Helper	Irving Reich	4.40

THE EDITOR.



TIGHT SQUEEZE

BY DEAN C. ING

He knew the theory of repairing the gizmo all right. He had that nicely taped. But there was the little matter of threading a wire through a too-small hole while under zero-g, and working in a spacesuit!

Illustrated by Freas

MacNamara ambled across the loading ramp, savoring the dry, dusty air that smelled unmistakable of spaceship. He half-consciously separated the odors; the sweet, volatile scent of fuel, the sharp aroma of lingering exhaust gases from early morning test-firing, the delicate odor of silicon plastic which was being stowed as payload. He shielded his eyes against the sun, watching as men struggled with the last plastic girders to be strapped down, high above the dazzling ground of White Sands. The slender cargo doors stood open around *Valier's* girth, awaiting his own personal O.K.

This flight would be the fourth for Major Edward MacNamara; as he neared the great, squatting shock absorbers he could feel the tension begin to knot his stomach. He had, of course, been overwhelmed by the opportunity to participate in Operation Doughnut. The fact that he had

been one of the best mechanical engineers in the Air Force never occurred to him at the time. He was a pilot, and a good one, but he had languished as C.O. of a maintenance squadron for nearly two years before he was given another crack at glory. Now, he wasn't at all sure he was happy with the transition. They needed master mechanics for Operation Doughnut, but he felt they should be left on the ground when the towering supply rockets lifted.

He stopped, leaning against scaffolding as he saw a familiar figure turn toward him. He cupped his hands before his face.

"Hey, douse that butt! Can't you . . . oh, Mac!" The commanding voice trailed off in a chuckle. Better to clown his way through the inspection, MacNamara thought, than to let Ruiz notice his nervousness. The co-pilot, Ruiz, walked toward him, still smiling. "One of these days, boy, you gonna go too far. Thought you were a real, eighteen carat saboteur." He clapped MacNamara on the shoulder and gazed aloft. "Good day for it. No weather, no hangover, no nothing."

"Yeah. You know, Johnny, I've been thinking about a modification for our breathing oxy." He sniffed appreciatively.

"What's that?"

"Put a little dust in it, a few smells. That stuff we breathe is just too sanitary!"

"I know what you mean. I sure begin to crave this filthy, germ-filled air after a few hours out there." They both smiled at the thought, then turned to the business at hand.

"By the way, Johnny, what're you doing out so early? Didn't expect to see you cabbies before ten."

"I donno," the bronzed Ruiz replied. "Went to bed early, woke up at six and couldn't drop off again. And here I am. Carl ought to be along around nine-thirty. Thought I'd help you preflight, if you want me to."

"Sure." He wanted nothing of the sort, but had the tact not to say so.

Edward MacNamara was as familiar with the *Valier* as he was with the tip of his nose. He had been on the scene when Dan Burke test-hopped the third stage, had made improvements and re-routing jobs, and had memorized every serial number of every bearing that went into *Valier*. As Flight Engineer, he was supposed to.

With Johnny Ruiz helping a little and hindering a little, he finished his tour of the cargo sections and grinned his approval to a muscular loading technician. "They can button her up, sergeant. I couldn't do a better job myself." It was a compliment of the highest order, and they both knew it.

Riding the tiny lift down to ground level, MacNamara stopped them every ten feet or so to circle the catwalks. He noticed Ruiz's impatience about halfway down. "No hurry, Johnny. I don't want another *Wyld* on our hands." He knew he shouldn't have

said it, but it slipped out anyway. Everyone tried to forget the *Wyld* disaster, particularly the flight personnel. The *Wyld*, one of the first ships to be built, had made only two orbits before being destroyed. Observers stated that a cargo hatch had somehow swung open when the *Wyld* was only a thousand feet in the air. At any rate, the pilot reported damage to one second-stage fin and tried to brake his way down. The *Wyld* settled beautifully, tilted, then fell headlong. The resultant explosion caused such destruction that, had there not been a number of men in orbit and waiting for supplies, the project might have been halted, "temporarily." It was generally conceded that a more thorough preflight could have prevented the *Wyld's* immolation.

Ruiz was noticeably quieter during the remainder of the inspection. The external check completed, MacNamara strapped a small flashlight to his wrist and began the internal inspection, jokingly called the autopsy.

An hour and over a hundred and fifty feet later, MacNamara wheezed as he swung over the bulkhead at the base of *Valier's* third and top stage. His aching limbs persuaded him to take a breather. After all, his complete inspection of the day before really made a final preflight unnecessary, and passing near the frigid oxygen tanks was a day's work in itself. He listened to the innumerable noises around and below him. The clicks and hums near him meant that Ruiz, having given up following him, was checking out the flight controls, with power on only in the top stage. From below came a vibrational rushing noise, nearly subsonic, which told him of the fueling operation. He thought of the electrical relays governing the fuel input and shuddered. He violently disliked the idea of having hot wires near fuel of any kind, and rocket fuel in particular.

MacNamara swept his light over his wrist watch. Fifteen after. Logan should be along soon, he thought, and hastened to finish checking the conduits, servos, pumps and hydraulic actuators below the cabin level. This done, he crawled up the final ladder to the cabin, or "dome."

"Well," cried a cheerful voice, "if it isn't our grimy Irishman."

MacNamara shook the sweat from his brow and muttered, "Irishman, is it? How about 'Logan'? That's a good Scandinavian name."

"How about Logan? He's great, as usual. Just look at me, Mac. What a specimen!" Logan, the inevitable optimist, bounced out of his acceleration couch and spread his arms wide as if to show the world what a superman he, Carl Logan, was. The gesture and its intimations made MacNamara smile. Logan wasn't much over five feet tall, and his flight suit made him look like a bald pussycat. His small physique covered a fantastic set of reflexes, however, and Logan's sense of humor

was a quality of utmost importance. He hadn't an enemy in the world. His enemy was out of this world by definition; Logan wanted to conquer space and, so far, was doing just that.

O.K., O.K. Laugh. Just remember this, Gargantua; I may not be tall, but I sure am skinny." MacNamara smiled again, nodding agreement. "Well, don't everybody talk at once. How is she, Mac?"

"With luck," answered MacNamara, "we might get ten feet off the turf." He paused for effect. "Seriously, Carl, she never looked better. You could take her up right now. Say, where's Johnny? I thought you'd just be checking in to the medics; looks like everybody's early today."

"He's probably over in some corner, making out his will. He was down below a while ago with a face a mile long."

Probably, thought Mac, *he's still thinking about the* Wyld. *Why did I have to bring that up?* Aloud, he said, "I ought to check the ground crew. Did you bring the forms?"

"Nope. Just my magnificent self. If anything had gone astray, they'd have told you."

"All the same, I think I'll go down and question the troops. Don't leave without me." He clambered out onto the catwalk, leaving the air lock open. The sun was riding higher every minute. In a little over an hour, he'd be a thousand miles away—vertically. The knot in his stomach began to form again. He wasn't scared, exactly; he kept telling himself "excited" was a nicer word.

The inspection forms signed, Mac held a short interrogation with the crew chief. The grizzled lieutenant, commissioned because of his long experience and responsibilities, gave *Valier* a clean bill of health. Each engine of the booster stage had been fired separately, before dawn. A cubic foot of mercury seemed to roll from Mac's shoulders as he saw Logan and Ruiz lounging at the bottom of the lift; there wasn't anything to worry about. He recalled feeling the tension before the other three flights, then chided himself. *Ya, ya, scared-y cat. Well, why not? It's a helluva risk every time you make a shot, in spite of all the propaganda. Hooey; if you didn't know everything's O.K., you wouldn't be getting ready to make the shot. Yeah, but you never can tell—* He stopped his inward battle and forced some spring into his step as he moved toward Logan and Ruiz.

"I've tried my best to abort this big bug, but I can't find anything amiss."

"That's Granny MacNamara for you," jibed Logan. "Always trying to find fault." He winked at Ruiz and rubbed his hands together. "Well—tennis, anyone?"

Mac knew without asking that Logan, for all his apparent indifference, had painstakingly gone over every phase of the flight, checking distribution, radar, final instructions from

Operations, weather, *et al.* Ruiz, as usual, watched and took notes as Logan gathered data.

At minus fifteen minutes, the trio was in the dome, checking personal equipment, while outside, the scaffolding ponderously slid away, section by section.

There was little time for soliloquies of *to go, or not to go;* within the quarter-hour, Captain Ruiz and Majors MacNamara and Logan would be in readiness for the final count-down. With the emergency bail-out equipment checked, the men busied themselves on another continuity test of the myriad circuits spread like a human neural system throughout the ship. All relays, servo systems and instrument leads were in perfect condition as expected, and the trio was settled comfortably in acceleration couches with minutes to spare.

Logan contacted Ground Control a few seconds after the minus-three minute signal, informing all and sundry that Gridley could fire when ready. MacNamara sighed, thinking that if Logan's humor wasn't exactly original, it was surely tenacious.

The ship was brought to dim half-life at minus one minute by Logan's agile fingers, and as the final count-down rasped in his headset, Mac felt his innards wrestle among themselves.

Valier bellowed her enthusiasm suddenly, lifting her eight thousand-odd tons from the ground almost instantly. Inside, her occupants grimaced helplessly as they watched various instruments guide tiny pointers across calibrated faces. Mac's throat mike threatened to crush his Adam's apple, weighing five times its usual few ounces. Of his senses, sound was the one that dominated him; an intolerable, continuous explosion from the motors racked his mind like tidal waves of formic acid. He forced himself to overcome the numbness which his brain cast up to defend itself. Then, as quickly as it had begun, *Valier* fell deafeningly silent; that meant Mach 1 was passed.

It was an eternity before stage one separated. The loss of the empty hulk was hardly felt as *Valier* streaked high over the Texas border. Ruiz, watching the radarscope, saw Lubbock slide into focus miles below. *Next stop, Fort Worth*, he thought. *I used to drive that in five hours*. The jagged line of the caprock told him they were well on their way to Fort Worth already.

The altimeter showed slightly over forty-two miles when stage two detached itself. Logan, in constant contact with White Sands, was informed that they were tracking perfectly as *Valier* arrowed over central Texas toward rendezvous at the doughnut. The exhausted lower stages were forgotten now; only the second stage was of any concern anyway. The radar boys tracked it all the way down, ready to detonate it high in the air if its huge 'chutes wafted it near any

inhabited community.

The motors of stage three blasted for a carefully calculated few seconds, then cut out automatically. With the destitution of his weight, Mac felt his spirits soar also. They were almost in orbit, now, climbing at a slight angle with a velocity sufficient to carry them around Earth forever, a streamlined, tiny satellite.

After the first few moments of disorientation, rocket crews found that a weightless condition gave them, ambiguously, a bouyant feeling. Only the doughnut crew had really adapted to this condition, living as they did without the effects of gravity for hours at a time every day. The temporary "housing" was rotated for comfort of the crews during rest periods, but while moving the plates and girders of the giant doughnut into place, they had no such luxuries. For these men, weightlessness became an integral part of their activities, but the rocket crews were subjected to this phenomenon only during the few hours needed to rendezvous, unload the cargo, and coast back after another initial period of acceleration.

Hence, Mac felt a strange elation when he tapped his fingers on the arm of his couch and saw his arm float upward, due to reaction from the tap.

Against all regulations, Logan unstrapped himself and motioned his comrades to do the same. This unorthodox seventh-inning stretch was prohibited because it left the pilot's arm-rest controls without an operator, hence could prove disastrous if, through some malfunction, the ship should veer off course.

The autopilot functioned perfectly, however, and Logan trusted it to the point of insouciance. The three men lounged in midair, grinning foolishly as they "swam" about the tiny cabin. No more satisfying stretch was ever enjoyed.

A few minutes of this was enough. Ruiz was the first to gingerly pull himself into his couch and his companions followed. Not a word had passed between them, since they were at all times in contact with monitor stations spaced across the world below. The first time they had enjoyed this irregular horseplay, on the second trip, Logan had made the mistake of saying, "Race you to the air lock!", and was hard put to explain those words. Nor could Logan switch to "intercom only," since a sudden radio silence would create anxiety below. Only their heavy breathing would indicate unusual activity to Earthside.

They were nearing the intercept point, a thousand miles above the Atlantic, when they realized their predicament.

"I'm in a fix, Carl," said Ruiz, meaning that he had tentatively fixed a position of intercept. "Correct our elevation; we're point-nine degrees high."

"Right-o. Correction in five seconds

from my mark—mark!"

For slight corrections in the flight path, small steering motors were utilized. These motors were located near the rear lip of *Valier's* conical cargo section on retractable booms. Extension of the motors with no resultant air friction gave a longer pivot arm and consequently better efficiency. Mac pressed the "Aux. Steer" stud and immediately three amber lights winked on in their respective instrument consoles.

Carl Logan fired the twelve o'clock motor briefly—only it didn't fire. The change in momentum wouldn't be much in any case, but it was always perceptible by feel and by instrument. There was no change.

Logan tried the firing circuit again, and again. Still *Valier* streaked along, now miles above the intended point of intercept. By this time, the embryo space station was quite near, sailing along in the 'scope beneath them. It slowly moved toward the top of the 'scope, passing *Valier* in its slightly higher relative velocity.

"We've got troubles, Mac—find 'em!" Logan had finally lost the devil-may-care attitude, but that fact was small consolation to MacNamara.

"Keep your mitts off those firing studs, Carl," he growled, unstrapping himself quickly. The malfunction was definitely in the auxiliary motor setup, he thought. A common trouble? It wouldn't pay to find out. If the other motors fired, it would only throw them farther off-course. If worst came to worst, they could roll *Valier* over and use the six o'clock auxiliary; there was a small arc through which the motors could turn on their mounts. But the trouble was unknown, and they might end up rifling or pinwheeling if they didn't let bad enough alone.

During his mental trouble-shooting, Mac was busily worming his bulk into a balloonish-looking suit identical to those worn by the doughnut's construction crew. Ruiz gave him some aid, helping him thrust his arms past the spring-folded elbow joints. For some reason, the legs gave less trouble. Within a fumbling few moments, he was ready for work.

He glanced at Logan through his visor, feeling a vicious pleasure over the beads of sweat on Logan's forehead. Time he sweated a little, thought the mechanic.

A final check of his headset followed, after which Mac oozed into the Lilliputian air lock at the bottom, now rear, wall of the cabin. He nodded to Ruiz, who secured the air lock, then adjusted his suit control to force a little pressure into his suit. Gradually the suit became livable. Then he cracked the other air-lock valve and allowed pressure to leak out around him.

His suit puffed out with soft popping noises and Mac heard the last vestige of air hiss out of the chamber. He found the hatchway too tight for

comfort and had a moment of fear when his tool pack caught in the orifice, wedging him neatly. He could hear Logan and Ruiz through his earphones, explaining their plight to Ground Control. They wanted to know why in blue blazes *Valier* hadn't contacted the doughnut when it came within range, and Logan had no defense save preoccupation with his own plight. Belatedly, Ruiz made radio contact with the doughnut, which was still well within range. All this time, Mac busied himself with his inspection light, tracing the electrical leads to the small, turbine operated auxiliary motor fuel pumps.

"Mac?" Logan's voice startled him. "Can you brace yourself? I'm going to try to match velocities with the doughnut. Won't take over one 'g' for a few seconds."

"Wait a minute." He looked wildly about him. *Valier* hadn't been built with a view toward stowaways; and every cubic inch of space was crammed with something, except for the passageway with its ladder, leading up from the main motor section. Well, if it wasn't over a "g," he could hang on to the ladder. Suit weighs another fifty pounds, though. My weight plus fifty, he thought. "Give me a chance to get set," he said aloud. He hooked one bulbous leg over a ladder rung and braced the other against a lower rung, hugging the ladder with both arms. "Any time you say, but kill it if you hear me holler!"

"Then five seconds from my mark —mark!" Mac tightened his grip, and then sagged backward as the main motors fired. The vibrations shook him slightly but deeply, and he fought to keep his hold. He felt his back creak and pop with the sudden surge of weight. Then the motors shut off, and Mac skidded several feet up the ladder. No matter how fast a man's reactions were, they couldn't be applied quickly enough to keep him from starting an involuntary leap after bracing against a suddenly removed gravity load. "All over, Mac. You O.K.?"

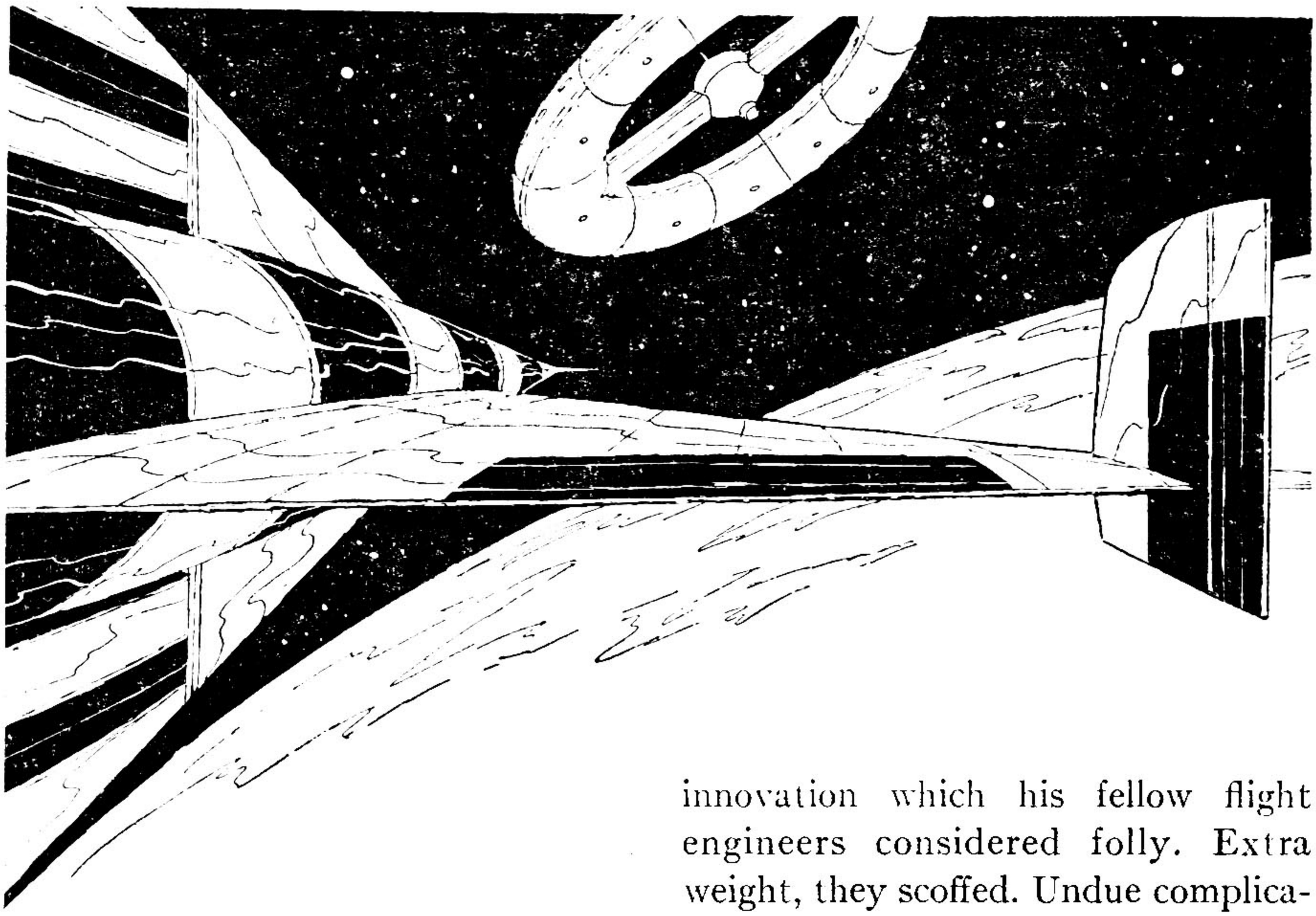
"Guess so, but I feel like a ping-pong ball. How're we sittin'?"

"Just fine," Ruiz cut in. "Find anything?"

"Not yet." Mac started his search anew. Everything seemed in perfect order up to the turbine pumps. Then, he feared, the trouble was near the little motors. That was tough, really tough. With the motors retracted it was next to impossible to get to them, past their hydraulically-operated booms and actuators. Extended, he'd have to go outside. He cringed from the thought, although he knew that there was little to fear if he linked himself to the ship.

He peered along the beam of light, searching for some telltale discoloration in wiring, or a gleaming icy patch which would indicate a fuel leak. "Might be the firing plugs," he muttered.

"Let's hope not. Where are you,



Mac? Maybe you better give us a blow-by-blow." Logan sounded worried.

"Good idea. Right now I'm at the nine o'clock actuator. Nothing so far." He looked around himself, forgetting for the moment how he was supposed to get past the equipment to the other auxiliary motor stations.

"Johnny," he said slowly, "I think you'd best break out the tapes. Auxiliary motor system; you'll find them under power plant." Months before, MacNamara had made a complete set of tape recordings of his own voice, recorded as he made a thorough-going rundown of every system and its components. This was a personal innovation which his fellow flight engineers considered folly. Extra weight, they scoffed. Undue complication. Mac nodded and went on with his impromptu speechmaking; a professional psychiatrist might have said, correctly, that Mac felt an unconscious need for supervision, a forgivable deficiency dating back to his cadet days. Mac simply claimed that the best of men could forget or omit when alone with a few million dollars' worth of Uncle's equipment. This way he could remind himself of each step to be taken ahead of time, in his own way.

