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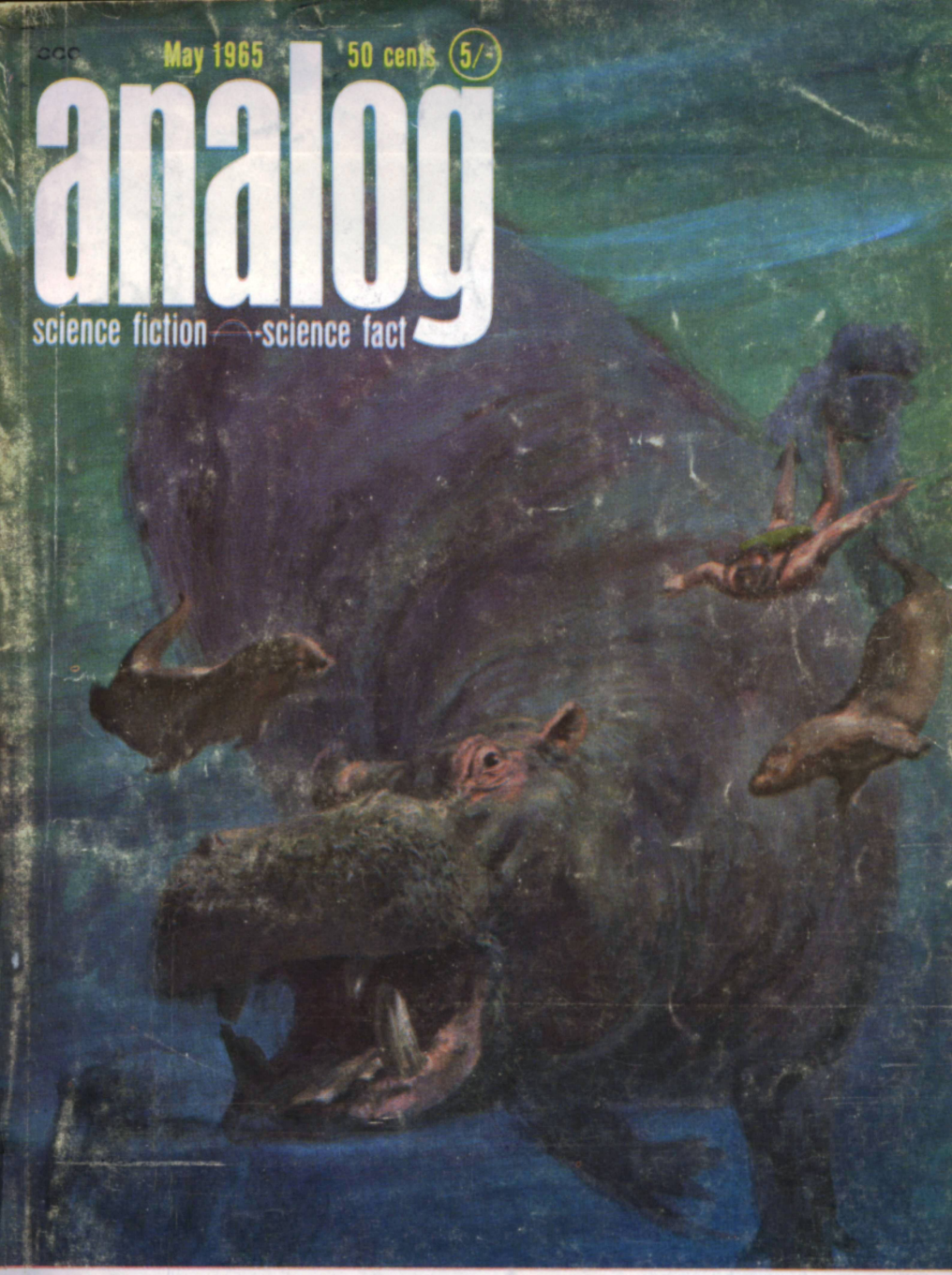
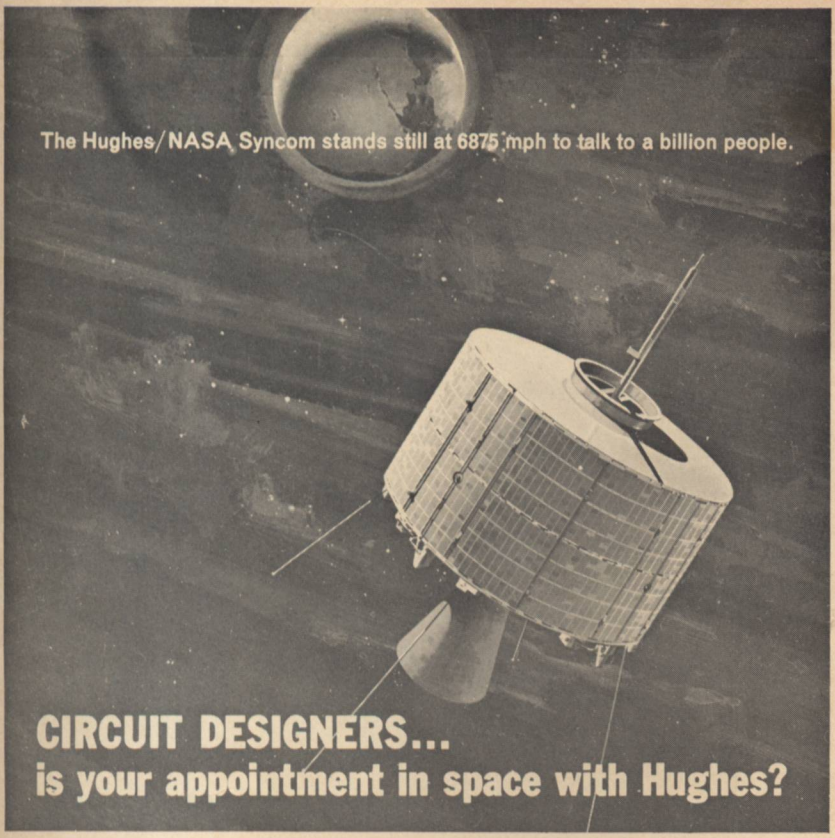


TROUBLE TIDE BY JAMES H. SCHMITZ



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astt

AN AMERICAN SOCIETY FOR TESTING THEORIES

editorial by
JOHN W. CAMPBELL

I have for some while been giving talks before various professional groups, proposing the formation of a new, and much needed professional Society—the American Society for Testing Theories. Such a Society could serve a highly useful function on behalf of Science, much as the esteemed American Society for Testing Materials does for the various Engineering groups.

The ASTM does not, itself, actually test materials; its function is to formulate and evaluate testing methods, and to establish test procedures by which industrial and engineering purchasers can specify a wanted material or device, and know that sound, genuinely revealing testing procedures have been used to determine that the material or device is, in fact, what the seller claims. Equally, the seller can know the buyer's testing standards, and not have to fight out with him some whimsical test-procedure that winds them up wrangling in court.

In a somewhat similar manner, the proposed ASTT would not actually test theories in fields of science, but would simply establish procedures for testing theories—establish tests for determining what constitutes "evidence".

This, incidentally, is an area where the legal profession may well be of great help; highly emotional fights over "truth" have been going on in law courts since before the beginning of history. Over many centuries of experience with such problems, law experts have developed and established Rules of Evidence—something which Science has never done.

The core of the problem is, of course, that since Man is not, and will not in any foreseeable future become omniscient, all his theories are either wrong, inaccurate, or misguided. The entire history of Science has been made up of the successive replacement of theory A by theory A^{I}, which was succeeded by theory A^{II}, followed by . . . each modification being somewhat better as a representation of observations.

The difficulty has been the enormous amount of emotional heat and the violent charges and countercharges that have been generated at each change of phase. The latent heat of fusion of a widely accepted theory seems to approach that of Pu-239.

Even more violent are the reactions when theory A cannot be modified to fit observations, but must be discarded, *in toto*, and a completely new theory B, starting from new initial postulates installed.

The recent discovery of a series of fluorine and oxygen compounds of the hitherto "inert" gases, for in-

stance, called for a revision and correction of theories of chemical valences.

Notice that one of the most crippling results of a wrong or incorrect theory is that it *tends to prevent experiments*—even simple experiments!—that would gather contradicting data. All it took to disprove the total inertness of xenon was to put some xenon and some fluorine—almost any proportions will do—into a nickel can, and heat in a hot oven for a couple hours. On cooling off and opening the can, the crystals of xenon fluoride are visible to the eye—no special equipment whatever needed.

That, however, was merely a "modification" problem—a shift from theory A to theory A^1.

The really violent reactions come when it is a matter of complete scrapping of theory A, as when Copernicus and Galileo, in team so to speak, showed that the Ptolemaic theory of cosmology was *wrong*, not merely incorrect. The basic postulates of the accepted theory had to be thrown out, and totally new, alien, and intensely disliked postulates had to be accepted.

Chemistry went through a similar violent revolution when Lavoisier & Cie. threw out phlogiston, and forced the acceptance of the oxidation theory.

The reason that I suggest lawyers can help greatly in drawing up the initial procedures for the ASTT is that the past history of science shows that these theory-change problems bear a remarkable emotional resemblance to damage suits, paternity cases, and inheritance disputes. Something needs to be done to minimize the emotional violence, and maximize the efficient determination of theory-validity.

Lawyers have a rule against hearsay evidence; this helps greatly to exclude the Authority effect so common in scientific-theory debate. Under that rule, a warring scientist would not be allowed to quote what Dr. Epaminondas said, but would be forced to confine himself to what he himself had seen and done. While this would be a terrible and frustrating burden to a debating scientist, the experience of the law has been that it makes for considerably less confused, and much more rapid resolution of problems.

One of the problems of admitting hearsay evidence is trickery, such as "Well, dammit, I know you're wrong, because Dr. George Harwell, head of the Physics Department at Yukon University, performed an experiment in 1963 that . . ." This is apt to be quite an impressive report, precisely confirming the debater's position. It can win an argument—though there will remain the fact that "A man convinced against his will is of the same opinion still!"

So far as I know, there is no Yukon University with a Department of Physics headed by anyone,

including no Dr. George Harwell, but a victim in a heated debate can frequently be snowed completely by such tactics. Very useful tactic . . . if all you want is to win the debate, and to hell with finding the truth.

One of the obstructive—i.e., it feels obstructive and frustrating!—aspects of the lawyers' Rules of Evidence is the insistence that the rules apply equally to *both* sides of the case. The District Attorney—the Claimant's lawyer—the defendant's lawyer alike are forced to submit to the same obnoxious Rules of Evidence.

This is not, currently, being applied in the fields of Science, because, perhaps, it so cripples free and creative endeavor. It's frustrating; it requires that much elaborate work be done in re-thinking methods of presenting data for example. It's particularly crippling to the well-established fields, while putting almost no burden on new ideas.

Recently, nuclear physicists at Brookhaven announced the proof-of-existence of the omega-minus particle.

The photographic plates proving its existence had resulted from using the great Brookhaven 33-billion-volt particle accelerator, to drive enormously high-energy particles into the Brookhaven 75-ton liquid-hydrogen bubble chamber. Automatic cameras photographed the resultant particle-events.

continued on page 160

Trouble Tide

You can, by mutation and selective breeding, adapt Earth life-forms to another planet. But that doesn't mean that the other planet life-forms are going to adapt to you!

JAMES H. SCHMITZ

Illustrated by John Schoenherr

Analog Science Fiction / Science Fact

I

When Danrich Parrol, general manager of the Giard Pharmaceutical Station on Nandy-Cline, stepped hurriedly out of an aircab before the executive offices, he found Dr. Nile Etland's blazing blue Pan Elemental already parked on the landing strip next to the building entrance.

Parrol pushed through the door, asked the receptionist, "When did she get here, and where is she now?"

The girl grinned, checked her watch. "She arrived four minutes ago and went straight into Mr. Weldrow's office. They called in Freasie immediately. Welcome home, Mr. Parrol! We've had a dull time since you left—at least until this thing came up."

Parrol smiled briefly, said, "Put any calls for me on Weldrow's extension, will you?" and went down the hall. At the far end, he opened the door to an office. The three people standing in front of a wall map looked around at him. Ilium Weldrow, the assistant manager, appeared relieved to see him.

"Glad you're here, Dan!" he said heartily. "It seems that . . ."

"Dan, it's a mess!" Dr. Nile Etland interrupted. The head of Giard's station laboratory appeared to have dressed hastily after Parrol called her at the spaceport hotel—she would have had to, to show up here within ten minutes. Her coppery hair was still piled high on her head; the intent face with its almost too perfectly chiseled features was innocent of make-up. She nodded at the heavily built woman beside Weldrow. "Apparently it isn't an epidemic. Freasie says there's been no trace of disease in the specimens and samples that came through the lab."

"Naturally not!" the lab's chief technician said sourly. "If the material hadn't been absolutely healthy, it would have been returned with a warning to the ranches that supplied it."

"Of course. And there've been no reports of sea beef carcasses seen floating around," Nile Etland went on.

Parrol asked, "Exactly what does seem to have happened? The news report I picked up at the hotel just now didn't tell much, but it didn't sound like an epidemic. The man talked of 'mysterious wholesale disappearances' among the herds in this area. The way he put it almost implied that one or the other of the local ranchers is suspected of rustling stock."

Nile turned to the wall map. "That's darn improbable, Dan! Here, let me show you. The trouble started there . . . a hundred and fifty miles up the coast. Eight days ago. Throughout the week the ranches south of that point have been hit progressively.

"The worst of it is that the estimated losses are going up fast! It was five to ten per cent in the first

herds affected. But the report this morning was that Lipyear's Oceanic is missing almost sixty per cent of its stock."

"Lipyear's? Sixty per cent!" Parrol repeated incredulously. "The newscast said nothing of that."

"I called the Southeastern Ranchers Association on my way here," Nile told him. "That's the figure Machon gave me. They haven't put it out yet. It's a big jump over yesterday's estimate, and Machon seemed to be in a state of shock about it. There are plenty of wild rumors but no useful explanation of what's happening."

Parrol looked at Weldrow, asked, "What have you done so far, Weldrow?"

The assistant manager frowned. Nile Etland said impatiently, "Weldrow's done exactly nothing!" She turned to the door, added, "Come on, Freasie! Let's get things set up in the lab. Be back in ten minutes, Dan."

Ilium Weldrow was a chubby, pink-faced man, Parrol's senior by ten years, whose feelings were easily bruised. As an assistant manager on a world like Nandy-Cline he was pretty much of a dead loss; but a distant relative on Giard's board of directors had made it impossible to ship him quietly back to the Federation's megacities where he should have been more in his element.

He was disturbed now by Nile Etland's comment, and Parrol spent a few minutes explaining that the coastal ranchers—particularly the ones under contract to Giard—depended on the company's facilities and expensively trained trouble-shooters to help them out in emergencies . . . and that if anything serious should happen to the local sea beef herds, Giard would drop a fortune in the medicinal extracts obtained by its laboratory from the glands of the specific strain of sea beef grown on Nandy-Cline and obtainable nowhere else.

Weldrow seemed to get the last point; his expression shifted from petulance to concern.

"But, Dan, this problem . . . whatever it turns out to be . . . appears to affect only this area of the eastern coast! What is to keep us from getting the required materials from sea beef ranches on the other side of the continent?"

"Mainly," Parrol said, "the fact that those ranches are under contract to outfits like Agenes. Can you see Agenes loosening up on its contract rights to help out Giard?"

Again the point seemed to sink in. Even Weldrow couldn't help being aware that Agenes Laboratories was Giard's most prominent competitor and one with a reputation for complete ruthlessness.

"Well," he said defensively, "I haven't had an easy time of it during the two and a half months you and Dr. Etland were in the

Hub, Dan! My duties at the station have absorbed me to the extent that I simply haven't been able to give much attention to extraneous matters."