The co-pilot rushed to comply. Mac, waiting, suddenly remembered how to get past his obstacle. Internal braces which helped keep the tanks rigidly in place on Earth were of little use while in "freeloading," or gravity-less, state. The braces were removable, and Mac

had loosened a single wing-nut to let the brace swing loose when he heard Johnny Ruiz's answer.

"Ready with your tape, Mac. Where shall I start it?"

"Run it through 'til you get to a blank spot, then another, then stopit." He was certain he didn't really need the tape, but it was a maintenance aid and he was determined to use it.

He heard a click, then a hum, as the recorder was jacked into his headset circuit. Immediately, a familiar voice began a slow dissertation on power leads from the dome, speeded up in the space of a second or two to a high-pitched alien gibberish, then to a faint scream. He began squirming around the turbine tanks, got past the first brace, and turned to attach it again. Of course it wasn't necessary, but—"PLAY IT SAFE" was embroidered on his brain by years of maintenance experience; back in his old maintenance squadron, he'd been called "the old lady" instead of "the old man," due to his insistence on precautions.

Ruiz slowed the tape suddenly, on cue, and Mac heard himself saying, ". . . Brace back in its slot and pin it. Be careful of those linkages on the turbine pumps. Now crawl around to the next brace and unpin it." Pause, scraping noises, and a muttered oath. "Pin sticks, but it won't without a load on it." It didn't.

He worked slower than he had on the ground, fumbling with the heavy gloves and cursing mightily. His voice rambled on, warning him of obstacles and reminding him about minor points that could give trouble. He listened carefully, discarding each suggestion.

Floating near the twelve o'clock auxiliary, Mac peered at each tubing connection, tugging and twisting. "Wait a minute," he said. His light flashed out at the motor, riding perched on its swivel, limned against cold, hard points of light that were the stars. His heart gave a bound. "I think I've found it!" His other voice droned on morbidly. "Turn that thing off a minute, Johnny. Listen; there's a lead to the twelve o'clock fuel valve solenoid that looks like . . . yes, I'm sure of it. It's pulled away from a bracket and looks like it might be charred." Mac twisted around to view the wiring better.

"Can you fix it?"

"Oh, sure, if that's all there is wrong. But I'd rather do the work with the motors retracted. Tell you what; retract them about forty-five degrees when I give the word."

Mac judged the distance the booms would cover during semiretraction and half floated, half crawled out of the way. He found himself breathing heavily, despite the freeload conditions. His suit was simply too cumbersome. The thought came to him that he didn't even know how long he'd been out of the dome. His breathing oxygen gauge showed half empty, so he must have been on the job for

around a half hour. He rationed his supply a bit, hoping he could finish the job without a refill.

"O.K., Johnny, you can run the tape again. And retract the motors while you're at it." He heard the tape start again on its course, watching the booms.

They leaped inward, then, and Mac felt a crushing blow across his back. He shook his head groggily and yelled.

He tried to scramble from his place between motor and turbine fuel lines without success; he was trapped like a wild animal by the heavy actuator which had swung past his head. He heard himself say, "And be sure to stay clear of the actuator. It swings through a ninety-degree arc when it's operated."

"Oh, shut up! I know it; I just judged it wrong." The tape moved on unperturbedly, reminding him to inspect the actuator bearings and extension rods.

"Mac," came Logan's voice, "you might try to hurry it. If you can't get it fixed in an hour or two, we'll have to try rolling *Valier* down to the doughnut. But it's up to you, fella. Take your time."

"Well, you might help me a bit by raising this hydraulic unit offa my shoulders. Lucky it didn't squash me." The actuator stayed where it was. "Johnny! Carl! Do you read me?" No answer. Obviously, the actuator had smashed his transmitter, but left the receiver section intact. Then all he could hope for would be a suspicion from one of the others that all was not well. If they asked him any questions and he failed to reply, they'd figure something was wrong. Well, he couldn't count on that.

He struggled with his vulcanized suit, trying to squeeze from under the actuator. If I'd had them retract it completely, he thought, I'd be a dead man. It was a tight squeeze, but he inched his way out of the trap by using every ounce of strength at his command. If his suit tore, he'd know it in a hurry.

Gasping for breath, Mac drew himself into a crouch and regarded the offending wire. His flashlight still operated, and he could see the heavy insulation which had been scraped away. No charring; then it must have been the extension rods that had scissored through the insulation. The wire hung together by a thread, the strands of metal severed completely. He groped for his tool kit, trying to ignore the voice in his headset.

"Well, that takes care of the actuators. Now for these dinky motors. The swivel mounts have to work without any lubricant, so look for indications of wear and—"

Mac cursed under his breath. He sounded so cocksure, so all-knowing. He felt like beating himself. His earlier self, who had blithely toured *Valier* trailing the microphone wires without any real premonition of trouble. It always happens to the

other guy— Not this time, chum, he reminded himself.

The gloves were systematically foiling his attempts to withdraw the coil of wire at his side. The tool kit was the ultimate in maintenance work, compact and complete with extension handles for the cutters and wrenches. Everything was there, but practically impossible to use. His fingers finally closed over the wire; he jerked it out and with it the splice tool. The little pliers caromed from the brace above him and sailed out toward the motor, beyond the ship. He watched, horrified, as the tool slowly cartwheeled away into space.

"All right," he muttered, "scratch one splice tool. It was also my only pair of pliers, but I'll manage." He knew he could use the wire cutters in a pinch. "In a pinch," he repeated. "Oh, that's a hot one. That's about all that's happened this trip, so far. Pinch me, pinch the wiring—What a pinch!"

Holding the roll of wire tightly in one hand, he grasped the cutters and pulled them from the kit with utmost care. He unrolled a foot-long section of wire and clipped it off, laying his flashlight in the tool kit so that it would shine out in front of him. He managed to attach the tiny splice lugs by pinching them with the cutters, then moved cautiously to the wire which still drooped from the jumble of machinery. "Drooped" wasn't precisely the word; actually the wire had been bent into its position and stayed that way.

As the harried major reached for the brace on which the wire had been bracketed, his tool kit vomited flashlight, wrenches and screwdrivers, leaving him in total darkness. His cursing was regular, now, monotonous and uninspired. There was another pencil light in the kit, snapped tightly to the case, and Mac reached for the whole business. The spare light was a maintenance problem in itself. Question: How to retrieve a fountain pen sized object, when it's held by a small snap and the retriever is encumbered by three pairs of arctic mittens?

Mac saw his errant flashlight out of the corner of his eye, its beam fastened on a collapsed screw driver while both swam sluggishly toward the inspection ladder. He located the pencil light and jerked it loose, holding the short wire and cutters in his other hand.

This, Mac knew, was the crucial point. If he could splice the wire hanging in front of him, *Valier* would once more be in perfect shape. He would have welcomed an extra hand or two, as he straddled a brace and shoved the tiny flash between his headpiece and shoulder fabric. The wire should be stripped, he knew, but he hadn't the tools. They were scarcely ten feet from him, but could have rested atop the Kremlin for all the good they did him. He got most of the strands of one end of wire shoved into a splice lug,

and called it good enough. It was like trying to thread a needle whose eye was deeper than it was wide, while in a diving suit, using the business end of a paintbrush to start the thread.

He withdrew one hand and searched the kit for friction tape. It might be mentioned that an insulating tape which would be adhesive at minus two hundred degrees centigrade yet keep its properties at plus one thousand, was the near culmination of chemical science. Silicon plastic research provided the adhesive, an inert gum which changed almost none through a fantastic range of temperatures and pressures. The tape Mac used to insure his connection had an asbestos base, with adhesive gum insinuated into the tape. He wrapped the wire tightly, then bound it to the brace. He noticed his visor fogging up and felt a faint, giddy sensation. Anoxemia! He let the tape drift as he reached for his regulator dial. *What a fool he was*, he thought, *to starve his lungs*. He turned the dial to emergency maximum and gulped precious liters of oxygen-helium mixture. The gauge showed a store of the gas which might possibly be enough to last him, if nothing else went wrong; perhaps ten minutes.

The pencil flash, mercifully, still rested in a fold of his shoulder joint fabric. The insulation tape floated near his waist; he grabbed it and stowed it between his knee and the brace, then reached once again for the wiring.

This time the splice went on without a hitch. He pinched the splice lug and taped the whole works feverishly. It was done; he had won. The trip back should take only a couple of minutes. Replacing the wire cutters in his kit, he held the pencil flash before him and started retracing his route.

He passed the twelve o'clock brace, pinned it in place again and saw one of his tools floating to the right of his head. He gathered it in and swept his tiny flash around in search of other jetsam from his tool kit. He collected a wrench and the skittish flashlight, started toward the last brace between him and the ladder, and felt his legs go limp. He wasn't particularly alarmed about it; his arms and vision failed him too, but his brain hadn't enough incoming oxygen to care much, one way or the other. The few remaining feet seemed to lengthen into a sewer-like passageway, then vanished as did all else as his perceptions died.

MacNamara was not the sort to wonder about heaven or hell when he first awoke. He saw a faintly rounded ceiling, a soft yellow tint accentuating its featurelessness. "How the devil—", he began. His voice failed him.

"Hi, Mac." Logan's beaming face loomed over him. "You rugged character, you. Cold as a pickle an hour ago, and already you're askin' silly questions." He held up his hand as Mac started to speak. "I hear you thinkin'. 'How the devil did I get here, and

where is here?' In reverse order, this is the most comfortable berth in the doughnut's facilities, and you got here courtesy of one Johnny Ruiz. Myself, I wouldn't have taken the trouble."

Mac grinned back at his pilot and cleared his throat. "Well, where is he? I wanta shake his hand, or give him half my knigdom, or something."

"You know Johnny; the shy type. He'll be along after a while. You know, I think he kinda likes you; when you quit transmitting out there, Johnny was like a cat on a hot skillet. Finally decided to go back and have a look for himself, but I told him you probably had a hot game of solitaire going. Anyway, he went back and found you asleep on the job, and lost a good ten pounds getting your fat carcass through the air lock." That was a job that must have taxed both Ruiz and Logan, but Mac held his silence. "And that was about the size of it. *Valier's* parked outside with some of the boys, good as ever. Come on, we'll sop up some coffee."

Mac swung himself up to a sitting position and realized dizzily that he was mother-naked. His ribs felt pulverized. "You guys sure mauled me up," he said accusingly.

"Unavoidable, my dear grease-monkey. You needed a little artificial respiration; I never was too good at that."

"Well, whoever did the job rates a prize of some sort," Mac answered, "but my ribs tell me he had more enthusiasm than practice."

Logan smiled his old familiar smile, relieved to find his engineer in joking spirits. "The credit again goes to Johnny. But," he added, "try not to be too hard on him. Try gaving artificial respiration to a big lump like yourself sometime, without any gravity."

Mac digested this tidbit as he pulled on a fresh pair of coveralls. "O.K.," he said, standing on the foamex "floor." "How did he do it?"

"Strapped you into your couch face down and locked his legs around it. I didn't dare apply any g's. Come on," he finished, "you've managed to upset every timetable in the project. Johnny's shaking like a leaf, or was when I left him. A bulb of coffee will do us both a world of good."

"I'm sold," Mac grunted, zipping up a flight boot. "But there's something I'd like to do, first chance I get."

"Which is?"

"Which is jettison every last strip of tape I have in *Valier*. I tell you, Logan," he went on as they entered the recreation bar, "you'll never know how degrading it is to hear useless, insipid information offered to you when you're in a tight spot, knowing full well the voice is your own!"

THE END

GRANDPA

BY JAMES H. SCHMITZ

The really appropriate epitaph for many and many a man is "Why, it's obvious . . ." Like it was obvious that Grandpa was just a vast, stupid vegetable, and no more. . . .

Illustrated by Kelly Freas

A green-winged, downy thing as big as a hen fluttered along the hillside to a point directly above Cord's head and hovered there, twenty feet above him. Cord, a fifteen-year-old human being, leaned back against a skipboat parked on the equator of a world that had known human beings for only the past four Earth-years, and eyed the thing speculatively. The thing was, in the free and easy terminology of the Sutang Colonial Team, a swamp bug. Concealed in the downy fur back of the bug's head was a second, smaller, semiparasitical thing, classed as a bug rider.

The bug itself looked like a new species to Cord. Its parasite might or might not turn out to be another unknown. Cord was a natural research man; his first glimpse of the odd flying team had sent endless curiosities thrilling through him. How did that particular phenomenon tick, and why? What fascinating things, once you'd learned about it, could you get it to *do*?

Normally, he was hampered by circumstances in carrying out any such investigation. The Colonial Team was a practical, hard-working outfit—two thousand people who'd been given twenty years to size up and tame down the brand-new world of Sutang to the point where a hundred thousand colonists could be settled on it, in reasonable safety and comfort. Even junior colonial students like Cord were expected to confine their curiosity to the pattern of research set up by the

Station to which they were attached. Cord's inclination towards independent experiments had got him into disfavor with his immediate superiors before this.

He sent a casual glance in the direction of the Yoger Bay Colonial Station behind him. No signs of human activity about that low, fortresslike bulk in the hill. Its central lock was still closed. In fifteen minutes, it was scheduled to be opened to let out the Planetary Regent, who was inspecting the Yoger Bay Station and its principal activities today.

Fifteen minutes was time enough to find out something about the new bug, Cord decided.

But he'd have to collect it first.

He slid out one of the two handguns holstered at his side. This one was his own property: a Vanadian projectile weapon. Cord thumbed it to position for anaesthetic small-game missiles and brought the hovering swamp bug down, drilled neatly and microscopically through the head.

As the bug hit the ground, the rider left its back. A tiny scarlet demon, round and bouncy as a rubber ball, it shot towards Cord in three long hops, mouth wide to sink home inch-long, venom-dripping fangs. Rather breathlessly, Cord triggered the gun again and knocked it out in mid-leap. A new species, all right! Most bug riders were harmless plant eaters, mere suckers of vegetable juice—

"*Cord!*" A feminine voice.

Cord swore softly. He hadn't heard the central lock click open. She must have come around from the other side of the station.

"Hi, Grayan!" he shouted innocently without looking around. "Come see what I got! New species!"

Grayan Mahoney, a slender, black-haired girl two years older than himself, came trotting down the hillside towards him. She was Sutang's star colonial student, and the station manager, Nirmond, indicated from time to time that she was a fine example for Cord to pattern his own behavior on. In spite of that, she and Cord were good friends, but she bossed him around considerably.

"Cord, you dope!" she scowled as she came up. "Quit acting like a collector! If the Regent came out now, you'd be sunk. Nirmond's been telling her about you!"

"Telling her what?" Cord asked, startled.

"For one," Grayan reported, "that you don't keep up on your assigned work. Two, that you sneak off on one-man expeditions of your own at least once a month and have to be rescued—"

"Nobody," Cord interrupted hotly, "has had to rescue me yet!"

"How's Nirmond to know you're alive and healthy when you just drop out of sight for a week?" Grayan countered. "Three," she resumed, checking the items off on slim finger-

tips, "he complained that you keep private zoological gardens of unidentified and possibly deadly vermin in the woods back of the station. And four . . . well, Nirmond simply doesn't want the responsibility for you any more!" She held up the four fingers significantly.

"Golly!" gulped Cord, dismayed. Summed up tersely like that, his record *didn't* look too good.

"Golly, is right! I keep warning you! Now Nirmond wants the Regent to send you back to Vanadia—and there's a starship coming in to New Venus forty-eight hours from now!" New Venus was the Colonial Team's main settlement on the opposite side of Sutang.

"What'll I do?"

"Start acting like you had good sense mainly." Grayan grinned suddenly. "I talked to the Regent, too—Nirmond isn't rid of you yet! But if you louse up on our tour of the Bay Farms today, you'll be off the Team for good!"

She turned to go. "You might as well put the skipboat back; we're not using it. Nirmond's driving us down to the edge of the Bay in a treadcar, and we'll take a raft from there. Don't let them know I warned you!"

Cord looked after her, slightly stunned. He hadn't realized his reputation had become as bad as all that! To Grayan, whose family had served on Colonial Teams for the past four generations, nothing worse was imagi-

nable than to be dismissed and sent back ignominiously to one's own home-world. Much to his surprise, Cord was discovering now that he felt exactly the same way about it!

Leaving his newly bagged specimens to revive by themselves and flutter off again, he hurriedly flew the skipboat around the station and rolled it back into its stall.

Three rafts lay moored just offshore in the marshy cove, at the edge of which Nirmond had stopped the treadcar. They looked somewhat like exceptionally broad-brimmed, well-worn sugar-loaf hats floating out there, green and leathery. Or like lily pads twenty-five feet across, with the upper section of a big, gray-green pineapple growing from the center of each. Plant animals of some sort. Sutang was too new to have had its phyla sorted out into anything remotely like an orderly classification. The rafts were a local oddity which had been investigated and could be regarded as harmless and moderately useful. Their usefulness lay in the fact that they were employed as a rather slow means of transportation about the shallow, swampy waters of the Yoger Bay. That was as far as the Team's interest in them went at present.

The Regent had stood up from the back seat of the car, where she was sitting next to Cord. There were only four in the party; Grayan was up front with Nirmond.

"Are those our vehicles?" The Regent sounded amused.

Nirmond grinned, a little sourly. "Don't underestimate them, Dane! They could become an important economic factor in this region in time. But, as a matter of fact, these three are smaller than I like to use." He was peering about the reedy edges of the cove. "There's a regular monster parked here usually—"

Grayan turned to Cord. "Maybe Cord knows where Grandpa is hiding."

It was well-meant, but Cord had been hoping nobody would ask him about Grandpa. Now they all looked at him.

"Oh, you want Grandpa?" he said, somewhat flustered. "Well, I left him . . . I mean I saw him a couple of weeks ago about a mile south from here—"

Grayan sighed. Nirmond grunted and told the Regent, "The rafts tend to stay wherever they're left, providing it's shallow and muddy. They use a hair-root system to draw chemicals and microscopic nourishment directly from the bottom of the bay. Well—Grayan, would you like to drive us there?"

Cord settled back unhappily as the treadcar lurched into motion. Nirmond suspected he'd used Grandpa for one of his unauthorized tours of the area, and Nirmond was quite right.

"I understand you're an expert with these rafts, Cord," Dane said from beside him. "Grayan told me we

couldn't find a better steersman, or pilot, or whatever you call it, for our trip today."

"I can handle them," Cord said, perspiring. "They don't give you any trouble!" He didn't feel he'd made a good impression on the Regent so far. Dane was a young, handsome-looking woman with an easy way of talking and laughing, but she wasn't the head of the Sutang Colonial Team for nothing. She looked quite capable of shipping out anybody whose record wasn't up to par.

"There's one big advantage our beasties have over a skipboat, too," Nirmond remarked from the front seat. "You don't have to worry about a snapper trying to climb on board with you!" He went on to describe the stinging ribbon-tentacles the rafts spread around them under water to discourage creatures that might make a meal off their tender underparts. The snappers and two or three other active and aggressive species of the bay hadn't yet learned it was foolish to attack armed human beings in a boat, but they would skitter hurriedly out of the path of a leisurely perambulating raft.

Cord was happy to be ignored for the moment. The Regent, Nirmond and Grayan were all Earth people, which was true of most of the members of the Team; and Earth people made him uncomfortable, particularly in groups. Vanadia, his own home world, had barely graduated from the status of Earth colony itself, which might explain the difference. All the Earth people he'd met so far seemed dedicated to what Grayan Mahoney called the Big Picture, while Nirmond usually spoke of it as "Our Purpose Here." They acted strictly in accordance with their Team Regulations—sometimes, in Cord's opinion, quite insanely. Because now and then the Regulations didn't quite cover a new situation, and then somebody was likely to get killed. In which case, the Regulations would be modified promptly, but Earth people didn't seem otherwise disturbed by such events.

Grayan had tried to explain it to Cord:

"We can't really ever *know* in advance what a new world is going to be like! And once we're there, there's too much to do, in the time we've got, to study it inch by inch. You get your job done, and you take a chance. But if you stick by the Regulations you've got the best chances of surviving anybody's been able to figure out for you—"

Cord felt he preferred to just use good sense and not let Regulations or the job get him into a situation he couldn't figure out for himself.

To which Grayan replied impatiently that he hadn't yet got the Big Picture—

The treadcar swung around and stopped, and Grayan stood up in the

front seat, pointing. "That's Grandpa, over there!"

Dane also stood up and whistled softly, apparently impressed by Grandpa's fifty-foot spread. Cord looked around in surprise. He was pretty sure this was several hundred yards from the spot where he'd left the big raft two weeks ago; and, as Nirmond said, they didn't usually move about by themselves.

Puzzled, he followed the others down a narrow path to the water, hemmed in by tree-sized reeds. Now and then he got a glimpse of Grandpa's swimming platform, the rim of which just touched the shore. Then the path opened out, and he saw the whole raft lying in sunlit, shallow water; and he stopped short, startled.

Nirmond was about to step up on the platform, ahead of Dane.

"Wait!" Cord shouted. His voice sounded squeaky with alarm. "Stop!"

He came running forward.

They had frozen where they stood, looked around swiftly. Then glanced back at Cord coming up. They were well-trained.

"What's the matter, Cord?" Nirmond's voice was quiet and urgent.

"Don't get on that raft—it's changed!" Cord's voice sounded wobbly, even to himself. "Maybe it's not even Grandpa—"

He saw he was wrong on the last point before he'd finished the sentence. Scattered along the rim of the raft were discolored spots left by a variety of heat-guns, one of which had been his own. It was the way you goaded the sluggish and mindless things into motion. Cord pointed at the cone-shaped central projection. "There—his head! He's sprouting!"