Parrol told him not to worry about it. On the way out, he instructed the receptionist, "If there are any calls for me during the next few hours, I'll be either at the Southeastern Ranchers Association or in Dr. Etland's car. That's the new job she had shipped out from Orado with us. She's had its call number registered here."

A few minutes later, he was easing Nile Etland's PanElemental off the landing terrace and into the air, fingering the controls gingerly and not without misgivings, while the doctor took care of her makeup.

"Don't be timid with the thing," she advised Parrol, squinting into her compact. "There's nothing easier to handle, once you get the hang of it."

He grunted. "I don't want to cut in its spacedrive by mistake!"

"That's impossible, dope . . . unless you're *in* space. Put up the windscreen, will you? Fourth button, second row, left side. Agenes? Well, I don't know. If those beef things were dying instead of disappearing, I'd be wondering about Agenes, too, of course."

Parrol found the windscreen button and shoved at it. The air whistling about them was abruptly quiet. Somewhat reassured about the PanElemental's tractability—nobody but Nile would sink two years' salary into a quadruple-threat racing car—Parrol stepped up their speed and swung to the right, towards the sea. A string of buildings rushed briefly towards them and dropped below, and the sun-bright blue rim of Nandy-Cline's world-spanning ocean came into view.

"Would there be chemical means of inducing a herd of sea beef to move out of a specific body of water?" Parrol asked.

"Naturally. But who's going to give that kind of treatment to a body of water a hundred and fifty miles long and up to eighty miles wide? Besides, they haven't *all* moved out." She loosened her hair, fluffed, shook and stroked it into place. "Better try another theory, Danny," she add.

"Do you have one?"

"No. We'll see what goes on at the ranchers' emergency meeting first." Nile motioned with her head towards the back of the car. "I dumped some testing equipment in there, in case we want to go for a dip afterwards."

There was silence for some seconds; then Parrol said, "Looks about normal down there, doesn't it?"

He had swung the PanElemental left again, slowing and dropping towards the shoreline of the continental shelf. Near low tide at present, the shelf stretched away for

almost sixty miles to the east, a great saline swamp and, from this altitude, a palette of bilious pigments. A number of aircars cruised slowly over it, and power launches were picking their way through the vegetation of the tidal lakes.

"Lipyear's Oceanic," Nile observed, "seems to have about every man they employ out spot-counting what's left!" She hesitated, added, "You're right about the herds we can see showing no sign of disturbance. Of course, nothing *does* disturb sea beef much."

Parrol sighed, said, "Well, let's get on to the meeting."

By midmorning the sun was getting hot on the shelf, turning the air heavy with mingled smells of salt water and luxuriating vegetation. Escorted by a scolding flock of scarlet and black buzzbirds, Danrich Parrol brought a water scooter showing the stamp of Lipyear's Oceanic down to the edge of an offshore tidal pool. The buzzbirds deserted him there. The scooter settled to the water, drifted slowly across the pool towards Nile's Pan-Elemental, berthed on the surface between two stands of reeds.

Parrol looked thoughtfully about. Passing overhead through the area half an hour earlier, he had seen the slender, long-legged figure of Dr. Etland standing in swimbriefs and flippers on her car. At the moment she was nowhere in sight. An array of testing equipment lay helter-skelter about on the Pan's hood, and the murkily roiled water indicated sea beef was feeding below the surface.

Parrol stepped over into the big car and tethered the scooter to it. He was wearing trunks and flippers; attached to his belt were an underwater gun and knife. The shelf ranchers were rarely invaded by the big deep-water carnivores, but assorted minor vermin wasn't too uncommon. He reached back to the rack of the scooter, fished cigarettes out from among a recorder, a case of maps and charts, a telecamera, a breather and a pocket communicator. As he was lighting a cigarette, a flat, brown animal head, fiercely whiskered and carrying a ragged white scar-line diagonally across its skull, broke the surface twenty feet away and looked at him.

"Hi, Spiff," Parrol said conversationally, recognizing the larger of the two hunting otters Nile kept around as bodyguards when engaged in water work. "Where's the boss?"

The otter grunted, curved over and submerged his nine-foot length again with a motion like flowing dark oil. Parrol waited patiently. A minute or two later there was a splash on his left. The face that looked at him this time showed the patrician features of Dr. Nile Etland. She came stroking over to him, and Parrol held a hand down to her. She grasped it, swung herself smoothly up on the hood of

the PanElemental, squeezed water out of her hair and pulled off the transparent breather which had covered her face and the front part of her head.

She glanced at the watch on her wrist, inquired, "Well, did you find out anything new during the past hour and a half?"

"I picked up a few items. Just how meaningful—" Parrol checked himself. Slowly and almost without sound, a vast, pinkish-gray bulk rose above the surface near the center of the tidal pool. A pair of bulging, morose eyes regarded the humans and their vehicles suspiciously. Terra's *hippopotamus amphibious*, adapted to a salt water life with its richer food and increased growth potential, enlarged, tenderized and reflavored, had become the sea beef which provided the worlds of the Federation with a considerable share of their protein staples. This specimen, Parrol saw, was an old breed bull, over thirty feet long, with a battle-scarred hide and Oceanic's three broad white stripes painted across its back.

"Is that ancient monster what you're messing around with here?" Parrol asked.

"Uh-huh." Nile was taking an outsized hypodermic from a flap in one of her flippers. She placed it on the hood. "He's a bit reluctant to let me have a blood sample."

"Why bother with him?"

She shrugged. "Just a hunch. What were you about to say?"

"Well, there's one detail about the big beef disappearance I can't see as a coincidence," Parrol told her. "The thing started at the north bend of the continent. It's taken it a week to move a hundred and fifty miles down the coast to Lipyear's Oceanic. That's almost the exact rate of speed with which the edge of the Meral Current passes along the shelf of the Continental Rift."

Nile nodded. "That's occurred to me. If it's only a coincidence, it's certainly an odd one. But deciding the Meral's involved doesn't answer the big question, does it?"

"Where have the stupid things gone? No, it doesn't." Parrol scowled. "None of the theories brought up at the meeting made sense to me. Animal predators can't have caused it. I've checked with half the northern ranches, and they've noticed no unusual numbers of dead or wounded beef floating around—or obviously sick ones either. And nobody's been running them off. There'd be no place to hide them in quantities like that, even if they could be moved off the ranches without attracting attention.

"I did hear about one thing I intend to look into immediately. Somewhat over two months ago—almost immediately after we'd left for the Hub, as a matter of fact—the Tuskason Sleds reported to mainland authorities that something had killed off their entire fraya pack."

Nile whistled soundlessly. "That's bad news, Dan! I'm sorry to hear it. You think there's a connection?"

"I don't know. The authorities sent investigators who couldn't find anything to show the pack hadn't died of natural causes. The sledmen claimed the frayas were deliberately poisoned, but they had no significant evidence to offer. The feeling here is they were fishing for federal indemnification. I've asked Machon to find out where the Tuskason fleet is cruising at present. He'll let me know as soon as it's been located, and I'll fly out there."

He added, "Then something occurred to me that might help explain the problem on the ranches. There's a possibility that it's chiefly the spot-counts on the beef that are way off at the moment. The computers figure that beef which is feeding submerged or napping on the bottom will, on the average, surface every ten minutes to breathe.

"But say something's happened to poison them mildly, make them exceptionally sluggish. If every animal in the herds is now surfacing only when it absolutely *has* to breath, it might almost make up for the apparent drop in their numbers."

"That's an ingenious theory," Nile said. "You've suggested an underwater check?"

"Yes. It will be a monstrous job, of course, particularly in an area the size of Lipyear's, but some of the ranchers are going at it immediately. You didn't . . ."

She shook her head. "So far there's been nothing in the water and blood samples I've sent in to the lab to suggest poisoning of any kind as a causative agent in the disappearances. But, as a matter of fact, I have noticed something which supports your idea."

"What's that?"

"The old bull who showed up just now," Nile said. "I don't know if you were watching him, but he went down again almost immediately. And one reason I wanted a blood sample from him is that he did *not* surface to breathe in anything like ten minutes after I'd started checking the pool. When you arrived, he'd been under water for better than half an hour. However, he isn't acting sluggish down there. He's busy feeding his face. In fact, I don't remember seeing a beef stuff away with quite that much steady enthusiasm before."