"Sprouting?" the station manager repeated uncomprehendingly. Grandpa's head, as befitted his girth, was almost twelve feet high and equally wide. It was armor-plated like the back of a saurian to keep off plant suckers, but two weeks ago it had been an otherwise featureless knob, like those on all other rafts. Now scores of long, kinky, leafless vines had grown out from all surfaces of the cone, like green wires. Some were drawn up like tightly coiled springs, others trailed limply to the platform and over it. The top of the cone was dotted with angry red buds, rather like pimples, which hadn't been there before either. Grandpa looked unhealthy.

"Well," Nirmond said, "so it is. Sprouting!" Grayan made a choked sound. Nirmond glanced at Cord as if puzzled. "Is that all that was bothering you, Cord?"

"Well, sure!" Cord began excitedly. He hadn't caught the significance of the word "all"; his hackles were still up, and he was shaking. "None of them ever—"

Then he stopped. He could tell by their faces that they hadn't got it. Or rather, that they'd got it all right but simply weren't going to let it change

their plans. The rafts were classified as harmless, according to the Regulations. Until proved otherwise, they would continue to be regarded as harmless. You didn't waste time quibbling with the Regulations—apparently even if you were the Planetary Regent. You didn't feel you had the time to waste.

He tried again. "Look—" he began. What he wanted to tell them was that Grandpa with one unknown factor added wasn't Grandpa any more. He was an unpredictable, oversized life form, to be investigated with cautious thoroughness till you knew what the unknown factor meant.

But it was no use. They knew all that. He stared at them helplessly. "I—"

Dane turned to Nirmond. "Perhaps you'd better check," she said. She didn't add, "—to reassure the boy!" but that was what she meant.

Cord felt himself flushing terribly. They thought he was scared—which he was—and they were feeling sorry for him, which they had no right to do. But there was nothing he could say or do now except watch Nirmond walk steadily across the platform. Grandpa shivered slightly a few times, but the rafts always did that when someone first stepped on them. The station manager stopped before one of the kinky sprouts, touched it and then gave it a tug. He reached up and poked at the lowest of the budlike growths. "Odd-looking things!" he called back. He gave Cord another glance. "Well, everything seems harmless enough, Cord. Coming aboard, everyone?"

It was like dreaming a dream in which you yelled and yelled at people and couldn't make them hear you! Cord stepped up stiff-legged on the platform behind Dane and Grayan. He knew exactly what would have happened if he'd hesitated even a moment. One of them would have said in a friendly voice, careful not to let it sound too contemptuous: "You don't have to come along if you don't want to, Cord!"

Grayan had unholstered her heat-gun and was ready to start Grandpa moving out into the channels of the Yoger Bay.

Cord hauled out his own heat-gun and said roughly, "I was to do that!"

"All right, Cord." She gave him a brief, impersonal smile as if he were someone she'd met for the first time that day, and stood aside.

They were so infuriatingly polite! He was, Cord decided, as good as on his way back to Vanadia right now.

For a while, Cord almost hoped that something awesome and catastrophic would happen promptly to teach the Team people a lesson. But nothing did. As always, Grandpa shook himself vaguely and experimentally when he felt the heat on one edge of the platform and then decided to withdraw from it, all of which was standard

procedure. Under the water, out of sight, were the raft's working sections: short, thick leaf-structures shaped like paddles and designed to work as such, along with the slimy nettle-streamers which kept the vegetarians of the Yoger Bay away, and a jungle of hair roots through which Grandpa sucked nourishment from the mud and the sluggish waters of the Bay, and with which he also anchored himself.

The paddles started churning, the platform quivered, the hair roots were hauled out of the mud; and Grandpa was on his ponderous way.

Cord switched off the heat, re-holstered his gun, and stood up. Once in motion, the rafts tended to keep traveling unhurriedly for quite a while. To stop them, you gave them a touch of heat along their leading edge; and they could be turned in any direction by using the gun lightly on the opposite side of the platform.

It was simple enough. Cord didn't look at the others. He was still burning inside. He watched the reed beds move past and open out, giving him glimpses of the misty, yellow and green and blue expanse of the brackish Bay ahead. Behind the mist, to the west, were the Yoger Straits, tricky and ugly water when the tides were running; and beyond the Straits lay the open sea, the great Zlanti Deep, which was another world entirely and one of which he hadn't seen much as yet.

Suddenly he was sick with the full realization that he wasn't likely to see any more of it now! Vanadia was a pleasant enough planet; but the wildness and strangeness were long gone from it. It wasn't Sutang.

Grayan called from beside Dane, "What's the best route from here into the farms, Cord?"

"The big channel to the right," he answered. He added somewhat sullenly, "We're headed for it!"

Grayan came over to him. "The Regent doesn't want to see all of it," she said, lowering her voice. "The algae and plankton beds first. Then as much of the mutated grains as we can show her in about three hours. Steer for the ones that have been doing best, and you'll keep Nirmond happy!"

She gave him a conspiratorial wink. Cord looked after her uncertainly. You couldn't tell from her behavior that anything was wrong. Maybe—

He had a flare of hope. It was hard to not like the Team people, even when they were being rock-headed about their Regulations. Perhaps it was that purpose that gave them their vitality and drive, even though it made them remorseless about themselves and everyone else. Anyway, the day wasn't over yet. He might still redeem himself in the Regent's opinion. Something might happen—

Cord had a sudden cheerful, if improbable vision of some bay monster plunging up on the raft with snapping jaws; and of himself alertly blowing out what passed for the monster's brains before anyone else—

Nirmond, in particular—was even aware of the threat. The bay monsters shunned Grandpa, of course, but there might be ways of tempting one of them.

So far, Cord realized, he'd been letting his feelings control him. It was time to start thinking!

Grandpa first. So he'd sprouted—green vines and red buds, purpose unknown, but with no change observable in his behavior-patterns otherwise. He was the biggest raft in this end of the Bay, though all of them had been growing steadily in the two years since Cord had first seen one. Sutang's seasons changed slowly; its year was somewhat more than five Earth-years long. The first Team members to land here hadn't yet seen a full year pass.

Grandpa then was showing a seasonal change. The other rafts, not quite so far developed, would be reacting similarly a little later. Plant animals—They might be blossoming, preparing to propagate.

"Grayan," he called, "how do the rafts get started? When they're small, I mean."

Grayan looked pleased; and Cord's hopes went up a little more. Grayan was on his side again anyway!

"Nobody knows yet," she said." We were just talking about it. About half of the coastal marsh-fauna of the continent seems to go through a preliminary larval stage in the sea." She nodded at the red buds on the raft's cone. "It *looks* as if Grandpa is going to produce flowers and let the wind or tide take the seeds out through the Straits."

It made sense. It also knocked out Cord's still half-held hope that the change in Grandpa might turn out to be drastic enough, in some way, to justify his reluctance to get on board. Cord studied Grandpa's armored head carefully once more—unwilling to give up that hope entirely. There were a series of vertical gummy black slits between the armor plates, which hadn't been in evidence two weeks ago either. It looked as if Grandpa were beginning to come apart at the seams. Which might indicate that the rafts, big as they grew to be, didn't outlive a full seasonal cycle, but came to flower at about this time of Sutang's year, and died. However, it was a safe bet that Grandpa wasn't going to collapse into senile decay before they completed their trip today.

Cord gave up on Grandpa. The other notion returned to him—Perhaps he *could* coax an obliging Bay monster into action that would show the Regent he was no sissy!

Because the monsters were there, all right.

Kneeling at the edge of the platform and peering down into the wine-colored, clear water of the deep channel they were moving through, Cord could see a fair selection of them at almost any moment.

Some five or six snappers, for one thing. Like big, flattened crayfish, chocolate-brown mostly, with green and red spots on their carapaced backs. In some areas they were so thick you'd wonder what they found to live on, except that they ate almost anything, down to chewing up the mud in which they squatted. However, they preferred their food in large chunks and alive, which was one reason you didn't go swimming in the Bay. They would attack a boat on occasion; but the excited manner in which the ones he saw were scuttling off towards the edges of the channel showed they wanted to have nothing to do with a big, moving raft.

Dotted across the bottom were two-foot round holes which looked vacant at the moment. Normally, Cord knew, there would be a head filling each of those holes. The heads consisted mainly of triple sets of jaws, held open patiently like so many traps to grab at anything that came within range of the long, wormlike bodies behind the heads. But Grandpa's passage, waving his stingers like transparent pennants through the water, had scared the worms out of sight, too.

Otherwise, mostly schools of small stuff—and then a flash of wicked scarlet, off to the left behind the raft, darting out from the reeds! Turning its needle-nose into their wake.

Cord watched it without moving. He knew that creature, though it was

rare in the Bay and hadn't been classified. Swift, vicious—alert enough to snap swamp bugs out of the air as they fluttered across the surface. And he'd tantalized one with fishing tackle once into leaping up on a moored raft, where it had flung itself about furiously until he was able to shoot it.

No fishing tackle. A handkerchief might just do it, if he cared to risk an arm—

"What fantastic creatures!" Dane's voice just behind him.

"Yellowheads," said Nirmond. "They've got a high utility rating. Keep down the bugs."

Cord stood up casually. It was no time for tricks! The reed bed to their right was thick with Yellowheads, a colony of them. Vaguely froggy things, man-sized and better. Of all the creatures he'd discovered in the Bay, Cord liked them least. The flabby, sacklike bodies clung with four thin limbs to the upper sections of the twenty-foot reeds that lined the channel. They hardly ever moved, but their huge, bulging eyes seemed to take in everything that went on about them. Every so often, a downy swamp bug came close enough; and a Yellowhead would open its vertical, enormous, tooth-lined slash of a mouth, extend the whole front of its face like a bellows in a flashing strike; and the bug would be gone. They might be useful, but Cord hated them.

"Ten years from now we should know what the cycle of coastal life is like," Nirmond said. "When we set up the Yoger Bay Station there were no Yellowheads here. They came the following year. Still with traces of the oceanic larval form; but the metamorphosis was almost complete. About twelve inches long—"

Dane remarked that the same pattern was duplicated endlessly elsewhere. The Regent was inspecting the Yellowhead colony with field glasses; she put them down now, looked at Cord and smiled. "How far to the farms?"

"About twenty minutes."

"The key," Nirmond said, "seems to be the Zlanti Basin. It must be almost a soup of life in spring."

"It is," nodded Dane, who had been here in Sutang's spring, four Earth-years ago. "It's beginning to look as if the Basin alone might justify colonization. The question is still"—she gestured towards the Yellowheads—"how do creatures like that get there?"

They walked off towards the other side of the raft, arguing about ocean currents. Cord might have followed. But something splashed back of them, off to the left and not too far back. He stayed, watching.

After a moment, he saw the big Yellowhead. It had slipped down from its reedy perch, which was what had caused the splash. Almost submerged at the water line, it stared after the raft with huge, pale-green eyes. To Cord, it seemed to look directly at him.

In that moment, he knew for the first time why he didn't like Yellowheads. There was something very like intelligence in that look, an alien calculation. In creatures like that, intelligence seemed out of place. What use could they have for it?

A little shiver went over him when it sank completely under the water and he realized it intended to swim after the raft. But it was mostly excitement. He had never seen a Yellowhead come down out of the reeds before. The obliging monster he'd been looking for might be presenting itself in an unexpected way.

Half a minute later, he watched it again, swimming awkwardly far down. It had no immediate intention of boarding, at any rate. Cord saw it come into the area of the raft's trailing stingers. It maneuvered its way between them with curiously human swimming motions, and went out of sight under the platform.

He stood up, wondering what it meant. The Yellowhead had appeared to know about the stingers; there had been an air of purpose in every move of its approach. He was tempted to tell the others about it, but there was the moment of triumph he could have if it suddenly came slobbering up over the edge of the platform and he nailed it before their eyes.

It was almost time anyway to turn the raft in towards the farms. If nothing happened before then—

He watched. Almost five minutes, but no sign of the Yellowhead. Still wondering, a little uneasy, he gave Grandpa a calculated needling of heat.

After a moment, he repeated it. Then he drew a deep breath and forgot all about the Yellowhead.

"Nirmond!" he called sharply.

The three of them were standing near the center of the platform, next to the big armored cone, looking ahead at the farms. They glanced around.

"What's the matter now, Cord?"

Cord couldn't say it for a moment. He was suddenly, terribly scared again. Something *had* gone wrong!

"The raft won't turn!" he told them.

"Give it a real burn this time!" Nirmond said.

Cord glanced up at him. Nirmond, standing a few steps in front of Dane and Grayan as if he wanted to protect them, had begun to look a little strained, and no wonder. Cord already had pressed the gun to three different points on the platform; but Grandpa appeared to have developed a sudden anaesthesia for heat. They kept moving out steadily towards the center of the Bay.

Now Cord held his breath, switched the heat on full and let Grandpa have it. A six-inch patch on the platform blistered up instantly, turned brown, then black—

Grandpa stopped dead. Just like that.

"That's right! Keep burn—" Nirmond didn't finish his order.

A giant shudder. Cord staggered back toward the water. Then the whole edge of the raft came curling up behind him and went down again, smacking the Bay with a sound like a cannon shot. He flew forward off his feet, hit the platform face down and flattened himself against it. It swelled up beneath him. Two more enormous slaps and joltings. Then quiet. He looked round for the others.

He lay within twelve feet of the central cone. Some twenty or thirty of the mysterious new vines the cone had sprouted were stretched out stiffly towards him now, like so many thin green fingers. They couldn't quite reach him. The nearest tip was still ten inches from his shoes.

But Grandpa had caught the others, all three of them. They were tumbled together at the foot of the cone, wrapped in a stiff network of green vegetable ropes, and they didn't move.

Cord drew his feet up cautiously, prepared for another earthquake reaction. But nothing happened. Then he discovered that Grandpa was back in motion on his previous course. The heat-gun had vanished. Gently, he took out the Vanadian gun.

A voice, thin and pain-filled, spoke to him from one of the three huddled bodies.

"Cord? It didn't get you?" It was the Regent.

"No," he said, keeping his voice low. He realized suddenly he'd simply assumed they were all dead. Now he felt sick and shaky.

"What are you doing?"

Cord looked at Grandpa's big, armor-plated head with a certain hunger. The cones were hollowed out inside; the station's lab had decided their chief function was to keep enough air trapped under the rafts to float them. But in that central section was also the organ that controlled Grandpa's overall reactions.

He said softly, "I got a gun and twelve heavy-duty explosive bullets. Two of them will blow that cone apart."

"No good, Cord!" the pain-racked voice told him. "If the thing sinks, we'll die anyway. You have anaesthetic charges for that gun of yours?"

He stared at her back. "Yes."

"Give Nirmond and the girl a shot each, before you do anything else. Directly into the spine, if you can. But don't come any closer—"

Somehow, Cord couldn't argue with that voice. He stood up carefully. The gun made two soft spitting sounds.

"All right," he said hoarsely. "What do I do now?"

Dane was silent a moment. "I'm sorry, Cord. I can't tell you that. I'll tell you what I can—"

She paused for some seconds again.

"This thing didn't try to kill us, Cord. It could have easily. It's incredibly strong. I saw it break Nir-

mond's legs. But as soon as we stopped moving, it just held us. They were both unconscious then—

"You've got that to go on. It was trying to pitch you within reach of its vines or tendrils, or whatever they are, too, wasn't it?"

"I think so," Cord said shakily. That was what had happened, of course; and at any moment Grandpa might try again.

"Now it's feeding us some sort of anaesthetic of its own through those vines. Tiny thorns. A sort of numbness—" Dane's voice trailed off a moment. Then she said clearly, "Look Cord—it seems we're food it's storing up! You get that?"

"Yes," he said.

"Seeding time for the rafts. There are analogues. Live food for its seed probably; not for the raft. One couldn't have counted on that. Cord?"

"Yes. I'm here."

"I want," said Dane, "to stay awake as long as I can. But there's really just one other thing—this raft's going somewhere. To some particularly favorable location. And that might be very near shore. You might make it in then; otherwise it's up to you. But keep your head and wait for a chance. No heroics, understand?"

"Sure, I understand," Cord told her. He realized then that he was talking reassuringly, as if it wasn't the Planetary Regent by someone like Grayan.

"Nirmond's the worst," Dane said. "The girl was knocked unconscious at once. If it weren't for my arm—But, if we can get help in five hours or so, everything should be all right. Let me know if anything happens, Cord."

"I will," Cord said gently again. Then he sighted his gun carefully at a point between Dane's shoulderblades, and the anaesthetic chamber made its soft, spitting sound once more. Dane's taut body relaxed slowly, and that was all.

There was no point Cord could see in letting her stay awake; because they weren't going anywhere near shore. The reed beds and the channels were already behind them, and Grandpa hadn't changed direction by the fraction of a degree. He was moving out into the open Bay—and he was picking up company!

So far, Cord could count seven big rafts within two miles of them; and on the three that were closest he could make out a sprouting of new green vines. All of them were traveling in a straight direction; and the common point they were all headed for appeared to be the roaring center of the Yoger Straits, now some three miles away!

Behind the Straits, the cold Zlanti Deep—the rolling fogs, and the open sea! It might be seeding time for the rafts, but it looked as if they weren't going to distribute their seeds in the Bay—

For a human being, Cord was a fine swimmer. He had a gun and he had a

knife; in spite of what Dane had said, he might have stood a chance among the killers of the Bay. But it would be a very small chance, at best. And it wasn't, he thought, as if there weren't still other possibilities. He was going to keep his head.

Except by accident, of course, nobody was going to come looking for them in time to do any good. If anyone did look, it would be around the Bay Farms. There were a number of rafts moored there; and it would be assumed they'd used one of them. Now and then something unexpected happened and somebody simply vanished—by the time it was figured out just what had happened on this occasion, it would be much too late.

Neither was anybody likely to notice within the next few hours that the rafts had started migrating out of the swamps through the Yoger Straits. There was a small weather station a little inland, on the north side of the Straits, which used a helicopter occasionally. It was about as improbable, Cord decided dismally, that they'd use it in the right spot just now as it would be for a jet transport to happen to come in low enough to spot them.

The fact that it was up to him, as the Regent had said, sank in a little more after that! Cord had never felt so lonely—

Simply because he was going to try it sooner or later, he carried out an experiment next that he knew couldn't work. He opened the gun's anaesthetic chamber and counted out fifty pellets—rather hurriedly because he didn't particularly want to think of what he might be using them for eventually. There were around three hundred charges left in the chamber then; and in the next few minutes Cord carefully planted a third of them in Grandpa's head.

He stopped after that. A whale might have showed signs of somnolence under a lesser load. Grandpa paddled on undisturbed. Perhaps he had become a little numb in spots, but his cells weren't equipped to distribute the soporific effect of that type of drug.

There wasn't anything else Cord could think of doing before they reached the Straits. At the rate they were moving, he calculated that would happen in something less than an hour; and if they did pass through the Straits, he was going to risk a swim. He didn't think Dane would have disapproved, under the circumstances. If the raft simply carried them all out into the foggy vastness of the Zlanti Deep, there would be no practical chance of survival left at all.

Meanwhile, Grandpa was definitely picking up speed. And there were other changes going on—minor ones, but still a little awe-inspiring to Cord. The pimply-looking red buds that dotted the upper part of the cone were opening out gradually. From the center of most of them protruded now something like a thin, wet, scarlet

worm: a worm that twisted weakly, extended itself by an inch or so, rested and twisted again, and stretched up a little farther, groping into the air. The vertical black slits between the armor plates looked somehow deeper and wider than they had been even some minutes ago; a dark, thick liquid dripped slowly from several of them.

Under other circumstances Cord knew he would have been fascinated by these developments in Grandpa. As it was, they drew his suspicious attention only because he didn't know what they meant.

Then something quite horrible happened suddenly. Grayan started moaning loudly and terribly and twisted almost completely around. Afterwards, Cord knew it hadn't been a second before he stopped her struggles and the sounds together with another anaesthetic pellet; but the vines had tightened their grip on her first, not flexibly but like the digging, bony green talons of some monstrous bird of prey. If Dane hadn't warned him—

White and sweating, Cord put his gun down slowly while the vines relaxed again. Grayan didn't seem to have suffered any additional harm; and she would certainly have been the first to point out that his murderous rage might have been as intelligently directed against a machine. But for some moments Cord continued to luxuriate furiously in the thought that, at any instant he chose, he could still turn the raft very quickly into a ripped and exploded mess of sinking vegetation.

Instead, and more sensibly, he gave both Dane and Nirmond another shot, to prevent a similar occurrence with them. The contents of two such pellets, he knew, would keep any human being torpid for at least four hours. Five shots—

Cord withdrew his mind hastily from the direction it was turning into; but it wouldn't stay withdrawn. The thought kept coming up again, until at last he had to recognize it:

Five shots would leave the three of of them completely unconscious, whatever else might happen to them, until they either died from other causes or were given a counteracting agent.

Shocked, he told himself he couldn't do it. It was exactly like killing them.

But then, quite steadily, he found himself raising the gun once more, to bring the total charge for each of the three Team people up to five. And if it was the first time in the last four years Cord had felt like crying, it also seemed to him that he had begun to understand what was meant by using your head—along with other things.