"Now why," Parrol said, puzzled, "would that be?"

Nile shrugged. "I don't know—yet." She picked up the king-sized syringe again. "Like to come down and help me get that sample? He doesn't want to let me get behind him, and Spiff and Sweeting aren't much help in this case because he simply ignores them."

The bull was stubborn and belligerent, not unusual qualities in the old herd leaders. Parrol wasn't too concerned. He and Nile Etland were natives of Nandy-Cline, born

in shallows settlements a thousand miles from the single continent, quite literally as much at home in the water as on land. Nile, if one could believe her, had been helping herd her settlement's sea beef by the time she was big enough to toddle. She slipped away from the bull's ponderous lunges now with almost the easy grace of her otters; then, while Parrol began to move about near the gigantic head, fixing the beef's attention on himself, she glided out of sight behind it.

She emerged a minute or two later, held the blood-filled hypodermic up for Parrol to see, and stroked up to the surface.

Parrol followed. They climbed back up on the Pan, leaving the sea beef to return to its surly feeding, and pulled off their breathers.

"I'm going to pack up here now, Dan, and move on," Nile said. She'd stored the hypodermic away, was arranging her equipment inside the car. "I'll drop this stuff off at the lab for Freasie to work over, then run eighty miles south and duplicate the samplings in an area where the herds don't seem to be affected yet. That might give us a few clues. Want to come along, or do you have other immediate plans?"

"I . . . just a moment!" The communicator on the rack of Parrol's borrowed scooter was tinkling. He reached over, picked up the instrument, said, "Parrol here. Go ahead!"

"Machon speaking." It was the voice of the secretary of the Ranchers Association. "We've contacted the Tuskason Sleds, Dan, and they very much want to see you! They've been waiting for you to get back from Orado. Here's their present location . . ."

Parrol scribbled a few notes on the communicator's pad, thanked Machon and switched off. "I'll fly out at once," he told Nile. "Typhoon season—I'd better take the Hunter. Give me a call if you hit on anything that looks interesting."

She nodded, said, "Throw your stuff in the back while I get in Sweeting and Spiff. I'll give you a ride to the station . . ."

II

The sun wasn't far from setting when Parrol took his Hunter up from the deck of the Tuskason headquarters sled and started it arrowing back towards the mainland. He was glad he hadn't decided on a flimsier vehicle. The Tuskason area lay well within the typhoon belt, and the horizon ahead of him was leaden gray and black, walls of racing cloud banks heavy with rain.

He had let himself be delayed longer than he'd intended by his discussions with the sledmen; and the information he'd gained did not seem to be of any immediate value. The probability was that he'd simply burdened himself with a new and unrelated problem now. The Tuskason Sleds handled a fleet of chemical harvesting machines for Giard

Pharmaceuticals and in consequence regarded Parrol and Nile Etland as their only dependable mainland contacts. The destruction of their fraya pack was a very serious economic loss to them.

The frayas were Nandy-Cline's closest native approximation of rich red mammalian meat, ungainly beasts with a body chemistry and structure which almost paralleled that of some of Terra's sea-going mammals, but with a quite unmanmalian life cycle. Their breeding grounds lay in ocean rifts and trenches half a mile to a mile deep, and each pack had its individual ground to which it returned annually. Here the fraya changed from an omnivorous, air-breathing surface swimmer to a bottom-feeder, dependent on a single deep-water plant form. Within a few weeks it had doubled its weight, had bred, and was ready to return to the surface. Every pack was the property of one of the sledmen communities, and at the end of the breeding period as many frayas as were needed to keep the sleds' mobile storehouses filled were butchered. Then the annual cycle began again. The animals weren't the sledmen's only food source by any means, but they were the principal one, the staple.

The Tuskason Sleds were certain their pack had been killed deliberately by a mainland organization, either one of the sea-processing concerns or a big rancher, with the intention of forcing them out of their sea area and taking over the chemical harvesting work there. The frayas had been within a hundred miles of their breeding ground and hurrying toward it when the disaster occurred. The following herd sleds were unaware of trouble until they found themselves riding through a floating litter of the beasts. The entire pack appeared to have died within minutes. It was a genuine calamity because the breeding ground could not be restocked now from other fraya packs. There was a relationship of mutual dependency between the animals and the chalot, the food plant they subsisted on during the breeding season. Each was necessary in the other's life cycle. If the frayas failed to make their annual appearance, the cha'ot died; and it could not be re-established in the barren grounds.

If some mainland outfit was found to be responsible, the Tuskason Sleds could collect a staggering indemnification either from those who were guilty or from the Federation itself. But aside from the reported blips of what might have been two submersible vessels moving away from the area, they had no proof to offer. Parrol promised to do what he could in the matter, and the sledmen seemed satisfied with that.

Otherwise, the afternoon had not brought him noticeably closer to answering the question of what was

happening to the coastal ranchers' sea beef. The frayas had died outright, either through human malice or through the eruption of some vast bubble of lethal gas from the depths of the ocean—which seemed to Parrol the more probable explanation at the moment. The beef, so far as anyone could tell, wasn't dying. It simply wasn't around any more.

Parrol battered his way through typhoon winds for a while, then máde use of the first extensive quiet area to put calls through to the mainland. At the Southeastern Ranchers Association, he was routed at once to the secretary's office. Machon was still on duty; his voice indicated he was close to exhaustion. He had one favorable fact to report: Parrol's hunch that a underwater check might reveal some of the missing stock had been a good one. At Lipyear's Oceanic, the estimated loss might be cut by almost a quarter now, and some of the northern ranches were inclined to go above that figure. But that left approximately seventy-five per cent of the vanished animals to be accounted for; and reports of new disappearances were still coming in from farther down the coast.

Parrol called the Giard Pharmaceuticals Station next. Nile Etland had been in and out during the day; at the moment she was out. She had left no message for him, given no information about where she might be reached. Freasie, at the laboratory, told him the checks Nile had them running on the sea beef specimens had been consistently negative.

He switched off as fresh gusts of heavy wind started the Hunter bucking again, gave his full attention for a time to the business of getting home alive. He'd already buzzed Nile's PanElemental twice and received no response. She could have called the Hunter if she'd felt like it. The fact that she hadn't suggested she had made no progress and was in one of her irritable moods.

By the time the Hunter had butted through the last of the typhoon belt, Parrol was becoming somewhat irritable himself. He reached for one of the sandwiches he'd brought along for the trip, realized he'd long ago finished the lot and settled back, stomach growling emptily, to do some more thinking, while the car sped along on its course. Except for scattered thunderheads, the sky was clear over the mainland to the west. He rode into the gathering night. Zetman, the inner moon, already had ducked below the horizon, while Duse rode, round, pale and placid, overhead.

An annoyingly vague feeling remained that there should be a logical connection between the two sets of events which had occupied him during the day. The disappearing herds of beef. The Tuskason Sleds' mysteriously stricken fraya pack . . .

Details of what the sledmen had told him kept drifting through Parrol's mind. He gave his visualization of the events they had reported free rein. Sometimes in that way—

The scowl cleared suddenly from his face. He sat still, reflective, then leaned forward, tapped the listings button on the communicator.

"ComWeb Service," said an operator's voice.

"Give me Central Library Information."

A few moments later, Parrol was saying, "I'd like to see charts of the ocean currents along the east coast, to a thousand miles out."

He switched on the viewscreen, waited for the requested material to be shown.

Another hunch! This one looked hot!

The location indicator showed a hundred and three miles to the Giard Station. Parrol was pushing the Hunter along. He was reasonably certain he had part of the problem boxed now, but he wanted to discuss it with Nile, and that annoying young woman still had not made herself available. The Pan-Elemental did not respond to its call number, and it had been three hours since she last checked in at the station.

Mingled with his irritation was a growing concern he was somewhat reluctant to recognize. Nile was very good at taking care of herself, and the thing he had discovered with the help of Central Library made it seem less probable now that human criminality was directly responsible for what had happened to the herds. But still . . .

The communicator buzzed. Parrol turned it on, said, "Parrol speaking. Who is it?"

A man's voice told him pleasantly, "My mistake, sir! Wrong call number."

Parrol's eyes narrowed. He didn't reply—the voice was a recording, and a signal from Nile. He snapped a decoder into the communicator's outlet, slipped on its earphones and waited. The decoder was set to a system they had developed to employ in emergencies when there was a chance that unfriendly ears were tuned to the communicators they were using.

After some seconds the decoder's flat, toneless whisper began:

"Alert. Alert. Guns. Air. Water. Land. Nile. Water. East. Fifty-eight. North. Forty-six. Come. Caution. Caution. Call. Not."

After an instant the message was repeated. Then the decoder remained silent.

Parrol removed the earphones, glanced at the speed indicator which showed the Hunter already moving along at its best clip, chewed his lip speculatively.

That meant, rather definitely, that a human agency *was* involved in the sea beef problem! Which didn't in itself disprove his latest conclusions but added another angle to

them. Nile liked to dramatize matters on occasion but wasn't given to sending out false alarms. Guns . . . the possibility of an attack by air, water, or land. By whom? She didn't know or she would have told him. She'd called from the surface of the sea, fifty-eight miles east of the Giard Station, forty-six miles to the north. That would put her due east of the upper edge of the Lipyear's Oceanic ranch, beyond the shallows of the shelf, well out above the half-mile-deep canyon of the Continental Rift.

Parrol slid out the Hunter's swivel-gun, turned on the detection screens, dropped to a water-skimming level, and sped on in a straight course for Lipyear's.

Fog banks lay above the Rift. Except for a slow swell, the sea was quiet. Half a mile from the location she had given him, Parrol settled the Hunter on the surface, rode the swells in to the approximate point where Nile should be waiting. He snapped the car's canopy back, waited another minute, then tapped the Hunter's siren. As the sound died away, there came an answering brief wail out of the eddying fog. Dead ahead, simultaneously, a spark of blurred light flared and vanished. Parrol grinned with relief, turned on the Hunter's running lights and came in on the PanElemental lying half submerged in the swells. Its canopy was down; an anchor engine murmured softly. The subdued glow of instrument lights showed Nile standing in her swim rig in the front section, hands on her hips, watching him move in.

Parrol cut his drive engine and lights, switched on the sea anchor as the cars nosed gently together.

"Everything all right here?" he asked.

"More or less."

"From whom are you hiding?"

"I'm not sure. At a guess, Agenes Laboratories is the villain in the act, as you suspected. Come into my car, Dan."

Parrol grunted, stepped across and down into the PanElemental. He asked, "What makes you think so?"

"The fact that around noon today somebody scorched my beautiful left ear lobe with a needle beam."

"Huh? Who?"

Nile shrugged. "I never saw him at all. I was checking out ranch beef about a hundred miles south, and this character fired out of a bunch of reeds thirty feet away. He'd sneaked up under water obviously. I peppered the reed bed with the UW. Probably missed him, but he must have got discouraged and dived, because there was no more shooting."

"You reported it?"

She shook her head. "No."

Parrol looked at her suspiciously. "Where were the otters?"

"The otters? Well . . . they may have gone after him, I suppose. Matter of fact, I remember there was some little screeching and

splashing back among the reeds. I didn't go look. Blood upsets me."

"Yes, I've noticed," Parrol said. "Where are the otters now?"

"Turned them loose in their sea run at Lipyear's before I came out here. I thought it would be best if whoever sent a needle-beam operator after me didn't find out for a while that the trick hadn't worked. It might keep them from trying something new immediately. But it's a cinch somebody *doesn't* want us to poke around too far into the mystery of the vanishing beef. You were right about that."

Parrol frowned. "Uh-huh. The fact is I'd just finished convincing myself I'd been wrong—that there was no human agency back of this."

"What gave you that idea?" Nile reached under the instrument shelf, brought out a sandwich, asked, "Have you eaten? I've a stack of these around."

"Glad to hear it," Parrol said gratefully, taking the sandwich. "I've been getting downright ravenous the past couple of hours."

She watched him reflectively while he told her about his visit to the Tuskason Sleds. "Now here's the point," he continued. "The sledmen think their animals were hit by a couple of subs which released something like a nerve gas beneath them. The gas killed the frayas, reached the surface and dissipated instantly into the air."

Nil nodded. "Could be done just like that, Dan."

"I don't doubt it," Parrol said. "But for the past half hour my theory has been that it wasn't done by something that dissipated instantly into the air."

"Why not?"

"Because the spot where this happened is near the northern edge of the Meral Current. The pack was destroyed around two and a half months ago, shortly after we'd left for the Hub. Anything drifting on from there with the Meral would reach the Continental Rift, and this section of the coast, in approximately that time."

Nile frowned, rubbed the tip of her nose. "Meaning that the trouble with the sea beef wasn't intended—that it was an accidental aftermath of poisoning the fraya pack?"

"That's what I was assuming," Parrol said. "That whatever hit the Tuskason pack two months or so ago has been hitting the local sea beef during the past week. It didn't have anything like the same instantaneously deadly effect here because it was widely dispersed by now. But suppose the stuff is brought into the shallows with the tides. Some of the beef absorbs enough of it to get very uncomfortable and starts moving out to sea to escape from what's bothering it. The nearest drift-weed beds are around a hundred and ten miles out. The tubs could make the trip if they got the notion, and until they were discovered there they would seem to have disappeared.

"But the fact that a direct attempt has been made to kill you changes the picture in one important respect. Somebody else evidently knows what's going on—and that makes it appear that Giard may have been the real target throughout. If the beef herds on our contract ranches can be destroyed and the sleds that work for us starved out of their area, our operations on Nandy-Cline would be shot, perhaps permanently. Agenes and a few others would have the field to themselves.

"My guess is now that the business with the Tuskason pack and the trouble with the sea beef were two different maneuvers, though carried out by the same people, and that the stuff that's affected the beef was scattered out over the Continental Rift not far north of the coastal ranches with the idea of letting the Meral carry it south."

Nile shook her head.

"I think you came closer with your other idea," she said.

"What makes you say so?"

"Two things I discovered while you were gone. I'll let you see for yourself." She nodded toward the rear of the car. "You'll find your trunks and diving gear back there. If you'll climb into them, we'll go for a dip."

"Here? Why?"

"To get your unprejudiced impression of something I noticed a few hours ago. Use the helmet instead of the breather so we can talk."

The water was comfortably warm. Quite dark, but the combined pulse of the two anchor engines made a beacon of sound behind them. A glimmer of phosphorescence came from the surface fifteen feet above. Nile Etland was a vague shadow on Parrol's left.

"All right, we're here," Parrol said. "Now what?"

"Let's circle around the cars at about this level," the helmet communicator told him.

Parrol turned to the left, aware that she was turning with him. He stroked along twenty or thirty yards was about to speak impatiently again when Nile asked, "You can hold your breath just under four minutes, can't you, Dan?"

"As you know."

"Just establishing the fact. Start holding it now and keep on swimming."

"What's the . . ." Parrol broke off. She seemed dead serious about this. He stopped breathing, stroked on, turning gradually to keep the sound of the sea anchors at the same distance to his lift. The shadow-shape of Pile dropped back behind him.

Irritation was simmering in Parrol, but so was curiosity. He was quite certain—certain in a somehow unpleasant way—that Nile wasn't playing some game in order to be mysterious. He kept moving along, jumbled questions and surmises flashing through his mind. After a time, his lungs labored

heavily for breath, became quiet again. The sea water suddenly seemed colder. He realized the double pulse of the anchor engines had receded somewhat, turned in more sharply towards them. How long had he been swimming by now? It must be—

"Dan?"

He opened his mouth, took in a lungful of air.

"Yes?" he said hoarsely.

"How do you feel?"

"Fine."

"Liar! You're scared spitless! I don't blame you. You've been holding your breath since I asked you to?"

"Yes—until now."

"That's been"—a pause—"eight minutes and fifteen seconds, Dan!"