Barely thirty minutes later, he watched a raft as big as the one he rode go sliding into the foaming white waters of the Straits a few hundred yards ahead, and dart off abruptly at an angle, caught by one of the swirling currents. It pitched and spun, made

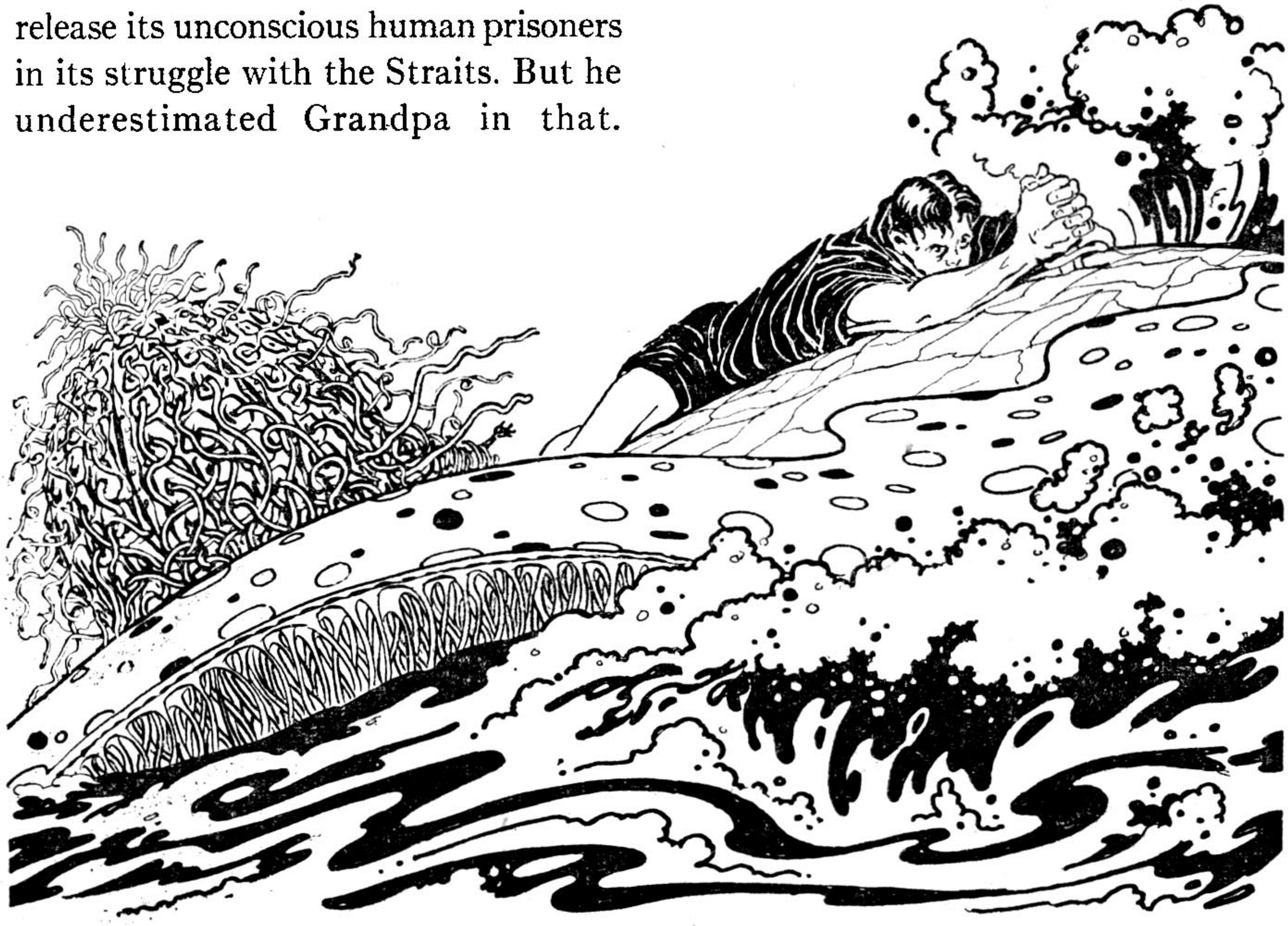
some headway, and was swept aside again. And then it righted itself once more. Not like some blindly animated vegetable, Cord thought, but like a creature that struggled with intelligent purpose to maintain its chosen direction.

At least, they seemed practically unsinkable—

Knife in hand, he flattened himself against the platform as the Straits roared just ahead. When the platform jolted and tilted up beneath him, he rammed the knife all the way into it and hung on. Cold water rushed suddenly over him, and Grandpa shuddered like a laboring engine. In the middle of it all, Cord had the horrified notion that the raft might release its unconscious human prisoners in its struggle with the Straits. But he underestimated Grandpa in that. Grandpa also hung on.

Abruptly, it was over. They were riding a long swell, and there were three other rafts not far away. The Straits had swept them together, but they seemed to have no interest in one another's company. As Cord stood up shakily and began to strip off his clothes, they were visibly drawing apart again. The platform of one of them was half-submerged; it must have lost too much of the air that held it afloat and, like a small ship, it was foundering.

From this point, it was only a two-mile swim to the shore north of the Straits, and another mile inland from



there to the Straits Head Station. He didn't know about the current; but the distance didn't seem too much, and he couldn't bring himself to leave knife and gun behind. The Bay creatures loved warmth and mud, they didn't venture beyond the Straits. But Zlanti Deep bred its own killers, though they weren't often observed so close to shore.

Things were beginning to look rather hopeful.

Thin, crying voices drifted overhead, like the voices of curious cats, as Cord knotted his clothes into a tight bundle, shoes inside. He looked up. There were four of them circling there: magnified sea-going swamp bugs, each carrying an unseen rider. Probably harmless scavengers—but the ten-foot wingspread was impressive. Uneasily, Cord remembered the venomously carnivorous rider he'd left lying beside the station.

One of them dipped lazily and came sliding down towards him. It soared overhead and came back, to hover about the raft's cone.

The bug rider that directed the mindless flier hadn't been interested in him at all! Grandpa was baiting it!

Cord stared in fascination. The top of the cone was alive now with a softly wriggling mass of the scarlet, wormlike extrusions that had started sprouting before the raft left the Bay. Presumably, they looked enticingly edible to the bug rider.

The flier settled with an airy fluttering and touched the cone. Like a trap springing shut, the green vines flashed up and around it, crumpling the brittle wings, almost vanishing into the long, soft body—

Barely a second later, Grandpa made another catch, this one from the sea itself. Cord had a fleeting glimpse of something like a small, rubbery seal that flung itself out of the water upon the edge of the raft, with a suggestion of desperate haste—and was flipped on instantly against the cone where the vines clamped it down beside the flier's body.

It wasn't the enormous ease with which the unexpected kill was accomplished that left Cord standing there, completely shocked. It was the shattering of his hopes to swim to shore from here. Fifty yards away, the creature from which the rubbery thing had been fleeing showed briefly on the surface, as it turned away from the raft; and that glance was all he needed. The ivory-white body and gaping jaws were similar enough to those of the sharks of Earth to indicate the pursuer's nature. The important difference was that wherever the White Hunters of the Zlanti Deep went, they went by the thousands.

Stunned by that incredible piece of bad luck, still clutching his bundled clothes, Cord stared towards shore. Knowing what to look for, he could spot the telltale roilings of the surface now—the long, ivory gleams that

flashed through the swells and vanished again. Shoals of smaller things burst into the air in sprays of glittering desperation, and fell back.

He would have been snapped up like a drowning fly before he'd covered a twentieth of that distance!

But almost another full minute passed before the realization of the finality of his defeat really sank in.

Grandpa was beginning to eat!

Each of the dark slits down the sides of the cone was a mouth. So far only one of them was in operating condition, and the raft wasn't able to open that one very wide as yet. The first morsel had been fed into it, however: the bug rider the vines had plucked out of the flier's downy neck fur. It took Grandpa several minutes to work it out of sight, small as it was. But it was a start.

Cord didn't feel quite sane any more. He sat there, clutching his bundle of clothes and only vaguely aware of the fact that he was shivering steadily under the cold spray that touched him now and then, while he followed Grandpa's activities attentively. He decided it would be at least some hours before one of that black set of mouths grew flexible and vigorous enough to dispose of a human being. Under the circumstances, it couldn't make much difference to the other human beings here; but the moment Grandpa reached for the first of them would also be the moment he finally blew the raft to pieces. The White Hunters were cleaner eaters, at any rate; and that was about the extent to which he could still control what was going to happen.

Meanwhile, there was the very faint chance that the weather station's helicopter might spot them—

Meanwhile also, in a weary and horrified fascination, he kept debating the mystery of what could have produced such a nightmarish change in the rafts. He could guess where they were going by now; there were scattered strings of them stretching back to the Straits or roughly parallel to their own course, and the direction was that of the plankton-swarming pool of the Zlanti Basin, a thousand miles to the north. Given time, even mobile lily pads like the rafts had been could make that trip for the benefit of their seedlings. But nothing in their structure explained the sudden change into alert and capable carnivores.

He watched the rubbery little seal-thing being hauled up to a mouth next. The vines broke its neck; and the mouth took it in up to the shoulders and then went on working patiently at what was still a trifle too large a bite. Meanwhile, there were more thin cat-cries overhead; and a few minutes later, two more sea-bugs were trapped almost simultaneously and added to the larder. Grandpa dropped the dead seal-thing and fed himself another bug rider. The second rider left its mount with a sudden hop, sank its

teeth viciously into one of the vines that caught it again, and was promptly battered to death against the platform.

Cord felt a resurge of unreasoning hatred against Grandpa. Killing a bug was about equal to cutting a branch from a tree; they had almost no life-awareness. But the rider had aroused his partisanship because of its appearance of intelligent action—and it was in fact closer to the human scale in that feature than to the monstrous life form that had, mechanically, but quite successfully, trapped both it and the human beings. Then his thoughts had drifted again; and he found himself speculating vaguely on the curious symbiosis in which the nerve systems of two creatures as dissimilar as the bugs and their riders could be linked so closely that they functioned as one organism.

Suddenly an expression of vast and stunned surprise appeared on his face.

Why—now he *knew*!

Cord stood up hurriedly, shaking with excitement, the whole plan complete in his mind. And a dozen long vines snaked instantly in the direction of his sudden motion and groped for him, taut and stretching. They couldn't reach him, but their savagely alert reaction froze Cord briefly where he was. The platform was shuddering under his feet, as if in irritation at his inaccessibility; but it couldn't be tilted up suddenly here to throw him within the grasp of the vines, as it could around the edges.

Still, it was a warning! Cord sidled gingerly around the cone till he had gained the position he wanted, which was on the forward half of the raft. And then he waited. Waited long minutes, quite motionless, until his heart stopped pounding and the irregular angry shivering of the surface of the raft-thing died away, and the last vine tendril had stopped its blind groping. It might help a lot if, for a second or two after he next started moving, Grandpa wasn't too aware of his exact whereabouts!

He looked back once to check how far they had gone by now beyond the Straits Head Station. It couldn't, he decided, be even an hour behind them. Which was close enough, by the most pessimistic count—if everything else worked out all right! He didn't try to think out in detail what that "everything else" could include, because there were factors that simply couldn't be calculated in advance. And he had an uneasy feeling that speculating too vividly about them might make him almost incapable of carrying out his plan.

At last, moving carefully, Cord took the knife in his left hand but left the gun holstered. He raised the tightly knotted bundle of clothes slowly over his head, balanced in his right hand. With a long, smooth motion he tossed the bundle back across the cone, almost to the opposite edge of the platform.

It hit with a soggy thump. Almost

immediately, the whole far edge of the raft buckled and flapped up to toss the strange object to the reaching vines.

Simultaneously, Cord was racing forward. For a moment, his attempt to divert Grandpa's attention seemed completely successful—then he was pitched to his knees as the platform came up.

He was within eight feet of the edge. As it slapped down again, he threw himself desperately forward.

An instant later, he was kniling down through cold, clear water, just ahead of the raft, then twisting and coming up again.

The raft was passing over him. Clouds of tiny sea creatures scattered through its dark jungle of feeding roots. Cord jerked back from a broad, wavering streak of glassy greenness, which was a stinger, and felt a burning jolt on his side, which meant he'd been touched lightly by another. He bumped on blindly through the slimy black tangles of hair roots that covered the bottom of the raft; then green half-light passed over him, and he burst up into the central bubble under the cone.

Half-light and foul, hot air. Water slapped around him, dragging him away again—nothing to hang on to here! Then above him, to his right, molded against the interior curve of the cone as if it had grown there from the start, the froglike, man-sized shape of the Yellowhead.

The raft rider—

Cord reached up and caught Grandpa's symbiotic partner and guide by a flabby hind-leg, pulled himself half out of the water and struck twice with the knife, fast, while the pale-green eyes were still opening.

He'd thought the Yellowhead might need a second or so to detach itself from its host, as the bug riders usually did, before it tried to defend itself. This one merely turned its head; the mouth slashed down and clamped on Cord's left arm above the elbow. His right hand sank the knife through one staring eye, and the Yellowhead jerked away, pulling the knife from his grasp.

Sliding down, he wrapped both hands around the slimy leg and hauled with all his weight. For a moment more, the Yellowhead hung on. Then the countless neural extensions that connected it now with the raft came free in a succession of sucking, tearing sounds; and Cord and the Yellowhead splashed into the water together.

Black tangle of roots again—and two more electric burns suddenly across his back and legs! Strangling, Cord let go. Below him, for a moment, a body was turning over and over with oddly human motions; then a solid wall of water thrust him up and aside, as something big and white struck the turning body and went on.

Cord broke the surface twelve feet behind the raft. And that would have been that, if Grandpa hadn't already been slowing down.

After two tries, he floundered back up on the platform and lay there gasping and coughing a while. There were no indications that his presence was resented now. A few lax vine-tips twitched uneasily, as if trying to remember previous functions, when he came limping up presently to make sure his three companions were still breathing; but Cord never noticed that.

They were still breathing; and he knew better than to waste time trying to help them himself. He took Grayan's heat-gun from its holster. Grandpa had come to a full stop.

Cord hadn't had time to become completely sane again, or he might have worried now whether Grandpa, violently sundered from his controlling partner, was still capable of motion on his own. Instead, he determined the approximate direction of the Straits Head Station, selected a corresponding spot on the platform and gave Grandpa a light tap of heat.

Nothing happened immediately. Cord sighed patiently and stepped up the heat a little.

Grandpa shuddered gently. Cord stood up.

Slowly and hesitatingly at first, then with steadfast—though now again brainless—purpose, Grandpa began paddling back towards the Straits Head Station.

THE END

IN TIMES TO COME

Next month, Mark Clifton's personnel psychologist who challenged the Army to supply him with six poltergeists, male type, gets his bluff called. Van Dongen's done a lovely cover on it; you'll find the Swami from Brooklyn precariously mounted on his Flying Bath Mat gracing you local newsstand next month. One of the best of our recent covers, I think. And Clifton, as usual, has fun with his "Sense From Thought Divide" — and, while he's having fun, makes a considerable amount of solid sense. If a medium insists he has to have a dim blue light to make his strange phenomena develop, how does he differ from a photographer who insists he has to have a dim reddish light to make his phenomena develop properly?

Astounding is also breaking a tradition next month; for the first time, we will publish a full page photograph of the author of one of our articles. Sylvia Jacobs has a piece on "Hold That Helium!" concerning the proper atmosphere for spaceships. I fear, however, that few readers are apt to recognize Mrs. Jacobs from her published picture. But you'll see next month. . . .

THE EDITOR.

HEMOGLOBIN AND THE UNIVERSE

BY ISAAC ASIMOV

***It's been said** that in an infinite universe, in infinite time anything can happen—and anything that ever has happened would be repeated. So? Well, how long would you have to wait for some specific event, say a molecule of a common protein, to show up . . . ?*

(*Special note:* For those readers who associate me with that amazing substance, thiotimoline, it is necessary for me to state categorically that the following article is not a hoax, gag, or comic piece. It is perfectly serious and legitimate. Cross my heart.)

Even the purest and most high-minded scientist finds it expedient sometimes to assault the fortress of truth with the blunt weapon of trial and error. Sometimes it works beautifully. As evidence and as a case in point, let us bring to the center of the stage the hemoglobin molecule.

Hemoglobin is the chief protein component of the red blood cells. It has the faculty of loosely combining with molecular oxygen to form oxyhemoglobin. That combination takes place in the small blood vessels of the lungs. The oxyhemoglobin there formed is carried by the blood stream to all the cells of the body; it gives up its oxygen to said cells and becomes hemoglobin once more. It is then ready to make its way to the lungs for another load.

Because of hemoglobin's vital function in life and because of its ready availability in fairly pure form, the protein has been favored with the closest scrutiny on the part of chemists. It was found, for instance, that the hemoglobin molecule is approximately a parallelepiped in shape, with dimensions of 6.4 by 4.8 by 3.6 milli-

microns. (A millimicron is one-billionth of a meter; a meter is forty inches.) The bulk of this molecule is "globin" which, by itself, is an unstable protein. It makes up ninety-seven per cent of the whole. Attached to the globin, and rendering the whole more stable, are four iron-bearing groups called "heme" (see Figure 1).

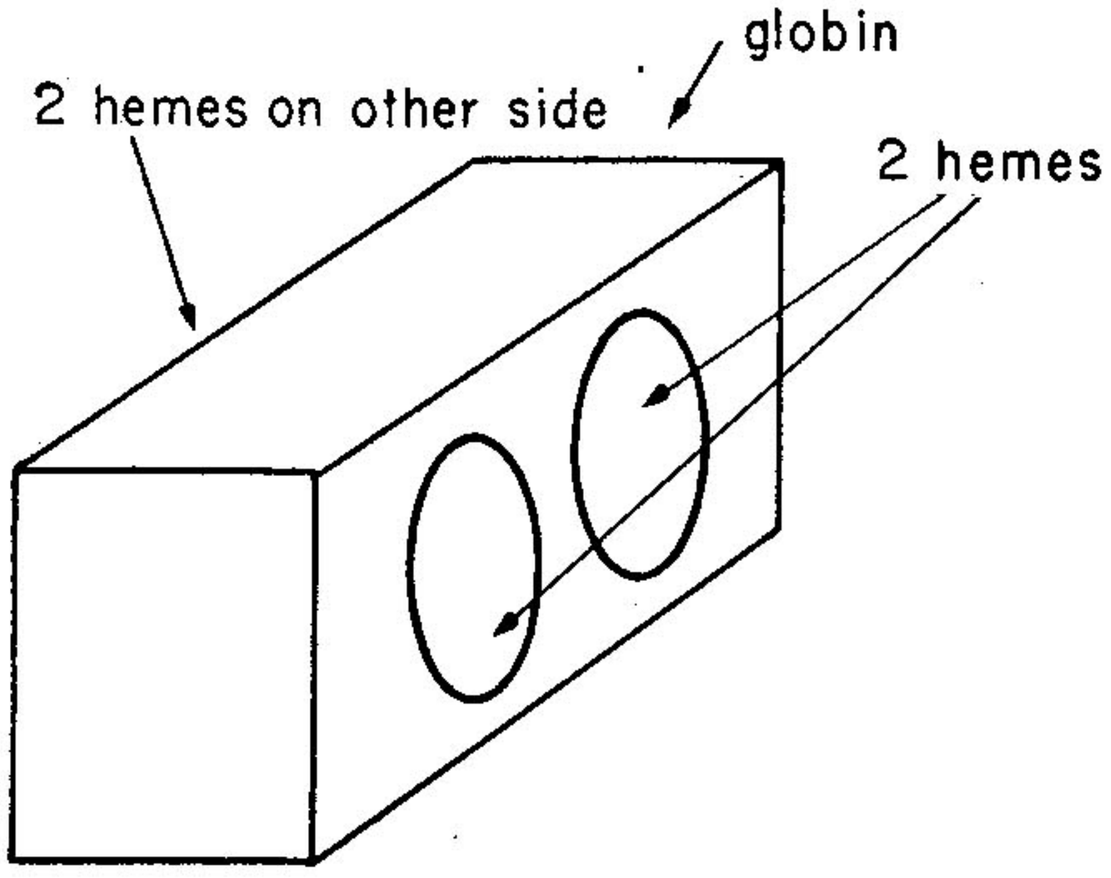


Figure 1. Schematic representation of hemoglobin molecule.

Hemoglobin can be split apart into a heme fraction and a globin fraction without very much difficulty, and the two can be studied separately. Heme, being simpler in construction and quite stable in addition, was naturally the more intensively investigated of the two.

The heme molecule is flat and approximately circular in shape. In the very center of heme is an iron atom. Surrounding that iron atom are twenty carbon atoms and four nitrogen atoms —plus some hydrogens—arranged in four small rings that are themselves connected into one big ring. This wheels within wheels arrangement occurs in numerous compounds other than heme—notably in chlorophyll—and is called the "porphyrin ring." Establishing the structure of the porphyrin ring itself took some fancy footwork, but was a relatively straightforward matter.