For a moment it made no sense. Then it did. Parrol felt numbed. He said at last, "That was the unprejudiced observation you wanted me to make?"

"Yes. Let's go up and get back into the car."

She swung herself into the Pan-Elemental ahead of him, turned as he started to follow her. "Better stay out till you're dry, Dan. You'd soak the upholstery. Climb on the hood and I'll toss you a towel."

Parrol inquired presently, drying himself, "Same thing with you?"

"It would have been if I'd been holding my breath."

"That old herd bull we were monkeying with this morning . . ."

"Uh-huh. He might come to the surface occasionally but not because he had to breathe. Same thing again with a lot of the other beef that's stayed on the ranches. *That's* why the spot checks were so far off. Something the matter?"

Parrol had sworn aloud in surprise. The towel in his hand was dripping wet now, while he didn't seem to be any drier. "Toss me another towel, will you?"

Nile made an odd, choking sound. "Here it is, Dan."

He caught it, looked over at her suspiciously, looked down again at himself. Water was trickling over every portion of his skin as freely as if he'd just climbed out of the sea.

"What the devil's going on?" he demanded.

She made the choked sound again. "I . . . don't worry about it, Dan! It'll stop in a minute or two. The same thing happened to me this afternoon. I'd probably have to dissect you under a microscope to be able to say exactly what's happening."

"An educated guess will do for now."

"An educated guess? Well—the thing that we, and the beef, picked up has developed some biological mechanism for drawing water in through our skin, extracting the oxygen from the water, and expelling the water again. We've become gills all over, so to speak. Did you feel your lungs start trying to work while you were holding your breath?"

Parrol reflected, nodded. "For just an instant."

"That," Nile said, "seems to be what brings the water-breathing mechanism into action—the first oxygen-shortage reflex. I think you can dry yourself and stay dry now, by the way. You noticed a feeling of cold immediately afterwards?"

Parrol asked distastefully, "That was the sea water coming through my skin?"

"Yes. As I say, I don't think it's anything to worry about. The mechanism should dissolve again in a day or two if we don't pick up any more of the stuff."

"No permanent changes?"

"At a guess again, no. If you hadn't held your breath while you were under water just now, you probably never would have known there had been any change in you. You look like you're going to stay dry now, so come on inside."

III

She held out a sandwich as he swung down into the car's interior. "Still hungry?"

"No. I—" Parrol broke off, looked surprised. "I certainly am! Like that bull beef stuffing himself, eh?"

"Yes. Whatever that breathing mechanism is, it eats up a lot of energy fast. Here, take it—I've been piling away calories all afternoon. And here's my other piece of evidence."

She thrust the sandwich into his hand, swung a camera recorder out of its compartment, settled it on the instrument shelf before Parrol. Her fingers spun the dial setting back a few turns, pushed the start button. The front surface of the recorder turned into a viewscreen.

"Fire forest," Parrol said, chewing. A flat stretch of sea floor had appeared in the screen, shot from a slight angle above it. Dotting the silt were clumps of shrublike and treelike growths, burning eerily with all the colors of the spectrum. Towards the background they blended into a single blanket of blazing white which forced the gloom of the abyss up a hundred feet above the floor. Parrol asked, "The local one?"

"Yes," Nile said. "The section immediately beneath us. I put in the last couple of hours prowling around the floor of the Rift. Now watch!"

The pickup swung about to a point where a cluster of giant yellow blooms was being slowly agitated by something dark moving through them. The view blurred for an instant as magnification cut in, then cleared.

Parrol paused on a bite of the sandwich, swallowed, leaned forward.

"Oh, no!" he said. "The floor's over a half-mile down! That isn't . . . but it is, of course!"

"Sea beef down in the Rift, alive—and feeding!" Nile agreed. "That's where something like eighty

per cent of the missing stock seems to be now. I can show you whole herds in a minute. They're thickest a little farther south. Here's a closer look at this specimen."

The magnification stepped up again. After a moment Parrol said, "You get the impression it's lost half its blubber! No wonder the thing's gorging on fire plants. Energy loss through adaptation again, I suppose?"

"Of course," Nile said. "There'd be rather drastic changes needed to let sea beef live even a minute down there."

"Lungs, ears, sinuses . . . yes, there would. It's almost unbelievable! But wait a second! Supposing we—"

"Apparently," Nile said, "the process is similar to that of the development of the underwater breathing mechanism. The outer stimulus is required. As the beef moved down into the Rift, it adapted to deep-water living. The ones that stayed in the ranches weren't subjected to the same succession of stimuli, therefore didn't change."

Parrol cleared his throat. "So you think that if we started swimming down without suits . . ."

"Well, we might find ourselves starting to adapt. Care to try it?"

"Not for anything!"

"Nor I. The sea beef's taking it, evidently. What would happen to a human body is something I don't care to discover in person. That's the end of the sequence. Want to see the herds to the south now?"

Parrol shook his head. "Skip that. I'll take your word that most of them are down there."

She turned the recorder off, swung it back into the compartment. "What do you make of it all, Dan?"

"Just what you're making of it, apparently," Parrol said. "When the Tuskason frayas turned belly up and died, they were around a hundred miles southwest of their breeding ground, headed there. And the breeding ground—the Tuskason Rift—lies inside the Meral Current. There's that symbiotic relationship between the frayas and the chalot, their food plant during the breeding period. The chalot produces mobile spores as the frayas start arriving. Spore enzymes produce reactions in the frayas to turn them into their deep-water breeding form—"

He paused, scowling. The frayas were living anachronisms among Nandy-Cline's present animal forms, the last of a class of pelagic browsers in whose life cycle certain luminants of the fire forests had been intricately involved. "The chalot spores are assumed to actively seek out the frayas when they appear in the breeding grounds," he went on slowly. "But this time, when the chalot released its spores into the Tuskason Rift the fraya pack didn't show up. Eventually the Meral carried the free spores off, and eventually it brought them along the Continental Rift and into

the shore ranches. Terran mammals —sea beef and humans, in this case —are a much closer approximation to frayas than any of Nandy-Cline's modern life strains. So the chalot spores settled for us! And we've responded to their enzymes almost as the frayas did."

"That's what it looks like," Nile agreed.

After a moment Parrol asked, "What makes you so sure the changes won't be permanent?"

"Simply the fact that the chalot doesn't grow here. The frayas maintain their deep-water form as long as there is chalot around for them to feed on. By the time the seasonal supply is exhausted, they've bred and are ready to return to their pelagic shape. The spores bring about only the initial reaction. It's maintained by contact with the parent plants. Some of the sea beef that went down into the Rift here may already be losing the effect and coming back to the surface, for that matter."

"All right," Parrol said. "We know now that the trouble with the beef wasn't planned. It was an accidental result of wiping out the fraya pack. But we're still thinking of Agenes. If they killed the frayas, their biochemists would realize soon enough what's happening now —and that would be a good enough reason to send needle-beam men after us before we worked it out. But why kill the frayas in the first place?"

"That's what I'm wondering," Nile said. "Agenes has all the sea harvest territory it can use."

Parrol said, "So it does. But it occurs to me now that the Grenley Banks are about two hundred miles north of the Tuskason Rift."

"What's that got to do with it?"

"You may remember," Parrol said, "that a week or two before we left Orado there was a report that Giard had lost a submarine harvester here which was working along the Grenley Banks the last time it gave its position."

Nile's eyes widened an instant.

"I'd forgotten! That does look interesting. Agenes knocks off one of our harvesters roughly three hundred miles north of the point they knocked off the fraya pack. Why? They had something going in the area they didn't want the sub to stumble over—or maybe it *did* stumble over it. Why kill the pack before that, three hundred miles to the south?"

"To keep it from going on toward the breeding grounds," Parrol said.

"Of course! The Tuskason herd sleds were following the frayas. If somebody attacked the sleds, the whole planet would hear about it. But with the frayas dead, the sleds has no reason to go on to the breeding grounds, and didn't. Now . . ."

"The breeding grounds!" Parrol said. "A fire forest, Nile!"

She was silent a moment, said, "You're right, Dan! It has to be that.

A new nidith bed Narcotics hasn't found out about!"