Now, however, there enters an additional refinement. There are eight points in the porphyrin ring where groups of atoms called "side-chains" can be, and are, attached. In the heme molecule, the eight side-chains are of three variaties: four of one kind, two

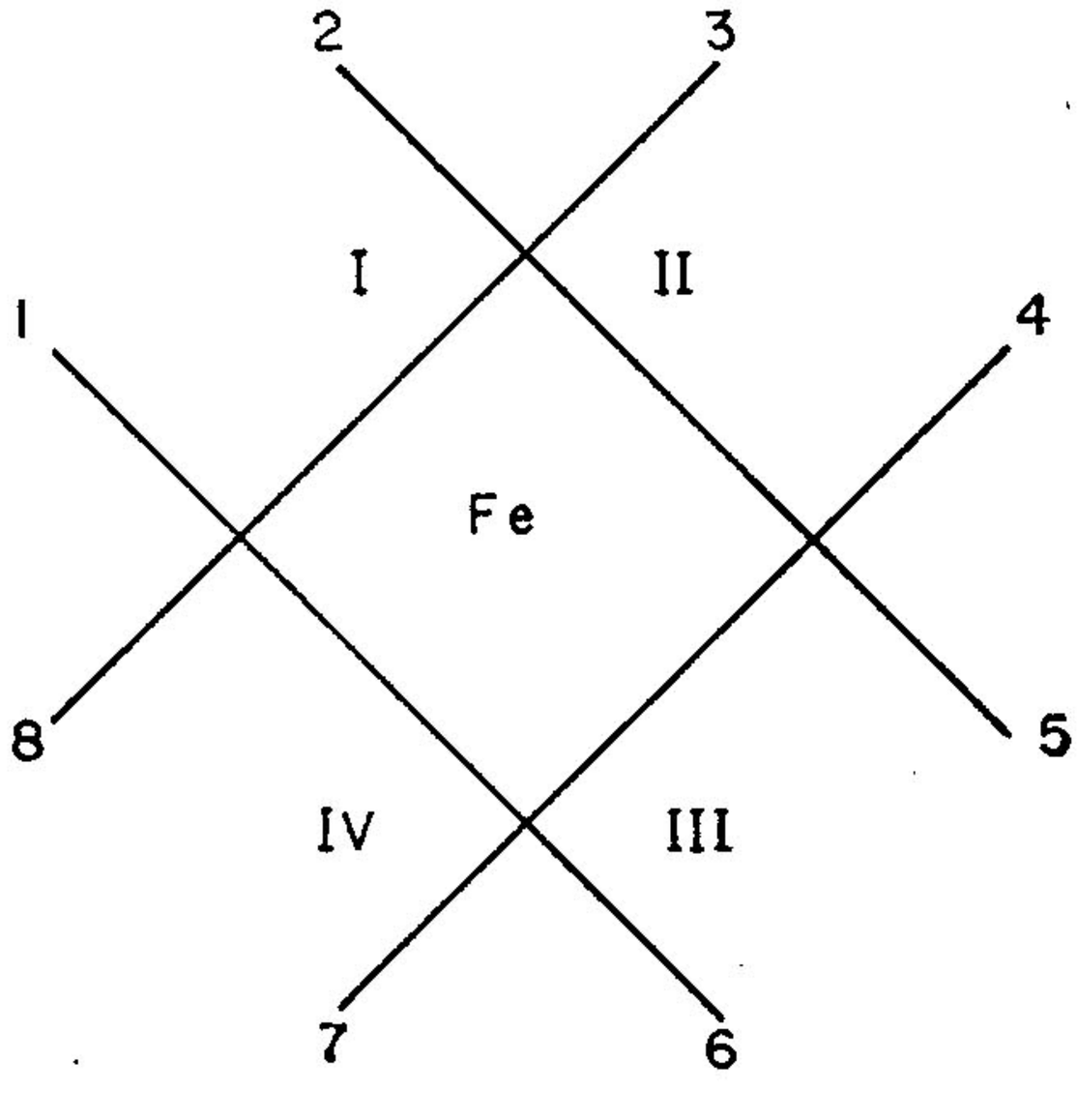


Figure 2. Schematic representation of heme molecule.
(Note: The positions available for side-chain attachment are numbered 1 to 8. The small rings which are themselves combined to form the porphyrin ring are numbered I to IV. The symbol Fe stands for the iron atom.)

of another, and two of a third. Porphyrin rings to which are attached that particular combination of side-chains are called "protoporphyrins."

Now this is the ticklish point. Which side-chains are attached to which positions in the porphyrin ring? To illustrate the difficulty, let's draw some pictures. Since this article concerns itself not with chemistry—despite appearances so far—but merely with some simple arithmetic, there is no need to make an accurate representation of the porphyrin ring. It will be sufficient to draw a ticktacktoe design (Figure 2). Topologically, we have achieved all that is necessary. The two ends of each of the four lines represent the eight positions to which side-chains can be attached.

If we symbolize the side-chains as *a*, *b*, and *c* (four *a*'s, two *b*'s, and two *c*'s), several arrangements can be represented. Two of these are shown in Figures 3a and 3b. Altogether fifteen different and distinct arrangements can exist. Each arrangement represents a molecule with properties that are in some respects different from those of the molecules represented by

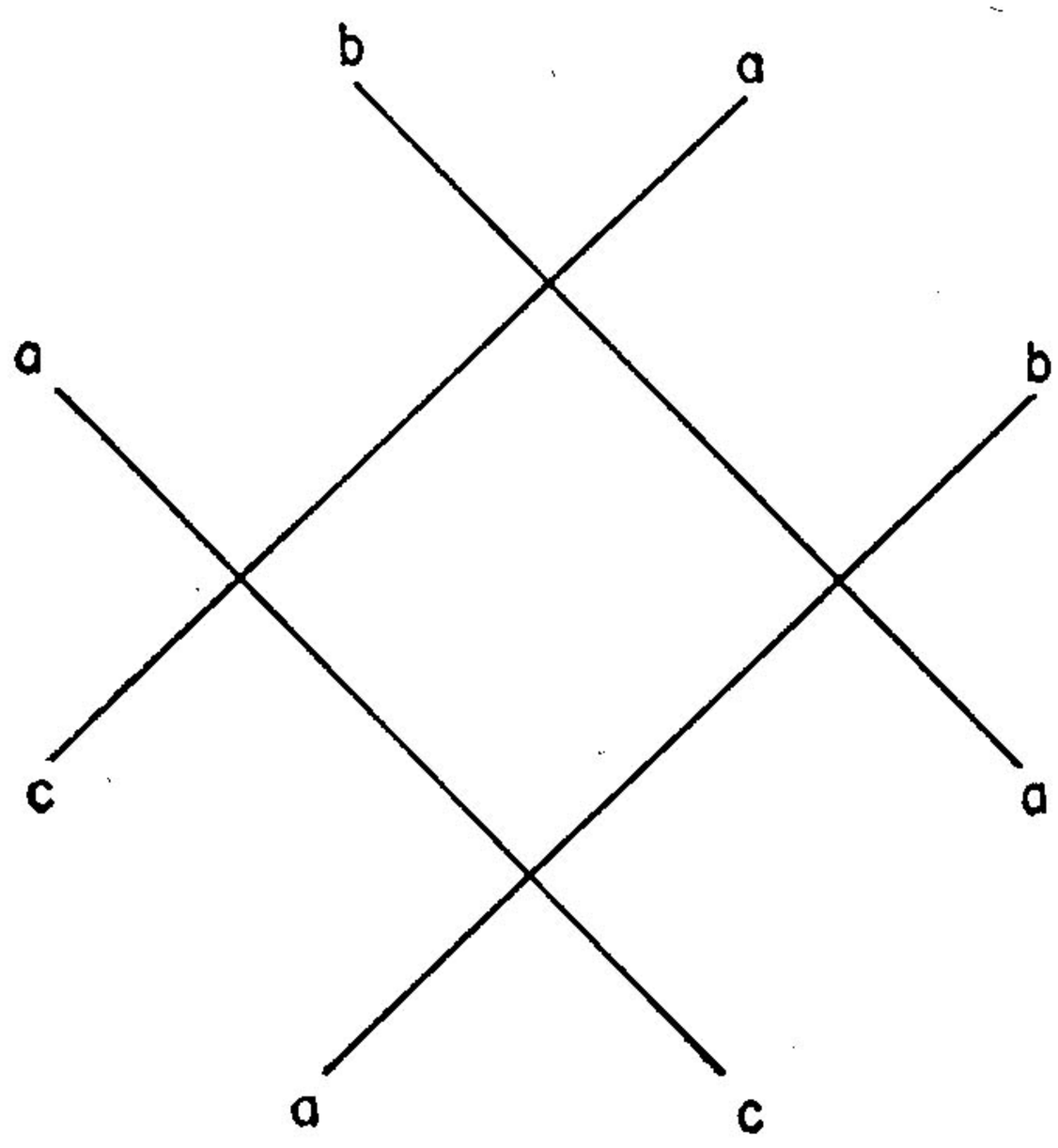


Figure 3a

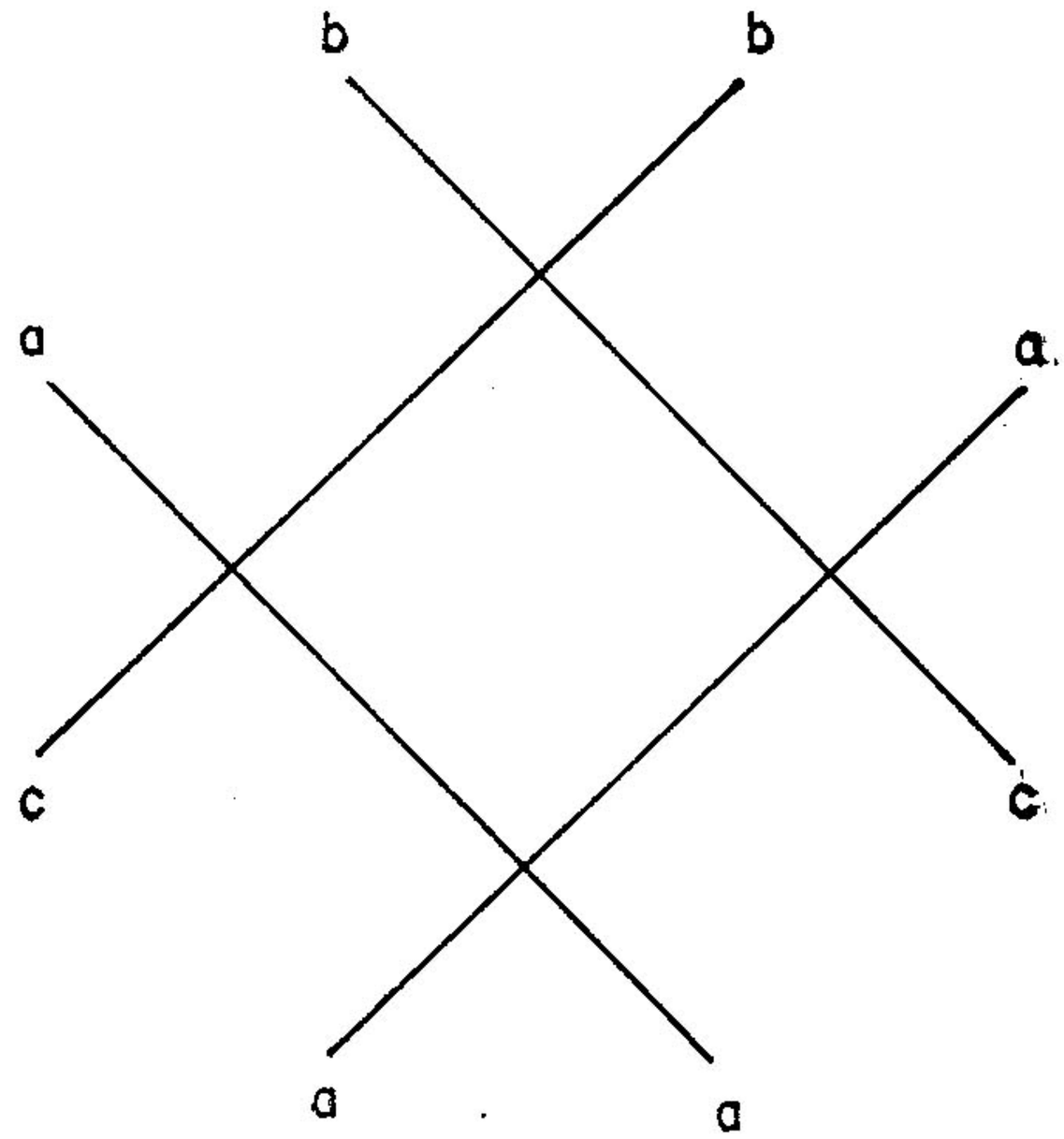


Figure 3b

Two possible arrangements of protoporphyrin side-chains.
(Note: The reader may think he can draw more arrangements than the fifteen stated in the article to be the number that can exist. So he can! However, the porphyrin ring possesses four-fold radial symmetry and front-back bilateral symmetry which reduces the number of *different* arrangements eightfold. Furthermore, certain arrangements could be ruled out for various chemical reasons. There remained, as stated, fifteen arrangements in all which could not be ruled out either by symmetry or by chemical reasoning.)

every other arrangement. Only one of the fifteen is *the* arrangement found in heme.

Which one?

A German chemist called Fisher was faced with that problem and he solved it in the most straightforward possible manner. He wrote down the fifteen possible arrangements on pieces of paper, numbering them arbitrarily from one to fifteen. He then, in effect, called out his sixty graduate students, marshaled them into platoons of four apiece, and gave each platoon one of the arrangements. Instructions were for each to synthesize the protoporphyrin with the particular arrangement pictured.

The students got to work. As each protoporphyrin was formed, its properties were compared with those of the natural protoporphyrin obtained from hemoglobin. It turned out that only one of the synthetic protoporphyrins matched the natural product. It was the one that Fisher had happened to assign the number 9, and it has the side-chain arrangement shown in Figure 4. Since then, generations of medical students and biochemists have memorized the formula of the natural product and learned to call it "Protoporphyrin IX." (It is my personal experience that few students show any curiosity at all as to why the IX.)

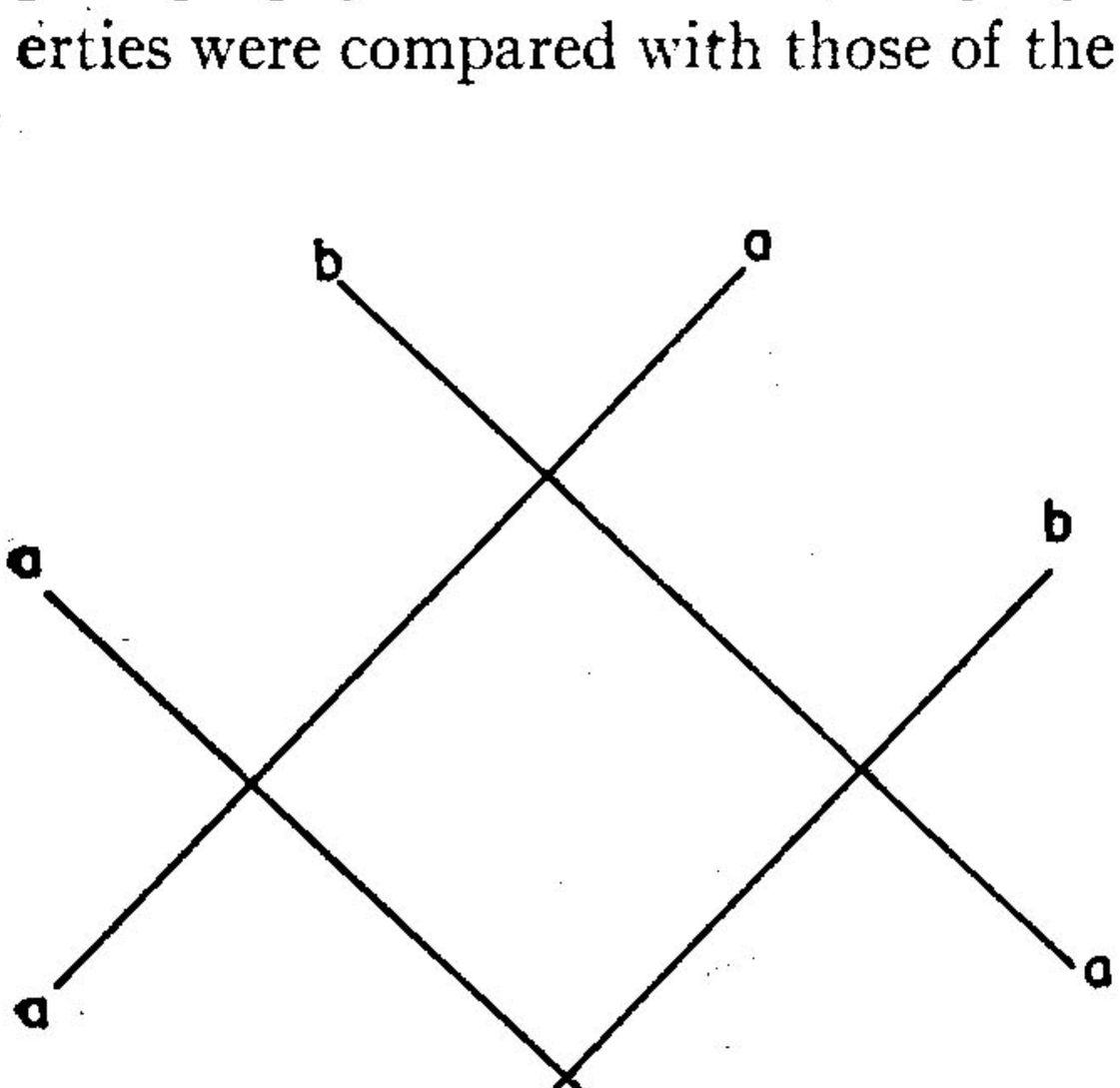


Figure 4. Side-chain arrangement in protoporphyrin IX.

Score a tremendous victory for pure trial and error!

Now let's tackle the globin portion of the hemoglobin molecule. Globin is, as has been said, protein in nature, and proteins are by far the most important chemicals in living tissue. There is no question but that most or all of the secrets of life lie hidden in the details of protein structure. A biochemist who could learn the exact structure of some protein would be an awfully happy biochemist. So let's get some notion as to what it would take to achieve that desirable end.

All protein molecules are made up of relatively small compounds called "amino acids," which are strung together in the molecule like beads on a string. There are about twenty different amino acids occurring in proteins and the structure of each one of them is exactly known. Furthermore, the exact manner in which amino acids are

a-b-c-d-	b-a-c-d-	c-b-a-d-	d-b-c-a-
a-b-d-c-	b-a-d-c-	c-b-d-a-	d-b-a-c-
a-c-b-d-	b-c-a-d-	c-a-b-d-	d-c-b-a-
a-c-d-b-	b-c-d-a-	c-a-d-b-	d-c-a-b-
a-d-b-c-	b-d-a-c-	c-d-b-a-	d-a-b-c-
a-d-c-b-	b-d-c-a-	c-d-a-b-	d-a-c-b-

Figure 5. The different arrangements of four amino acids in a protein chain.

hooked together in a chain to form a protein molecule is also known. Finally, in the case of many proteins, including hemoglobin, we know exactly how many of each amino acid the molecule contains. Most of the problem seems to be licked. The only thing left is to figure out the exact order in which the different amino acids occur along the protein chain.

To show what we mean, let's suppose we have a very small protein molecule made up of four different amino acids: *a*, *b*, *c*, and *d*. These four amino acids can be arranged in twenty-four different ways, as shown in Figure 5. Each arrangement represents a molecule with distinct properties of its own. The situation is then similar to that in the case of heme. Each of the twenty-four possible molecules can be synthesized and its properties compared with the natural product. One of the twenty-four *must* be the right one.

To be sure, hemoglobin has somewhat more than four amino acids in its molecule so the number of possible arrangements is to be expected to be somewhat more than twenty-four. Still, proteins are so important that biochemists would be willing to go to an unusual amount of effort to solve the problem of their structure and the mere presence of additional arrangements might not discourage them. Trial and error might be a little more tedious than in the case of heme, but, given time enough, it ought to be as sure as death and taxes.

Or should it?

To begin with, hemoglobin is a protein of only average size. Its molecule is made up of five hundred thirty-nine amino acids of exactly twenty different varieties and the number of each amino acid present is known. There is no need to name each amino acid. We can accomplish all that is necessary for our purposes by lettering them from *a* to *t* inclusive. There are seventy-five amino acids of type *a* present in the molecule, fifty-four of type *b*, fifty of type *c* and so on. One possible arrangement of the five hundred thirty-nine amino acids is shown in Figure 6.

Obviously the letters in Figure 6 can be written down in quite a few different arrangements and the reader may well shiver a bit at the thought of trying to write down all possible combinations and then counting them. Fortu-

a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-q-r-s-t-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-q-r-s-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-q-r-s-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-q-r-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-q-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-p-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-a-b-c-d-e-f-g-h-i-j-k-l-m-n-o-a-b-c-d-e-f-g-h-i-j-k-l-m-n-a-b-c-d-e-f-g-h-i-j-k-l-m-n-a-b-c-d-e-f-g-h-i-j-k-l-m-n-a-b-c-d-e-f-g-h-i-j-k-l-m-n-a-b-c-d-e-f-g-h-i-j-k-l-a-b-c-d-e-f-g-h-i-j-k-l-a-b-c-d-e-f-g-h-i-j-k-a-b-c-d-e-f-g-h-i-j-k-a-b-c-d-e-f-g-h-i-j-a-b-c-d-e-f-g-h-i-j-a-b-c-d-e-f-g-h-i-a-b-c-d-e-f-g-h-i-a-b-c-d-e-f-g-h-i-a-b-c-d-e-f-g-h-i-a-b-c-d-e-f-g-h-i-a-b-c-d-e-f-g-h-i-a-b-c-d-e-f-g-h-a-b-c-d-e-f-g-h-a-b-c-d-e-f-g-h-a-b-c-d-e-f-g-a-b-c-d-e-f-g-a-b-c-d-e-f-a-b-c-d-e-a-b-c-d-e-a-b-c-d-a-b-c-d-a-b-c-d-a-b-c-d-a-b-c-d-a-b-c-d-a-b-c-d-a-b-c-d-a-b-c-d-a-b-c-d-a-b-c-a-b-c-a-b-a-b-a-b-a-b-a-a-a-a-a-a-a-a-a-a-a-a-a-a-a-a-a-a-a-a

Figure 6. One possible arrangement of the amino acids in the hemoglobin molecule.

nately, we don't have to do that. The number of combinations can be calculated indirectly from the data we already have.