It was almost certainly the answer, Parrol thought. The luminant nidith plant was the source of a drug of unique medical properties when used with strict safeguards, viciously habit-forming when not. It could be harvested legally only under direct government supervision and in amounts limited to the actual medicinal demand. The nidith beds required for that purpose were patrolled; in the other fire forests on the planet Narcotics teams had painstakingly exterminated the plant.

But if a fresh bed had sprung up and been discovered by the wrong people . . .

"Agenes would take a chance on it!" he said. "Two or three seasonal hauls would be worth everything else they could expect to get out of the planet."

"That's what it is!" Nile said. She stared at him a moment, teeth worrying her upper lip. "How do we pin it on them, Dan?"

Parrol said, "This is about the peak of the nidith harvest season, isn't it?"

"Of course. They should be working there right now! Whom do we give it to? Fiawa and the cops? Narcotics? No, wait . . ."

"Uh-huh," Parrol agreed. "I just had that thought, too."

"They can harvest it on the quiet," Nile said, "at the expense of a few murders if somebody happens by. But they can't haul it off Nandy-Cline unless they've got people both in Narcotics and among the mainland police bought and paid for. This thing's organized to the hilt! If we blow our horn and nobody happens to be at the nidith bed at the moment, we'll never hang it on Agenes. We're got to be sure they're caught with the goods before we make another move."

Ilium Weldrow appeared disturbed. He had stared at Parrol and Nile with unconcealed disapproval when they called him into Parrol's office on their return to the station. By contrast with the assistant manager in his trimly proper business suit, the pair looked like criminally inclined beachcombers. Both wore their guns, and Parrol hadn't troubled to do more than pull his trousers back on over his swim trunks, while Nile had added only a short jacket to her swimming attire. But it was more than the lack of outer respectability in his colleagues that had upset Weldrow.

"I'm afraid I don't follow you, Dan," he said, frowning. "I'm to stay in your office, glued—as you say—to your private communicator, while the station is to remain darkened and locked after you leave. Why the latter?"

"Because if you indicate you're here during the next few hours, somebody might blow that pointed little head off your shoulders," Nile told him inelegantly.

Weldrow's face showed alarm. "But what is this desperate business all about?"

"If you don't know what it's about, you won't be involved in it," Parrol said. "And you'll be in no danger if you simply carry out your instructions and don't stick your neck out of the station before we get back. Let's go over the instructions now to make sure you've got them straight."

The assistant manager complied grudgingly. He was to wait here for a call from a Captain Mace, on the Giard cropper tender *Attris*. The call should come within three to six hours and would be an innocuous request to have certain spare parts flown out to the tender. This would be Weldrow's cue to dial two emergency call numbers of Parrol's communicator. One would put him in contact with Chief of Police Fiawa, the other with a Federation Narcotics man with whom Parrol had worked before. When they responded, he was to press the transmission button on the communicator's telewriter, which contained certain coded information Parrol had fed into it, and silently switch the machine off again.

Weldrow appeared to have absorbed the instructions well enough, Parrol decided. Even if he slipped up, it shouldn't do more than delay action by a few hours.

The night sky was clear above the Meral Current and Duse flood-lighted the sky. "You're sure that's the *Attris* ahead?" Nile Etland asked.

Parrol said, "Uh-huh. Mace is around forty miles off his check point, but it's the *Attris*. I know that tub." The magnified image of the cropper tender eight thousand feet below was centered in the ground-view screen. Two flocks of pelagic cropping machines near it rose and sank slowly on the shimmer of the swells. The croppers were restless in the full moonlight, and the tender's chase-plane was circling beyond the farther of the two flocks, guiding a few runaways back to the fold.

"Then what are we waiting for?" Nile asked.

Parrol glanced over at her. "You've checked your position chart?"

"Of course. The ship's anchored above the north third of the Tuskason Rift. I see. You feel she'd be in danger if somebody spots the Pan snooping around the floor of the Rift?"

"She might be in danger, and in any case she's too close to where we want to operate," Parrol said. "If they're loading nidith down there, they're nervous people. They know a ship of that type can't spot them, but the mere fact the tender's at anchor here will make them that much more ready to dump the evidence and run at the first hint that something's wrong."

"So what do you want to do?"

"Go aboard, tell Mace to move his croppers fifty miles west and wait for us there. That will get him out of everybody's hair. He'll know something unusual is up, but he never asks questions. Give them the visual signal."

Nile's hand moved, and the Giard identification light . . . blue . . . blue . . . red . . . flashed out beneath the PanElemental. After a ten-second pause it was repeated. The communicator burred.

"Negative," Nile muttered. Her fingers shifted on the signal box; a purple glow appeared beneath them. As it faded, the communicator burr ended and Giard's blue-blue-red flickered up at them from the tender.

Nile said, "He's got the idea that we don't want conversation." She flashed the coming-in signal. A few moments later a clear green spark showed on the *Attris*.

Nile snapped off the signal box. "That's it! Let's go down." She shoved the car's nose over and fed it speed as Parrol switched off the ground-view plate. The sea was rising towards them, moonlit and stirring; then it tilted sharply up to the right, swung back and was level again just below. Water hissed under them as the Pan knifed lightly through the back of a swell. The tender's stern appeared ahead, its details outlined in Duse's light. Several men stood about the deck. Two of them . . .

"NILE! TURN—"

Parrol had no time to complete the warning. On the deck of the *Attris* a piece of shielding had dropped. Behind it stood a squat gun, nose pointed at them. Nile saw the trap in the moment he did, reacted instantly. The Pan shot down toward the water.

A blaze of light filled the screen and a giant fist rammed the car up and around. Nile was flung heavily over on Parrol, dropped away. He was struggling to reach the flight controls while the car flipped through the air, engine roaring wildly. In the screen, he had a flashing glimpse of the bow of the *Attris* receding from them, another of the tender's chase-plane darting past. A hail of steel rattled and tore at the PanElemental for an instant. Then the engine was dead. He had the car under partial control for the moment needed to straighten it out before it crashed into the sea.

The water was pitch-black all around. The PanElemental, sinking tail first now, ruined engine section flooded, settled heavily against some yielding obstruction, dropped again a few feet, was checked once more. It swayed over slowly into something close to a horizontal position, turned sideways and lay still in a grappling tangle of the vegetation that rode the Meral Current below the surface.

Parrol, out of his trousers and shoes, tightened the dive belt around his waist, groped about for

the scattered rest of their diving equipment, cursing the darkness, the treachery of the *Attris* crew, his own stupidity. With an illegal source of drugs, that could make millionaires out of a thousand men, to exploit, Agenes would have had no difficulty in finding all the useful confederates it needed. Now he and Nile had one slim chance to outlive their blunder at least for a short while. They had to be out of the crippled car and away in the sea before the *Attris* got divers down to make sure they were finished off.

Nile lay doubled half across the slanted instrument board at his feet. There had been no time to find out how badly she was injured. She was certainly unconscious. But he could handle her in the water.

Parrol found the two sets of flippers behind the seat, had just finished slipping his on when there was a flicker of light in the blackness. He glanced around, startled, saw above and to the right what might have been a moving cluster of fireflies. Comprehension came instantly . . . the vision screen was showing him a group of jet divers approaching from the *Attris*.

Which left him perhaps thirty seconds to be away from here—

Swearing savagely, Parrol snapped the other set of flippers to his belt, squirmed around the front seat, picked up Nile and clamped her against him. His free hand groped about for the manual canopy release, found it. He pulled down the rear release first, instantly grasped the other and wrenched at it.

There was a roar, a momentary cold brutal pounding that smashed the air from his lungs, whirled him upwards.

He rolled over in water above the car, clutching Nile, came up against the rubbery trunk of a giant drift plant and straightened out. The fireflies were bigger and brighter here, turning toward the uprush of air from the PanElemental, moving closer through the great sodden underwater thicket in which it hung, gradually illuminating it. Parrol swung away from the lights, floated behind the car, saw a patch of empty blackness before and below him. He shifted Nile to his left arm, grasped the lower edge of the car's open section, reached down with his legs and gripped two of the plant trunks between his thighs. Locking himself to the plants, he hauled at the car. It swung around heavily, then began to turn, was suddenly sliding past him. In an instant, it had plunged out through the thicket and disappeared below.