Thus, if we have *n* different objects, then the number of ways in which they can be arranged in a line is equal to the product of all the integers from *n* down to 1. The number of combinations of four objects, for instance, is: 4 x 3 x 2 x 1, or 24. This is the number we found by actually writing out all the different combinations (see Figure 5). The product of all the integers from *n* to 1 is called "factorial *n*" and is symbolized as *n!*

a-a*-b-b*	b-a-a*-b*
a-a*-b*-b	b-a-b*-a*
a-b-a*-b*	b-a*-a-b*
a-b-b*-a*	b-a*-b*-a
a-b*-a*-b	b-b*-a-a*
a-b*-b-a*	b-b* a*-a
a*-a-b-b*	b*-a-a*-b
a*-a-b*-b	b*-a-b-a*
a*-b-a-b*	b*-b-a-a*
a*-b-b*-a	b*-b-a*-a
a*-b*-a-b	b*-a*-a-b
a*-b*-b-a	b*-a*-b-a

Figure 7a. The *total* arrangements of four amino acids, two of one kind and two of another.

If the *n* objects are not all different, an additional complication is introduced. Suppose that our very small four-amino-acid protein is made up of two amino acids of one kind and two of another. Let's symbolize the amino acids as *a*, *a**, *b* and *b**. The twenty-four theoretical combinations are presented in Figure 7a. But if *a* and *a** are indistinguishable, and *b* and *b** likewise, then the combination *ab** is identical, for all practical purposes, with *a*b*, *a*b**, and *ab*. The combination *aba*b** is identical with *a*bab**, *ab*a*b* and so on. The total number of *different* combinations among those

a-a-b-b

a-b-a-b

a-b-b-a

b-a-a-b

b-a-b-a

b-b-a-a

Figure 7b. The *different* arrangements of four amino acids, two of one kind and two of another.

found in Figure 7a is shown in Figure 7b, in which asterisks are eliminated. You will note that the number of different combinations is 6.

The formula for obtaining the number of different combinations of n objects of which the number p are of one kind, q of another, r of another, and so on, involves a division of factorials, thus:

$$\frac{n!}{p! \times q! \times r! \ldots\ldots}$$

In the case we have just cited—that is, the four-amino-acid protein with two amino acids of one type and two of another—the formula is:

$$\frac{4!}{2! \times 2!} \text{ or } \frac{4 \times 3 \times 2 \times 1}{2 \times 1 \times 2 \times 1} \text{ or } 6$$

Of course, the factorials involved in calculating the number of amino acid combinations in hemoglobin are larger. We must start with factorial 539—the total number of amino acids in hemoglobin—and divide that by the product of factorial 75, factorial 54, factorial 50 and so on—the number of each amino acid present.

The factorials of the lower integers are easy enough to calculate (see Figure 8). Unfortunately they build up rather rapidly. Would you make a quick guess at the value of factorial 20? You're probably wrong. The answer is approximately twenty-four hundred quadrillion, which, written in figures, is 2,400,000,000,000,000,000. And factorial values continue mounting at an ever-increasing rate.

In handling large numbers of this sort, recourse is had to exponentials of the form 10^n. 10^n is a short way of representing a numeral consisting of 1 followed by n zeros. 1,000 would be 10^3 and 1,000,000,000,000 would be 10^{12} and so on. A number like 2,500 which is in between 1,000 (that is 10^3) and 10,000 (that is 10^4) could be expressed as 10 to a fractional exponent somewhere in between 3 and 4. More often, it is written simply as 2.5×10^3 (that is, 2.5 x 1,000—which, obviously, works out to 2,500).

Written exponentially, then, factorial 20 is about 2.4×10^{18}.

For the purposes of this article, there are several things that must be kept in mind with regard to exponential numbers:

1) In multiplying two exponential numbers, the exponents are *added*.

1!	equals	1	equals	1
2!	equals	2 x 1	equals	2
3!	equals	3 x 2 x 1	equals	6
4!	equals	4 x 3 x 2 x 1	equals	24
5!	equals	5 x 4 x 3 x 2 x 1	equals	120
6!	equals	6 x 5 x 4 x 3 x 2 x 1	equals	720
7!	equals	7 x 6 x 5 x 4 x 3 x 2 x 1	equals	5040
8!	equals	8 x 7 x 6 x 5 x 4 x 3 x 2 x 1	equals	40320

Figure 8. The factorials of the first few integers.

Thus, the product of 2 x 10^4 and 3 x 10^5 equals 6 x 10^9. If you translate the first two numbers to 20,000 and 300,000, you will see that the product is indeed 6,000,000,000.

2) A number like 2,560,000 can be expressed as 256 x 10^4, or 25.6 x 10^5 or 2.56 x 10^6 or 0.256 x 10^7. All are the same number, as you can see if you multiply 256 by 10,000; 25.6 by 100,000; 2.56 by 1,000,000; or 0.256 by 10,000,000. Which one of these exponential numbers is it best to use? It is customary to use the one in which the nonexponential portion of the number is between 1 and 10. In the case of 2,560,000, the usual exponential figure is 2.56 x 10^6. For this reason, in multiplying 2 x 10^4 by 6 x 10^5, we present the answer *not* as 12 x 10^9, but as 1.2 x 10^{10}. (Where the number 10^{10} is presented by itself, it is the same as writing 1 x 10^{10}.)

3) The appearance of exponential numbers may be deceiving. 10^3 is ten times greater than 10^2. Similarly, 10^{69} is ten times greater than 10^{68}, despite the fact that intuitively they look about the same. Again, it must be remembered that 10^{12}, for instance, is not twice as great as 10^6, but a *million* times as great.

And now we are ready to return to our factorials. If factorial 20 is 2.4 x 10^{18}, you may well hesitate to try to calculate the value of such numbers as factorial 50, factorial 54, factorial 75 and, above all, factorial 539. Fortunately, there exist tables of the lower factorials—say, to factorial 100—and equations whereby the higher factorials can be approximately determined.

Using both tables and equations, the number of combinations possible in hemoglobin can be computed. The answer turns out to be 4 x 10^{619}. If you want to see what that number looks like written out in full, see Figure 9. Let's agree to call 4 x 10^{619} the "hemoglobin number." Those of you, by the way, who have read Kasner and Newman's "Mathematics and the Imagination" will see that the hemoglobin number is larger than a googol (10^{100}) but smaller than a googolplex (10^{googol}).

Of all the hemoglobin number of combinations, only *one* combination

40,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,
000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,
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000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000.

Figure 9. The hemoglobin number.

has the precise properties of the hemoglobin molecule found in the human being. To test that number of combinations one after the other to find *the* one would, as you probably rightly suspect, take time. But given enough time, enough scientists, enough generations of scientists, surely trial and error would come through with the answer, inevitably, at long, long last. But exactly how much space and time would be required?

In order to answer that question we must first get an idea of the size of the hemoglobin number. It seems awfully big, so we'll begin by taking something grandiose as a comparison. For instance, how does the hemoglobin number compare with the total number of molecules of hemoglobin on Earth? That's a fair beginning.

The human population of the Earth is 2,500,000,000 or, exponentially, 2.5×10^9. The average human being, including men, women and children, weighs, let us say, one hundred twenty pounds, which is equal to 5.5×10^4 grams. (There are 454 grams in a pound.) The total number of grams of living human flesh, blood, and bone on Earth is, therefore, about 1.4×10^{14} grams.

Seven per cent of the human body is blood so that the total amount of blood on Earth is 9.0×10^9 liters. (Since a liter is equal to about 1.06 quarts, that figure comes to nine and a half billion quarts.) Every liter of blood contains five trillion (5×10^{12}) red cells, so the total number of human red cells on Earth is, therefore, 4.5×10^{22}.

Although the red cell is microscopic in size, there is still enough room in each red cell for nearly three hundred million hemoglobin molecules—2.7×10^8, to be more precise. There are thus, on all the Earth, 10^{31} human hemoglobin molecules.

But those are the hemoglobin molecules belonging to human beings only. Other vertebrates, from whales to shrews, also possess hemoglobin in their blood, as do some lower forms of life. Let's be generous and assume that for every human hemoglobin molecule on Earth there are one billion (10^9) nonhuman hemoglobin molecules. In that case, the total number of hemoglobin molecules on Earth, human and nonhuman, is 10^{40}.

Even this number, unfortunately, is nowhere near the hemoglobin number and so it will not serve as a comparison.

Let us bring in the element of time and see if that helps us out. The average red blood cell has a life expectancy of about one third of a year. After that it is broken up and a new red blood cell takes its place. Let us suppose that every time a new red blood cell is formed, it contains a completely new set of hemoglobin molecules. In one year, then, a total of 3×10^{40} hemoglobin molecules will have existed.

But the Earth has existed in solid state for something like three and a third billion years—3.3×10^9. Suppose

that in all that time, Earth has been just as rich in hemoglobin as it is now. If that were true, the total number of hemoglobin molecules ever to have existed on Earth would be 10^{50}. This is still nowhere near the hemoglobin number.

Well, then, let us stop fooling around with one dinky little planet and its history. We have all of space and time at our disposal and as science-fiction enthusiasts we ought to have no qualms about using it.

It is estimated that there are one hundred million stars in the galaxy and at least that many galaxies in the universe. Let's be generous. Let's never stint in our generosity. Let's suppose that there are a billion stars in the galaxy, rather than merely a hundred million. Let us suppose there are a billion galaxies in the universe. The total number of stars in the universe would then be $10^9 \times 10^9$ or 10^{18}.

Suppose now that every star—every single star—possessed in its gravitational field no less than ten planets, each one of which was capable of holding as much life as Earth can and that each one was as rich in hemoglobin. There would then be 10^{19} such planets in existence and in one year, the number of hemoglobin molecules that would have existed on all those planets —assuming always a life-expectancy of a third of a year for each molecule —would be 3×10^{59}.

Now let us suppose that each of these planets remained that rich in hemoglobin for, from first to last, three hundred billion years—3×10^{11}. This is a very generous figure, really, since the sun's life expectancy is only about ten to twenty billion years, during only a portion of which time will life on Earth be possible. And this life expectancy is rather longer than average for other stars, too.

Still, with all the generous assumptions we have been making, all the hemoglobin molecules that could possibly exist in all the space and time we have any knowledge of—and more —comes out to 10^{71}. This number is still virtually zero compared to the hemoglobin number.

Let's try a different tack altogether. Let's build a computing machine—a *big* computing machine. The whole known universe is estimated to be a billion light-years in diameter, so let us imagine a computing machine in the form of a cube *ten* billion light-years on each edge. If such a machine were hollow, there would be room in it for one thousand universes such as ours, including all the stars and galaxies and all the space between the various stars and galaxies as well.

Now let us suppose that computing machine was completely filled from edge to edge and from top to bottom with tiny computing units, each one of which could test different combinations of hemoglobin amino acids in order to see whether it was *the* hemoglobin combination or not. In order to

make sure that the computing units are as numerous as possible, let's suppose that each one is no larger than the least voluminous object known, the single neutron.

How many computing units would the machine contain?

A neutron is only one-ten-trillionth of a centimeter in diameter. One cubic centimeter—which is equal to only one-sixteenth of a cubic inch—will, therefore, contain $10^{13} \times 10^{13} \times 10^{13}$ or 10^{39} neutrons, if these were packed in as tightly as possible. (We assume the neutrons to be tiny cubes rather than tiny spheres, for simplicity's sake.)

Now light travels at the rate of 3×10^{10} centimeters per second. There are about 3.16×10^{8} seconds in a year. A light-year is the distance traversed by light in one year, and is, therefore, $3 \times 10^{10} \times 3.16 \times 10^{8}$ or about 10^{19} centimeters in length. Our computing machine which is ten billion (10^{10}) light-years along each edge is, therefore, 10^{29} centimeters long each way and its volume is $10^{29} \times 10^{29} \times 10^{29}$ or 10^{87} cubic centimeters all told. Since each cubic centimeter can contain 10^{39} neutrons, the total number of neutrons that can be packed into a cube a thousand times the volume of the known universe is $10^{87} \times 10^{39}$ or 10^{126}.

But these "neutrons" are computing units, remember. Let us suppose that each computing unit is a really super-mechanical job, capable of testing a billion different amino-acid combinations every second, and let us suppose that each unit keeps up this mad pace, unrelentingly, for three hundred billion years.

The number of different combinations tested in all that time would be about 10^{155}.

This number is still approximately zero as compared with the hemoglobin number. In fact, the chance that the right combination would have been found in all that time would be only 1 in 4×10^{464}.

But, you may say, suppose there is more than only one possible hemoglobin combination. It is true, after all, that the hemoglobin of various species of animals are distinct in their properties from one another. Well, let's be unfailingly generous. Let's suppose that every hemoglobin molecule that ever possibly existed on Earth is just a little different from every other. It would then be only necessary for our giant computing machine to find any one of 10^{50} possibilities. The chances of finding any one of those in three hundred billion years with 10^{126} units each turning out a billion answers a second is still only 1 out of 10^{414}.

It would seem then that if ever a problem were absolutely incapable of solution, it is the problem of trying to pick out the exact arrangement of amino acids in a protein molecule out of all the different arrangements that are possible.

And yet, in the last ten years, biochemists have been making excellent

progress in solving just that sort of problem. The amino acid arrangements in the protein, insulin—lack of which brings on diabetes—was completely worked out in 1953. To be sure, insulin is only one fifth the size of hemoglobin, but there are still just about 8 x 10^{113} possible arrangements of its amino acids, and that is a most respectable quantity.

How did the biochemists do it?

The fact is that straight trial-and-error technique would have been an unbearable trial and a colossal error. So they used other methods. There *are* other methods, you know.

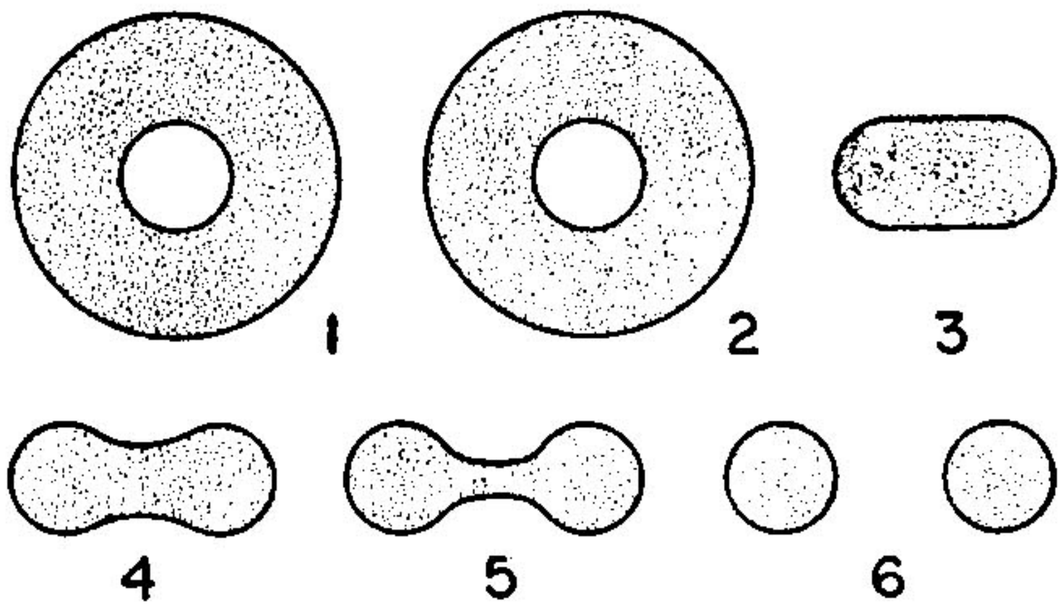
What, for instance?

Well, that's another story for another article at another time. What we have now is enough for one sitting.

THE END

PURELY COINCIDENCE, NO DOUBT

The following series of figures is almost certainly familiar to you:



This series of figures are all — including #6, despite appearances — *single* figures, produced by simple geometry. They are single members of a family of figures similar to the family of conic sections. Conic sections range from a straight line through hyperbola, parabola, ellipse to circle.

The above figures are toroidal sections; they don't come from a biology text, but can be produced at home with a knife and a doughnut. #1 and #2 are produced by cutting the doughnut in a plane parallel to the plane of the doughnut. #3 through 6 are produced by cuts varying distances from the axis of the doughnut's hole — #6 being the intersection of the plane passed through the axis, of course. #6 looks for all the world like two separate entities, but recognizing it as simply the cut surfaces of a doughnut, it's evident that it's actually a single figure.

A smoke-ring would show the same characteristics, of course, but being highly dynamic, retaining its structure only by reason of its dynamic movement, it can't be sectioned without dissolution.

THE REFERENCE LIBRARY

BY P. SCHUYLER MILLER

"SERIOUS" STUFF

Last month I was complaining that we're letting the adventure element go out of our science fiction, with the result that it is in danger of becoming a pastime for cultists. This month I want to look at what happens when so-called "serious" writers take up science-fiction themes.

They seem to be doing this with increasing frequency of late. Some of it may be an attempt to cash in on what they have heard is a popular and profitable field. Others, I think, have discovered that science fiction— and/or fantasy—has more elbow-room in it than the rather stiffly self-conscious social novels of the day. There's a chance to give old ideas a novel tinge, to preach a lesson, or occasionally—as in Graham McInness' "Lost Island" —just to tell a good story for the fun of it.

Some of you who have picked up J. B. Priestley's "The Magicians" (*Harper & Brothers, New York. 246 pp. $3.00*) may consider it pure fantasy. Others will recognize echoes of J. W. Dunne's multidimensional theory of time ("An Experiment With Time," "The Serial Universe"). which has interested Mr. Priestley for a good many years and which he has fitted into others of his novels and plays before this one. The three "magicians"

who drop in out of nowhere and help Sir Charles Ravenstreet to find himself are men who have learned the Dunne trick of "looking down" on Time as on a great field where past, present and future all exist together and simultaneously.

In a purely science-fiction yarn—where this gimmick has been used again and again—the story would traditionally deal with Ravenstreet's learning to relive the past—and perhaps the future—and to change it. But Priestley is a mature novelist who is concerned with people as they are (his "Angel Pavement" and "The Good Companions" were as close as we've come to Twentieth Century Dickens), and what changes in "The Magicians" is not the past but the present—namely, Sir Charles himself. A lonely man, past middle age, tempted to fall in with plans for what amounts to the wholesale doping of mankind, he experiences "time alive" and comes out of it a very different person. He, not the twists of time, is the center of interest throughout.

"The Second Conquest," by Louis de Wohl (*J. B. Lippincott Co., Philadelphia. 239 pp. $3.00*) is an attempt to do for Catholic theology what C. S. Lewis did much better for his own particular mysticism in "Out of the Silent Planet" (and less well in its sequels, "Perelandra" and "That Hideous Strength"). He uses the framework of a voyage to Mars, and some clumsily assimilated science-fictive trappings, to illustrate the dogma that God and Lucifer are actively struggling in the world today as they have been since the day of Adam. The Martians, whose civilization has developed without the drag of Satan, are consequently wholly good, and the physical climax comes when "Am-ba Om-bal," the serpent of Eden, attempts to lure the Martians within his sphere of influence and make a second conquest of them as he did long ago of mankind. Now this is very much the structure of the Lewis books, and the picture of Martian society is superficially interesting—if you can overlook the scientific absurdities: sapphires made of carbon, hair as "vegetable" and a good many more. But the preaching of a creed—even though to Catholics it is *the* creed—is anything but convincing, as the more mystical theologizing of Lewis and Charles Williams are. Science fiction is rarely a good medium for tracts.

It can be a good medium for satire of the Gulliver school, and that is Willy Johns' approach in "The Fabulous Journey of Hieronymus Meeker" (*Little, Brown & Co., Boston. 370 pp. $3.50*). However, Johns is no Swift and his alien societies are drawn with a very heavy hand and an occasional bawdiness much more self-conscious than the passages which are expurgated from children's editions of "Gulliver's Travels"—and illustrated in limited editions. Where Louis de Wohl

blundered at a kind of pseudo-scientific setting—really no worse than much current and a great deal of past science fiction—Willy Johns makes no pretense at logical explanation—what price such gems as the "unfamiliar smell" of empty space, or "gravity wicks" which "draw gravity out of the air when there was too much of it" with complementary "gravity wafers" which replaced it by evaporating?

His voyagers, bound for Mars, are dragged away by a comet and land on a planet in another galaxy. Here a handful of them are followed through their adventures in a series of societies which, much like those Gulliver encountered, are to be taken as broad commentaries on some of our own. The jungle theocracy of the half-worm half-vegetable Kodliks is either the most subtle or the most savage of these, depending on whether you conclude that Mr. Johns looks on the church-centered state with as much disgust as you do on the Kodliks. The Gromliks, on the other hand, with their capital of Mscv (no vowels), offer a wholly recognizable parallel to Soviet savagery, and the merchant culture of their Vimlik neighbors—which seduces away as many of our explorers as the Gromliks killed—is overly close to our own. Finally, in the Optlik utopia beyond the mountains, we have what may be the author's message: a society built on the six freedoms—Freedom from Marriage, Salvation, Progress and Contributions, Freedom of Difference and Laughter.

A lot of rich imagination has gone into these societies, and our hero and his friends go through a terrific number of physical adventures, but, except in the repulsive Kodlik episode, they're not very convincing.

Finally, in "Atta," by Francis Rufus Bellamy (*A. A. Wyn, New York. 216 pp. $3.00*), we have a story with no particular pretensions at satiric significance, which somehow just doesn't come off. Its hero, Brokell, is suddenly reduced to the size of an ant—it takes him nearly half the book to recognize the fact. He befriends an actual ant, Atta, and they live together in a walnut shell for a while before they are taken prisoner by another breed of ants, escape, reach Atta's own people, and find themselves again in hot water. The plot structure itself is very close to the "Tarzan and the Ant Men" formula, right down to the evil overlords and priests and the good but stupid gladiators, with a few vicious struggles in the arena.

If this was intended to give a mite's eye view of ant society, it doesn't succeed at all: the ants—who by some coincidence call themselves by the Latin names of their species—are hopelessly anthropomorphized. If it is intended as a satire on human society, it's rather fumbling. And if it's just a story—just science fiction—it could be more skillfully told.

Far be it from me to put up any "Keep Off" signs around the science-

fiction domain. The more we find experienced "serious" authors experimenting in the field—as they have long done with fantasy—the better the reading is going to be. The Priestley book shows that clearly. But the writer has also got to accept the same disciplines that bind every writer for this magazine and its fellows. We can't have "gravity wicks" just because they have an amusing sound. We can't have preachment for its own sake: how much better, for example, to *show* the Martians following the Christian philosophy.

We've all agreed here, over and over, that science-fiction writers are going to have to learn to write (I think they're doing it). By the same token, writers are going to have to learn to write science fiction.

HERO'S WALK, by Robert Crane. Ballantine Books, New York. 1954. 198 pp. $2.50; paper 35¢

"Robert Crane" is said to be the pen name of a young British novelist who has turned his own memories of a walk through London's blitz into a story of a future walk through a New York under bombardment from space.

In a long flashback we watch the internal maneuvering in InterCos—a future U.N.—gradually shaken by mysterious whisperings from far space. Our representative in the InterCos inner circle is Neil Harrison, a minor member of the American delegation. And to Neil's brother Mark, a scientist monstrously deformed by radiation, the whisperings are a warning to Earth to stray no farther than Mars or suffer the consequences.

The story is of the internal struggle of the British-American faction to stop InterCos President Werner, backed by a Russian-Asian bloc, from launching and arming a space-station beyond Mars—while in a parallel race against time Mark Harrison tries to discover the identity of the "Ampiti," the invading voices, and translate their babble.

Somehow there is no feeling of suspense or urgency about the book. The threat of the Ampiti is never real, even when bombs begin to fall in rising arithmetical progression, and Neil Harrison's final search for his girl through the ruined city is only a stroll before a Hollywood process screen. Make it "Hero's Stroll."

ANGELS AND SPACESHIPS, by Fredric Brown. E. P. Dutton & Co., New York. 1954. 224 pp. $2.75

This collection of short stories—and one novelette: "The Angelic Angleworm"—which appeared in this magazine and *Unknown* between 1941 and 1949 is a joy indeed. They are by no means in a class with last year's "The Lights in the Sky Are Stars," but—fantasies and science fiction alike—they're good fun. The least of the lot, in my rating, is "The Waveries"

(about the radio-wave critters that send us back to the age of steam); the best are probably the zany "Placet is a Crazy Place" and "Etaoin Shrdlu" (mishaps in the printing business pop up repeatedly: might give this to a printer friend, if you have one), with the thoughtful "Letter to a Phoenix."

But by far the freshest feature of this particular collection is that Fredric Brown—to belie the old axiom that you can't have good short-short science fiction—has inserted nine brand-new two-page dillies between the other stories. They have the unexpected quirks that we've come to expect of Brown. They'd make wonderful black-out skits for some fan group to stage at a convention, or for a 16-mm movie bug to produce. Who'll try it?

THE VICTORIAN CHAISE LONGUE, by Marghanita Laski. Houghton Mifflin Co., Boston. 1954. 119 pp. $2.75

This slight but beautifully written novelette may not appeal to readers who want their time travel robust and gadgety. Its mood and method are more nearly those of "Berkeley Square" than of "The Man Who Mastered Time."

Melanie Langdon, recovering from tuberculosis and eager to be reunited with her husband and seven-months-old son, falls asleep on an ugly Victorian chaise longue—and wakes in 1864, in the body of Milly Baines, dying of the same disease on the same chaise longue. Half participant, half spectator, she plays out the tragedy of Milly's last hours.

Let's hope that this talented English novelist turns again to the borderlands of fantasy and science fiction.

DARK DOMINION, by David Duncan. Ballantine Books, New York. 1954. 208 pp. $2.50 & 35¢

This seems to have been the last of the Ballantine science fiction to be published in both hard-bound and pocket-book formats. It was originally scheduled for last winter, but was postponed until *Collier's* had serialized a condensation. Coming from the author of seven "serious" novels, well done and well received, it is strangely flat and unsatisfying.

The theme is very much like Kornbluth's "Takeoff": a secret scientific task-force has been working somewhere along the California coast to put the "Black Planet," the first space station, into an orbit and achieve military dominance of the planet. When the secret leaks out, America's former allies are as determined to smash the dragon's egg in its nest as are more obvious enemies. Meanwhile there are inner jealousies and clashes of temperament on the project, which lead to the narrator-director's being arrested for treason.

Interwoven with this is the kind of scientific puzzle that has been most characteristic of John Taine's books:

a strange synthetic element, Magellanium, whose unbelievable properties give Dr. Phillip Ambert and his backers a way of bringing a kind of victory out of defeat and flinging the Black Planet into space. But where John Taine's concepts, however outlandish, always seem fundamentally to hold water, Magellanium A, B and C are no more plausible than the people who work with them.

If David Duncan had put the atmosphere of his "Madrone Tree" into a science-fiction theme, we might have had a memorable book. This just doesn't come off.

RIDERS TO THE STARS, by Curt Siodmak. Ballantine Books, New York. 1954. 166 pp. 35¢

Old-time science-fiction fans remember Curt Siodmak as the author of "Donovan's Brain." Newer-fledged readers may recall his credit line on various film versions of that gruesome classic. This is a novelization by an otherwise unidentified "Robert Smith" of his script for the rather good film, "Riders to the Stars."

Book and film have the same virtues: a spare but very detailed and realistic account of the physical and mental testing by which three scientists are selected to pilot the first three manned rockets into space. The "science" which explains their attempt is less plausible, though perhaps no worse than the patter in many older stories—and some recent ones. It seems that cosmic rays destroy the strength and structure of all metals carried into space by rockets, but meteors come through hale and hard: ergo, meteors must be coated with something impervious to cosmic rays. Our boys are to go up with meteor scoops and bring an unspoiled meteor back "alive." (I should sue someone for that gimmick: I used it in an otherwise best forgotten yarn called "The Coils of Time," right here, back in May 1939.) The book, let it be said, does not reproduce the absurd "secret" revealed at the end of the film, though it does have some of its other weirder effects.

It's easy to see why Ballantine didn't bother with a hard cover for this—but worse books have had 'em. The characterization of Gordon, the third of the "winners," is a good deal more interesting here than on the screen. On the other hand, Dr. Jane Flynn doesn't emerge as anything to whistle at. See it if it comes your way: then read it for the sake of comparison.

THE DELUGE, by Leonardo da Vinci, edited by Robert Payne. Twayne Publishers, New York. 1954. 99 pp. $3.00

Something I rarely say: I can't see why you should buy this, unless you're a simon-pure completist.

Reportedly the great Leonardo, as do most of us, jotted down chapter

headings, notes, and scraps of copy for a novel dealing with a second deluge. (Or were they, perhaps, "captions" for his violently striking sketches on the same theme? Or were the sketches to be illustrations for the book: one is used, without identification, as the frontispiece for this one.) Where these fragments now are, we are not told. At any rate, Mr. Payne, who teaches at Alabama College, came upon them in a study of the Renaissance and has fitted them into what he imagines might have been Leonardo's story.

The original passages are clearly enough set off between pairs of asterisks, and identified again at the end. I suppose Mr. Payne has come close enough to matching their tone in his own interpolations. The result reads like a deliberate Victorian archaism, quite out of place in the here and now.

ONE IN THREE HUNDRED, by J. T. M'Intosh. Doubleday & Co., Garden City. 1954. 223 pp. $2.95

These are the three long novelettes which have been appearing in *Fantasy and Science Fiction* during the last two years, assembled as a book—as they pretty well had to be, considering their popularity.

The author of "World Out of Mind" and "Born Leader" continues his progress in the direction of what Sam Mines, in the anniversary issue of James Taurasi's *Fantasy Times*, calls "a higher credibility index"—science fiction for general readers who have not cut their teeth on the conventions and clichés which are old stuff to the fans. This is the Noah's ark, the "Worlds Collide" theme with a leavening of realism in the recognition that when a cosmic catastrophe does impend Mankind won't be able to get more than one in three hundred of the population off the Earth, more than one in one thousand to another planet —and that in those few survivors there will be "one too many" who should never have survived.

We watch Lieutenant Bill Easson as he, first, selects the ten people in a little town of three thousand whom he will take with him to a refuge on Mars, then ferries them to safety. Finally, still with him, we watch the new human society building on the fragments of the old. It's a good job that deserves to be better: the people of the story are far from black-and-white stereotypes, but they don't really emerge as individuals and Morgan Smith's inner rottenness, in particular, seems to develop out of nothing—yet this week's papers are full of four "good" boys like Smith, who have been amusing themselves beating people to death: why ask a writer to do more then society does?

J. T. M'Intosh—which is no news to anybody—is a writer to watch.

A GUIDE TO THE PLANETS, by Patrick Moore. W. W. Norton & Co., New York. 1954. 254 pp. Ill. $4.95.

This handsome companion volume to the author's "A Guide to the Moon" should supply readers and writers alike with a compact and particularly an up-to-date portrait-gallery of the solar family. The color plates by L. F. Ball aren't Bonestells by any means, but they are a striking and handsome addition to an excellent book.

Let me make my criticisms first: the author, one of Britain's leading young astronomers, is oddly vehement in denouncing the meteor theory of the origin of the craters of the Moon — and similar structures elsewhere — quite at odds with his tolerance and fair explanation of other disputed ideas. And the editors have in many cases hopelessly tangled the cross-references between the text and the illustrations, presumably by rearranging and renumbering the plates without changing the copy from the British edition.

Most impressive is the amount of work now being done on planetary problems, as revealed by the differences between this account and even the latest astronomy texts. We've heard about some of it in R. S. Richardson's occasional articles, here and in other magazines, but much of the rest will be new to you as it was to me. (Did you know that "Callistos" was originally Homer's name for Venus? Did you know that the Martian vegetation turns from green to brown in the summer? Have you ever seen a map of the markings on Ganymede?)

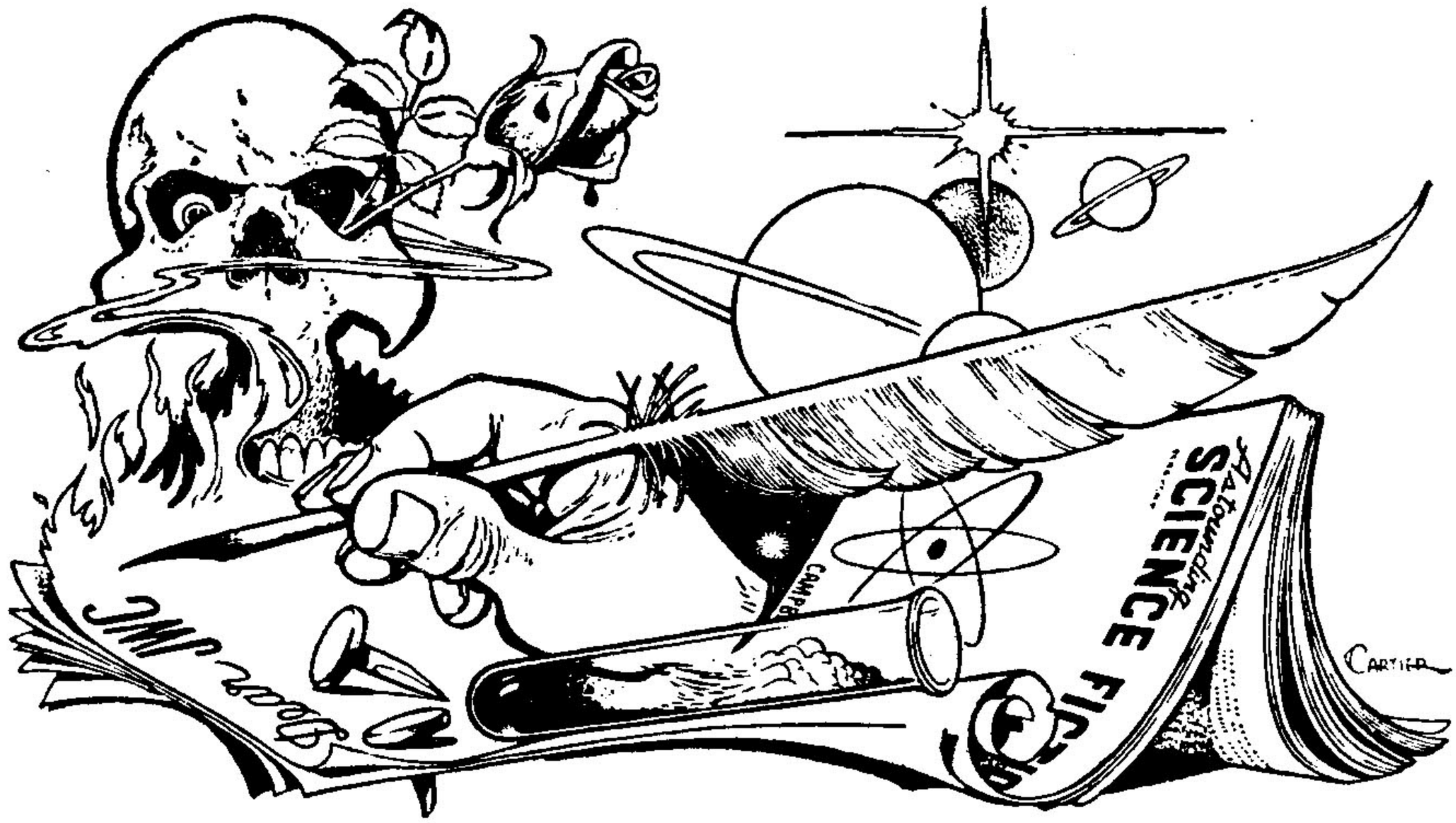
I think you'll want this on your science shelf. If you don't, go around and recommend it to your public library: one for reference, two or three copies to circulate, and more for the branches.

BIBLIOGRAPHICAL NOTE:

Donald B. Day, whose "Index to the Science Fiction Magazines: 1926–1950" we described here a while back, reports that he is now ready to supply correction sheets *without charge* to anyone who has his book. Mostly the errors are matters of spelling and similar typographical slips—which mighty few professionally published bibliographies bother to correct—but Don has added the contents of a complete issue of *Fantastic Adventures* (December '45) which he had managed to overlook.

If you ordered your copy of the "Index" directly from Don, he's sent you the errata sheets. You can cut out the corrections and paste 'em over the faulty lines. If you ordered through a dealer, write to Perri Press, Box 5007, Portland 13, Oregon and ask for the errata sheets.

And if you have any magazine collection at all, or want to track down old stories, Don says that there are still a few copies of the "Index" left at the original $6.50 price. Same address.



BRASS TACKS

Dear John:

After eight successive readings of C. K. Bradley's truly fascinating articles on symbolic logic and paradoxes I am obsessed by the notion that the mere existence of paradoxes is a paradox in itself. To inflict you and your readers with a dreadful sentence: it appears to me illogical for logical minds to try to deal logically with the basically illogical.

Offhand I can think of nothing abstract or concrete that can be said to exist entirely as a thing-in-itself and therefore can be contemplated, so to speak, *in vacuo*. This applies especially to any so-called paradox which can exist as such only within its particular frame of reference. Within a framework too tight and rigid there must be distortion. My notion of illogicality derives from the philosophical convention that efforts to straighten out the distortion must be made *without altering the framework*.

To cite Russell's Paradox, quoted by Bradley. The framework here consists of an arbitrary ruling: "All adjectives are self-descriptive or non-self-descriptive" with the addendum that this exhausts all possible classes. The paradox: "Into which class falls the adjective 'non-self-descriptive'?" It's said to be a prize baffler. But is it? What's wrong? The paradox? Or its framework?

Let's commit the major crime of reshaping the framework to closer semblance of reality. "All adjectives are self-descriptive, non-self-descriptive, neither or both." Where's the paradox now? It has ceased to exist. Obviously, as an attempt to define a feature of adjectives the new setup is quite meaningless. What of it? The human mind is no more than half-functioning when it can contemplate only positive values and not negative ones. In the problems of real life lack of fact can and often does convey some other fact by what the lack implies. The presence of a negative points to a previously unsuspected positive.

I wonder how many paradoxes exist only within a twisted framework that is ignored, no attempt being made to alter the terms within which they are confined. For example, let me erect without argument the proposition that all human beings are white-skinned or black-skinned and—alley-oop!—five hundred million living paradoxes in China.

ASF's numerous mathematicians may like to try this one for size providing they keep to the rules by not changing the framework. I have a box three feet long with a two-inch diameter hole at each end. The box contains a skunk which sticks his head through one hole, runs like hell and sticks his head through the other hole. He goes on doing this for days, weeks, months. The problem: If the skunk makes his first trip at one mile per hour and doubles his speed on each successive journey, how many trips must he make before he can stick his head through both holes at the same time?
—Eric Frank Russell

As I suggested, the paradox serves much the function that the bad-smelling compounds gas companies add to their gas. The function is to warn people, to say, in effect, "Hey! Your system's leaking!"

Don't just deny the paradox; of course it is unimportant for itself. Just as nobody has been killed by the bad smell that leaking gas has. The smell is not important for itself alone.

But people who ignore the bad smell are killed—because the bad smell gets into the room due to a leak in the system, and that can be fatal, if not attended to!

Dear Sir:

I have been a reader of Astounding Science Fiction since its first issue and it has been about twelve years since I have been moved to write to your Brass Tacks section. I have some comments to make on your articles by Gotthard Gunther, since he deals with a subject which has been of great interest to me for more than fifteen years. I disagree with some of Mr. Gunther's ideas and conclusions, and I will do my best to set forth my thinking as clearly as possible.

As a physicist and an engineer, I

make considerable usage of mathematics as, for example, in the analysis of transient impulses and shock waves in mechanical systems by means of Heavisides Operational Method or the so-called Classical Method, whichever is preferred. I have often felt that the importance of mathematics as such is overrated. There is always the possibility of some mathematical thinker, like Zeno for example, who puts his tongue in his cheek and comes up with a logically inescapable result which can not possibly conform to reality. It seems fairly evident to me that a large part of the difficulty lies in the assumptions which are made.

Mr. Gunther, in his article in the August issue, mentions that physics is coming to recognize the necessity of a quantized structure of space. He then does an about-face and proves to his own satisfaction that such quantization can not exist. Both of these ideas are in the category of assumptions or postulates. I think in all fairness we should carry our thinking along one line or the other. As a matter of fact, after many years of devotion to this problem, I am personally satisfied that the idea of a quantized universe is completely compatible with reality but will also admit quickly that there are many cases where a quantized space structure would appear to be incompatible. But so far such difficulties have been successfully overcome by reorientation of thinking.

To get down to cases regarding Mr. Gunther's article, he states that "Zeno's thesis that Achilles must occupy as many positions as the tortoise is, and remains, unassailable." In my view this is by no means unassailable, particularly if you postulate a quantized structure of space.

Assume for the sake of argument that space is constructed of discrete "space quants" and that motion takes place in discrete "motion quants." Physically this is equivalent to a wagon wheel moving by small leaps and bounds over a cobblestone street. In the race between Achilles and the tortoise, Zeno's problem would follow his mathematical solution until the distance between Achilles and the tortoise was reduced to one space quant. At this point the succeeding pulse or motion quant would put Achilles at the same position or beyond the tortoise. Subsequent motion would put Achilles ahead which is, of course, obvious in the first place.

The point I am trying to make with this little physical example is that the whole dilemma of Zeno disappears when you look at physical reality. The paradox can only exist in a mathematical sense and even there it only exists by virtue of the fact that the primary assumption of the mathematical method is that number is infinitely divisible. Physical measurements of our universe quickly demonstrate that energy, motion, and I would say even time itself, comes in bunches or quanta.

One more comment on Mr.Gunther's article is in reference to his statement that "the secret of motion is that it does not happen on the basis of quantized physical conditions where distances gradually pile up to almost immeasurable orders of magnitude." I do not believe this statement goes far enough. Take, for example, the transition of an electron from one energy level to another in an ionized atom. If we picture the atom as a miniature solar system—a debatable viewpoint —an electron would move from one orbit to another. This does not take place in a uniform transition over a period of time. Rather, the electron disappears from one orbit and reappears in another without any transition phase. If we want to give our fancy complete freedom, it is certainly conceivable that we could push a physical body into the space continuum at a point on earth and have it pop out either on the Moon or on Proxima Centauri, as desired.

Returning to Achilles, I submit that if Achilles at point A is twice as far from point Z as the tortoise who is at point B, then according to a quantized universe there are twice as many possible positions for Achilles between A and Z then there are for the tortoise between B and Z. In the race, Achilles is bumping over his various possible positions twice as fast as the tortoise. When the two competitors reach point Z a discontinuity occurs and the physical procession turns inside out.—

James R. Alburger, 7356 Santa Boulevard, Hollywood 46, California.

The great importance of paradoxes, as I see it, lies in their ability to call attention to the fact that the logic system, system of assumptions being used in thinking about the matter, is not perfect.

The best way to do this is to use the logic system to force a conclusion which is "intuitively"—which actually means "by experience of general living"—nonsense. At that point, human beings will seek to resolve the conflict—and, thereby, learn!

The danger of a logic system is that when we find one that is useful in many instances, it is easy to relax back on it and assume it works in all instances. When that happens, your thinking is limited by the capabilities of your logic system; shortly your actions are circumscribed by your refusal to try that which is logically *impossible. Until a new logic system comes along, it will remain logically impossible, therefore unthinkable, and therefore all men trained in the logic system will "know" it is useless to try it!*

Paradoxes can help to break this vicious circle, this self-sealing, leak-proof humanity-tank system!

Currently, we can't solve general field theory. New electrons are quantized by nature; magnetic fields are not. But if we impose on magnetic fields "lines of force" to match our

logic-conceptions, we may be making *the problem insoluble.*

Dear Mr. Campbell:

I have a few questions about SPACE which have bothered me for some time. I have read the first two instalments of "Achilles and the Tortoise" which have not clarified the matter for me. As no doubt I will not be able to understand Part Three either, I'll ask the questions now.

When I drive my car from a side road onto a main highway, I stop. This is partly because there is a stop sign, partly because I must wait for a SPACE to come by so that I can get into it. Now there is no doubt in my mind that the SPACE I am waiting for is movable because I have to wait for it. Now it isn't there and now it is. It may be that it is moving through time, but since I can see it coming down the road, I conclude it is moving through my ordinary layman three-dimensional universe.

Now, imagine that I approach the highway at some hypothetical time when there is no traffic on the road. There are plenty of SPACES available. My questions are these: Are those SPACES moving? If so, which way? Do they conform to the American custom of keeping to the right? Do they stop at red lights? Do they pass each other? Do they ever collide? How big are they?

And the big question from a pragmatic viewpoint is: How can I save one for use at a time when the highway is fully congested?—Robert E. Fogg, 1815 North 54th Street, Seattle 3, Washington.

That's a lovely question! Darned if I can answer it, though!

Dear Mr. Campbell:

What manner of man is it that planks down thirty-five cents and says to the clerk, "Gimmie that ASF over there"?

Last year, February or thereabouts, ASF ran a letter of mine asking for ideas on how to record the movements of the tongue during a spasm of stuttering. I threw the subject open and just asked for help from anybody. At the same time we sent similar letters to several physics journals, several technical communication journals and so forth.

Results? ASF by a landslide!! Some of the hoity-toitier publications—you know, those that you can't buy at the newsstands but must subscribe to at a university address—refused to run the letter, saying it was "policy," but of the ones that did, the results from ASF were outstanding. The letters from ASF came in like a wave—from doctors, engineers, plumbers, radio hams, electricians, et cetera and et cetera. The letters were full of ideas—some good, some fair. One could sense that these people had something to

say. The broad spectrum of ideas that were offered varied from the complex pages of electronic diagrams to simple notes on a postal card. They came from all over: Cuba, South Africa, Europe, the States. It was heady champagne, reading those letters. Here were men who knew nothing about this thing we wanted to do (or to put it another way . . . were not loaded down with a lot of inhibitions and well established misconceptions) and they took off like big birds . . . swooping and hollering up there in the thin cold air of speculation. We got something like fifty letters and each one must have taken about ten hours to write—most of the letters ran heavy to electrical layouts and mechanical gadgetry—and if an engineer's time on short jobs like this is worth twenty bucks an hour—not too much since that's what a plumber just got through clipping me—you can see that we got about ten grand worth of advice from the investment of a three-cent stamp. Were the suggestions good? Were they applicable? I turned the letters over to Those Who Serve the Great God Therapy. They are using the ideas but that unreliable, mercurial, skittish old devil, the human nervous system is giving lots of trouble.

The richest mine in the world is not the Whachamacallit Diamond mine in Africa—it's the fund of knowledge available on tap in the free-roving imagination of the guys who read ASF.—Julius Lucoff.

We won't guarantee to solve your problem—but we will guarantee to think on it!

Dear Mr. Campbell:

Re your editorial in the November issue: At heart, I'm not a gambler; in other words, I bet only on sure things. And I'm not sure that my sources of information are as complete as yours. For example, if Dr. Rhine's work is not, by your definition, as yet established as a new field of science but will assuredly be so in the next eight years, then let someone else cover your bet. If not, here are some points for your consideration:

1. You imply, I believe, that *by definition* a field of science is not new if inorganic metering equipment has been built which can produce measurements in that field. May I disagree? Might not a meter be devised which works beautifully in a known field, yet measures in the new field if a hitherto excluded, extraneous variable were introduced?

I could postulate a voltmeter, say, which works quite will under normal Earth type conditions. It ignores electromagnetic fields, pays little attention to changes in humidity and temperature. Take the voltmeter—you must understand that this is a special voltmeter designed to get around patent problems—out in free space. No voltage across the probes, but it starts indicating 7.65 volts.

Further investigation shows up a hitherto unknown type of radiation—the whifflepiffle effect—which is completely blanketed by the combination of Earth's atmosphere and gravitational field. The voltmeter turns out to be a lovely whifflepiffle meter. Want to bet that this can't happen? And it *would* be a new field of science, you know!

To be more mundane, take a common germanium crystal. As a diode in certain configurations it can meter the height of a voltage pulse. This, by the Fourier integral, can be shown as an infinite series of alternating voltages. Recently has been added a hitherto absent variable—a magnetic field—and the crystal became a direct-current transformer which plays an important part in certain types of direct-current measuring devices, and flux-density meters.

Perhaps this is a poor analogy, since these effects are a part of, by most definitions, the same, somewhat-well-established field. But the point I am trying to make is this: a meter may work well in a known field of science, measuring what it was designed for, *only* if some unknown force, radiation, field, or what have you stays completely out of the picture. If the unknown suddenly enters, the meter may inadvertently begin to measure *it*, to the consternation of the poor technician!

Three other points for consideration:

2. The applications of some equations in the unified field theory may provide as interesting, and just as new, fields of science as did Maxwell's equations.

3. We have available highly sensitive accelerometers which can measure changes in acceleration. They are used to control the roll, pitch and yaw of aircraft. Of course, we have one built into our noggins, too, but the aircraft jobbies are inorganic.

4. Such accelerometers can conceivably be used to measure the change in a gravitational field immediately surrounding said accelerometers.

Still want to make that bet?—Dennis D. Willard, 2734 Watson Boulevard, Endicott, New York.

I'm still betting! Remember that a bet depends, practically by definition, on probability. Agreed that a meter can turn out to measure something other than it was intended to—but the fact that living organisms are designed to react to everything, *while confusing in many instances, also means that they will in all probability show up reacting to the brand-new X phenomenon before any inorganic meter can be made for the job.*

———

Dear Mr. Campbell:

Something struck me as contradictory to previous data as I read your latest published editorial (Brainwashing—October 1954). Certainly I agreed with the healthy emphasis you gave the fact that we do have *organic*

brains which are affected by the supply of food and oxygen they receive, and that since "judgment" and "will" are functions of some part of the brain, they, too, are dependent on these physical components. (I don't think either of us would like to insist that the words in quotes above have been sufficiently sharpened to enable direct correlation with a single brain process.)

Today, three days later, my search-mechanism presented me with the answer. Not contradictory after all, but puzzling all the same. There exists an almost traditional correlation between semistarvation and genius! How is it that the creative part of the brain is not the first to be dulled by adverse physical effects? A striking example which comes to mind is the youthful French Mathematician Galois who continued to develop his marvelous Group Theory (see letter from J. P. Fairfax in October ASF) while imprisoned as a revolutionary—suffering from ill-treatment, poor food, damp living conditions et cetera. Another, the English madman, Heaviside, who developed the operational calculus while living in the (traditional) garret, writing his ideas out in pencil that had nearly faded before the scraps of paper were discovered to contain anything so valuable.

The wish of the creative mind, in many cases, for solitude appears to offer another "contradiction" to your statements. Often this is given them freely as they are regarded as odd birds, or else they may develop powers of concentration regardless of environment (Socrates, Madame Curie), or they may actively seek it: Descartes hitting on "Existimo, ergo sum" while holed up in a wrecked boiler; Kant refuting Hume while on his long walks; Schweitzer being struck by his ethic: "Reverence for Life" while paddling his canoe on a quiet jungle river.

These men were surely not extra-terrestrial entities. Is one forced to admit that the most highly advanced sectors of the most highly advanced brains are indeed *not* subject to physical deprivation unless in its more extreme forms?—J. P. Huston, 543 Balliol Street, Toronto, Ontario, Canada.

It has also long been held that an excess of food, drink and company effectively dulls the mind. Too much vitamin A is as toxic as none!

Dear Sir:

It strikes me there is a definite need in our world of today for a publication which would bridge science fiction and science-fact.

What I have in mind is something in the nature of a clearing house for what we might term "speculative science." For example, say I have an idea for a television screen using polaroid filters, crystals, and a planar

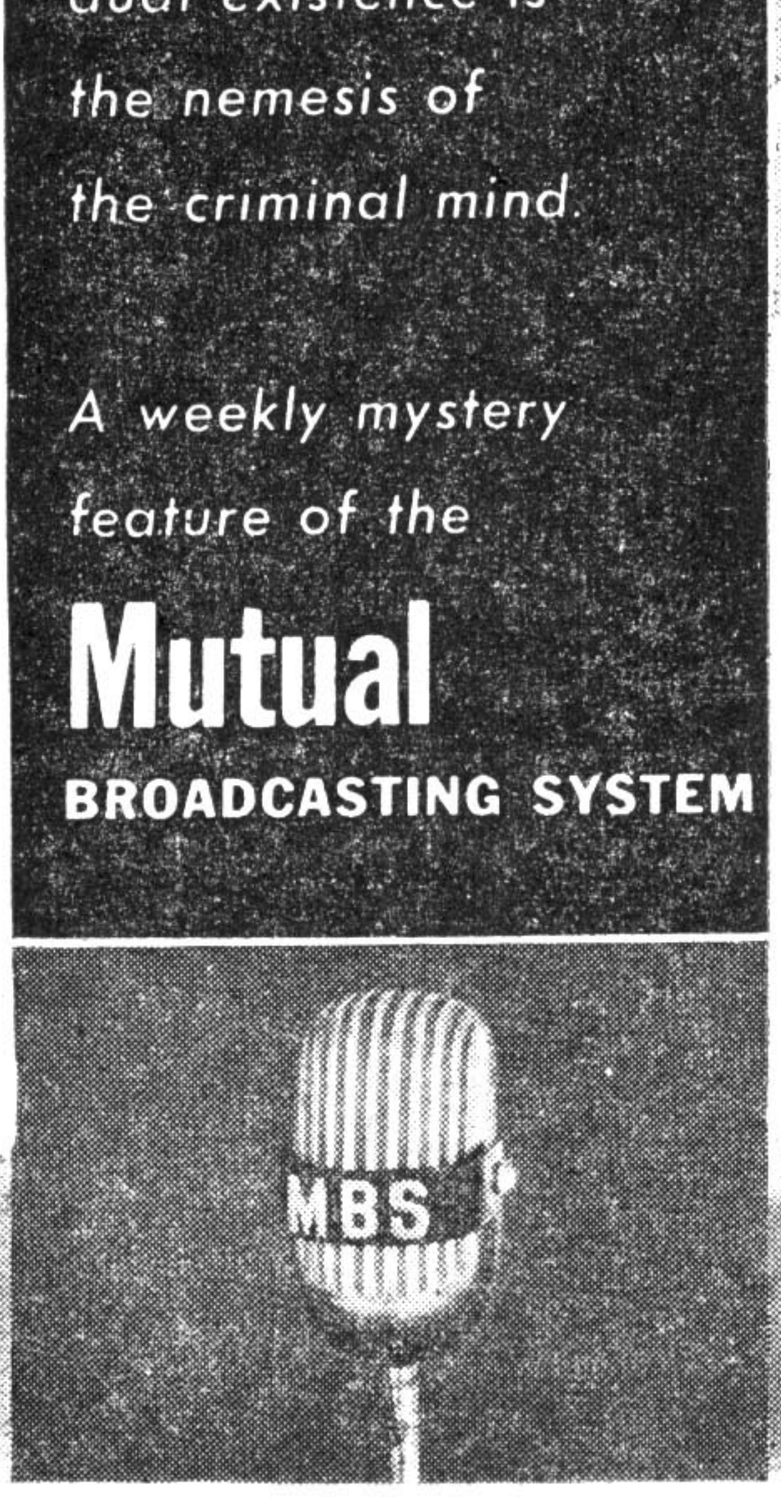
The Shadow

Unusual adventures of a man whose dual existence is the nemesis of the criminal mind.

A weekly mystery feature of the

Mutual

BROADCASTING SYSTEM



light source. The screen would be perhaps one inch deep and as large as is desired. However, I need a crystal which will rotate the plane of polarized light when it is excited at its resonant frequency. Assume further that I am not aware of the existence of such a crystal.

The thing for me to do is get the idea to appear in our hypothetical publication which we will say enjoys circulation among scientists as well as nonscientists. Now assume 1) that such a crystal is known to exist; or 2) that it is not. In the first case our wafer-thin TV screen would be a reality in a very short time. In the second case some enthusiastic chemist or solid state physicist would possibly be on the lookout for such a crystal, or might even take it upon himself to search for one. In either case it seems probable to me that if we are *ever* to have such a screen we would certainly have it much sooner than if the publication did not exist.

Subjects could range from possibly theory—although the inclusion of "speculative theories" might lead to a publication of considerable bulk!—to would-be inventions, and from psychology and biology to mathematics and physics.

I grant you that the undertaking suggested here would doubtless be a tremendous task; however, the contribution to humanity would likewise be tremendous.

Do you want atomic rockets, interstellar travel, a microscopic atomic generator in every home appliance, antigravity, matter transmitters, et cetera?

The articles would be similar to the recent three-part article in ASF, "Achilles and the Tortoise." This is the missing link between science and science fiction and we need much more of it.

You, sir, are the man for the job: 1) ASF is read by scientists and nonscientists. The new publication would need association with your name and the publicity ASF could give it. 2) You seem to have a natural flair for this sort of thing as evidenced by your editorials and the articles in ASF. This would make your editorship of the publication invaluable.

What do you think?—Homer B. Tilton.

I think that if you write up the idea into a story, you'll have exactly what science-fiction has been doing for some twenty-five years!

So far, no one seems ready to establish "The Journal of Speculative Science" I proposed a couple years back, however.

Dear Sir:

In your November issue you featured an article called "It Didn't Come from Mars," by Roy F. Clough, Jr. It was as far as it went, but it didn't go anywhere.

I would like to have more details about this article. Perhaps you could put me in touch with the author.

In recent issues I have found the features — especially the editorial page — highly interesting and thought-provoking, but the stories have been miserable and the November issue hit a new low. I enjoy Astounding very much but if the stories continue in this vein, I suggest you give up the ghost.

Respectfully yours,
JOHN HOROWITZ
235 Lefferts Ave.,
Brooklyn 25, N. Y.

More details on Clough's model appeared in the April 1954 issue of Air Trails.

Dear Mr. Cambell:

I have just read Pfc. Richard Bruner's letter in BRASS TACKS. I would like to comment on one of his criticisms regarding sociologists and psychologists and mathematical methods.

In commenting, he quotes your editorial "The sociologists and psychologists have long maintained that *mathematical* methods are not applicable to human problems". He then counters with "Man! I defy you to find one psychologist doing experimental research of any kind who has not used *statistical* methods in his research. He refers to five books. The first uses the word *methods* but the

contents reeks with *statistics*. The other four actually and rightfully are titled *Statistics*, not *Mathematics*.

Pfc. Richard Bruner surprises me. I am surprised that a man who has the intellect to compose such a well written letter, does not understand the vast difference between these two words. Quite often book keepers, time keepers, and census takers classify themselves as mathematicians. I am well aware of the great amount of statistics on race horses, but if Pfc. Bruner can show me one good mathematical formula to calculate how fast any one horse will run, I will gladly share with him my million dollars race horse profit.

A young woman leaves her husband because she sees ahead a life of misery. She is willing, because of her children, to change her ways if her husband is willing to change his ways. But in what way should she change? How should he change? What was wrong with his philosophy, or her philosophy that marred their married life? Mathematically, how loud can he talk before emotions are irritated? How tired can he be after a day's work before she should not ask to go out? Who can answer these questions in terms of chemistry, physics or mathematics without being influenced by his own emotional characteristics?

These are human problems. Statistics will not answer them except in a vague probability factor based on average wives and average husbands. But these two are individuals, not averages. Like chemistry, electricity etc., mathematics can be applied to human behavior and human problems as soon as we can measure emotional stress in terms of volts, tiredness in terms of a chemical condition meter, which each of us would carry on our instrument panel so others could know how to deal with us.

The defense of your editorial rests;

WILLIAM O. NIXON, 1651
Anita avenue, Grosse
Pointe Woods 36, Michigan

The greatest problem facing Man is this; that each individual is simultaneously and inescapably both *an individual and a member of one or more groups. And Mankind does not know how to handle the problem of individual-group relationships. It's rather like the physicist's problem that light simultaneously displays particle-individual nature and group-wave nature — and we can't, yet, conceive of a single expression that relates both natures simultaneously.*

The social scientists can't solve the problem of Mankind until they can derive an expression that inter-relates both aspects of the individual human being.

☆ ☆ ☆

Continued from page 7

"Ah, women are irrational!" If he's somewhat older, more patient, and saner, he'll start with the postulate: "A theory that doesn't yield a useful result isn't a useful theory. The theory "Mary is not rational" may be valid, but it isn't useful, so I might as well discard that one. I certainly can't solve the problem if I maintain that Mary's behavior can only be described by a wild, discontinuous, fluctuating variable."

You know, that problem seems to bear a strong basic resemblance to the problem of solving a seven-body problem. Maybe Mary isn't irrational at all; maybe the logic system is just inherently incompetent to solve a complex seven-factor problem with the necessary speed and directness. An astronomer has several centuries to figure out Pluto's orbit; Bill doesn't have quite that much leisure in solving his problem.

Could be that's what the social scientists mean when they say that mathematics doesn't work in their field. It doesn't work in any field where it has to consider a simultaneously mutually interacting system of multiple factors, save by multiple approximation. Try it some time when 160,000,000 individual factors are interacting in varying degree, and you'll understand why politics is an art, not a science.

Anyhow, what Bill and Mary need, evidently, is a logic that works in a nonobjective system. (So do the astronomers; they want a mathematics that can actually handle multi-body problems without playing the game of "We'll pretend the other seven bodies aren't present.")

Bertrand Russell found that Logic involves the proposition that the Class of All Classes cannot be a member of itself. That is, in essence, what the "objective viewpoint" means; you can't logically consider a problem when logical consideration of the problem is itself part of the problem. That produces an infinite series of fluctuating corrections, and no con-

clusion can be reached.

But that's precisely the problem we have to solve! What we need is a method of thinking that *can* handle the fact that I am thinking, and thinking about the problem I'm thinking about, and that that thinking is going to interact on and change the problem.

You know, this sounds suspiciously like another type of problem. What kind of a set *can* be a proper member of itself? Easy; any mathematician can tell you! An infinite set.

If you consider the set of all the whole numbers, you have an infinite set. But if you count off only the numbers that end in —5, they, too, are an infinite set, and they're just as infinite as the set of all the whole numbers. Also, the set of all the numbers that end in —,000,000,000 is equal to the set of all whole numbers—it's just exactly as infinite.

Now in a finite set, no matter how large, there is one and only one way for two sets to be equal; they have to be identical. If two groups of numbers are different, then they are not equal. The set 17395 is *not* equal to the set 17935. That's one of its very useful characteristics.

Aristotelian logic will do just as well as any three-valued, four-valued, or *n*-valued logic in handling human problems. Or just as badly, actually. It makes no difference how large the value of *n* in an *n*-valued logic may be, if it's a finite value, it still maintains the rule that only identical sets are equal. It still can't be a member of itself. That characteristic is possessed only by transfinite sets—and by a transfinite logic.

Under an Aristotelian, or any *n*-valued logic, the statement "A is not identical to B" means that A and B can be ordered, that A can be put in a superior or inferior rank position, but cannot be put equal to B. But in a transfinite logic, A can be equal to B. A might be "the set of all odd numbers" while B was "the set of all whole numbers." They're different, all right, but equal.

If I say, "Bill doesn't think the way Tom does," it is automatically assumed that I imply a rank, a non-equality, a superiority-inferiority ordering. But suppose Bill happens to be the world's greatest mathematician, and Tom is the world's greatest biochemist. They certainly don't think alike.

You can work with *n*-valued logics till the world freezes over, but in any logic having finite values, you can't make different sets be equal, nor can you make the existence of that logic a factor within the logic itself. But infinity plus infinity is infinity; infinity minus infinity is infinity. A transfinite logic can include itself very happily.

Now—all we need is the laws and rules of a transfinite logic.

Anybody got the rule-book handy?

THE EDITOR.

continued from BACK COVER

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