Parrol turned around with Nile and went stroking steadily down at a steep slant into the chilled night of the Tuskason Rift.

IV

It had been horribly hungry and weak; and now it was eating. Its memory and awareness covered al-

most nothing but that. There were blurred visual impressions—light, darkness, color—indicating other things out there which interested it not at all. There were booming, whistling, chirping sounds; and those it also ignored.

Taste and touch held interest, however. The eating process was a simple one. Something was put into its mouth, and it swallowed; and as soon as it had swallowed, something was put into its mouth again, and it swallowed again. Occasionally there would be a pause before something new came into its mouth; and then it had a feeling of anxiety. But the pauses were always short.

Its awareness of taste and touch was connected with whatever was brought into its mouth. There would be one kind of thing for a while, then another. There were variations in flavor, in saltiness, in slipperiness, degree of firmness. But it was all very good.

"I must have been nearly starved to death!" it thought suddenly. It wondered then what "I" was, but almost at once forgot the matter again.

A while later, it had another thought. It decided it didn't want to eat any more, at least not just now. Something was being pushed into its mouth, but it ejected the something and closed its mouth firmly. There was no impulse to do anything else. It remained exactly where it was, contentedly unmoving.

Now its other senses began to click in. It discovered the blue was gone from its vision and that there was a wide, colorful vista out there, full of individual details. There were things that moved, and many more things that stood still. It became aware of sounds again and for a while tried unsuccessfully to connect them to things it could see. Then there was a sudden awareness of buoyancy, of near-weightless-

ness. At once it knew what *that* meant!

"I'm under water . . .

". . . And I'm me, of course!"

Nile Etland concluded, with a pleased sense of summing up the situation.

She was sitting here, upright, in the underwater ooze. Not quite upright—she was leaning back a little, against something hard.

Something moved. Nile tilted her head to look down at it. It was an arm. A repulsive arm—thick, mottled-gray, with corrugated, oily-looking skin. It was reaching around from behind her, and the cupped hand at its end held some bluish, sloppy oblongs, lifting them toward her face.

She realized that the hard thing she learned against was the monster to which this arm was attached.

Nile jerked upward convulsively to get away from the thing. Somewhat to her surprise she succeeded. Next a powerful stroke of flipper-tipped legs that knocked up a cloud of ooze, and she was driving straight across the bottom towards an electric-blue stand of fan-shaped luminants.

Luminants! Where . . . ?

Memory blazed up. The stern deck of the *Attris,* ghostly clear in white moonlight, the sudden appearance of the gun. They'd been hit—

Nile twisted about, braking her forward momentum, got her legs under her and turned, looking back.

The gray thing which had to be Danrich Parrol was on its feet but making no attempt to follow. Nile's gaze went beyond him, to the dense, multihued ranks of a fire forest burning coldly in endless night on the floor of the Tuskason Rift.

Slowly—shocked, horrified, oddly fascinated—she brought up her hands and stared at them, twisted and turned briefly to inspect as much as she could of her body, ran palms like hard rubber over her rubbery face and head. The sense of shock drained away. Aesthetically she had nothing on Parrol; the pattern of modifications seemed much the same, was presumably identical. It still beat, by a long way, being dead.

He wasn't moving from where he stood, probably to avoid alarming her again. Nile went stroking back, stopped a few feet away, a little above him. The changed, ugly face turned toward her; otherwise he remained motionless. Armies of tiny luminous feeders darted about his trunklike legs, crept in the soft mud, swarming about the litter of smashed shells, cracked carapaces and other remnants of their own ravenous feeding.

She studied him quickly, no longer repelled by what she saw. There were transparent horny sheaths over the eyes, bulging outward a little. She had them, too. The lids wouldn't close over them, but there was no discomfort involved with that. Their outer ears were covered by a bone-hard growth like a thick,

curved sausage. Whatever the internal arrangement was, the growths were excellent sound conductors. Broadened noses with no indications of nostrils. When she tried to expand or compress her lungs, nothing happened. Lungs were out of the picture here. The shape remained humanoid if not human, thickened, coarsened, grotesque, but functional, at least temporarily, beneath more than a thousand feet of water. She felt strong and vigorous; the awkward-looking body had responded to her purpose with agile ease. It was better, miraculously so, than they could have had any reason to expect!

She drifted closer to Parrol, touched his shoulder with her hand. His face split in a rather grisly grin; then he turned, momentarily scattering the feeders, and crouched beside a creamy luminous globe protruding from the ooze a few feet away. Nile floated down to see what he was doing.

Parrol laid a fingertip on the plant-animal's surface. The luminant shuddered. A dark spot appeared where the finger touched it. The finger moved slowly up along the glowing surface, curved down again. A line of darkness followed it as the creature's surface cells reacted to the touch. Parrol was, Nile realized suddenly, writing on his living parchment. After a few seconds she read:

RATIONAL NOW?

She moved her head irritably up and down, telling herself it wasn't an entirely unreasonable question. The transformed Parrol produced his unpleasantly transformed grin again, detached something from his belt, held it up to her. With a shock of pleasure Nile recognized her gun. She clipped the sheathed UW to her belt while he resumed writing, then shifted to where she could read over his shoulder.

The two words of the question had almost faded out. New words appeared gradually:

OUR FRIENDS ARE HERE.

Nile gave him a startled glance. He nodded, motioned her to follow, turned and swam toward the thicket of brilliant-blue luminants for which she had headed when she broke away from him. Half crawling, half swimming, he moved into the thicket, Nile close behind. After some fifty feet they came into a less dense but much taller stand of a darkly red growth; here Parrol moved more cautiously. Presently he stopped, beckoned Nile up to him, pushed a few soggy armfuls of the red fronds apart.

Nile found herself looking down a sharply slanted rock slope at another section of the Rift floor a hundred yards below. The fire forest began again at the foot of the shelf, stretched away, clearly detailed nearby but blurring quickly as distance increased into a many-colored glow. Following Parrol's pointing

finger, she could barely make out the long dark hull of a submarine harvester grounded along the towering wall of the side of the Rift on the right. Two other harvesters lay farther out among the luminants. Together the ships formed a rough triangle, within which Nile now began to detect the moving figures of men, bulky in deep-water armor.

There was no mistaking the nature of their activity. The nidith was pale blue, a slender two-foot structure, individually unobtrusive among the greater luminants. But from the top of the shelf it was apparent that there must be millions of them in the bed which stretched away up the floor of the Rift, forming an unbroken carpet of undergrowth among the thickets and groves of the fire forest.

Parrol pointed to the right. About halfway between their position and the harvesters, a single armored figure sat astride a beam-gun floating just off the bottom, its short snout pointed upwards.

Nile nodded comprehendingly. Of the myriads of creatures that crawled, walked and swam among the fire forest's branches and over the ooze, almost all were completely harmless from the viewpoint of a man in underwater armor. But a few species were far from harmless. As she looked, the beam-gun made an abrupt half-turn, following something which slithered rapidly through the fringes of darkness overhead, vanished upward into the gloom again without attempting to descend.

She felt a brief inward shudder. One glimpse of that flattened, rubbery twenty-foot disk had been enough to identify it—a cloakfish, a rather small one but quite large enough to be an immediate menace to any member of the nidith harvesting gang outside of the ships. The cloakfish ordinarily were found clinging to the walls of the ocean rifts they inhabited, grinding into the rock with the multiple sets of jaws lining their undersides to get at a variety of burrowing wormlike creatures within. But they put no strict limitation on their diet, frequently attacked divers on sight, and had been known to saw open a deep-water suit in less than a minute.

Parrol turned away, motioned with his head. She wasn't sure what he intended but guessed he wanted to follow the edge of the shelf to a point on the right where a cluster of luminants rose high enough to let them drop into the lower section of the Rift without being detected by the guard riding the beam-gun. She nodded agreement, followed as Parrol wound his way through the thicket, moving parallel to the open slope.

As they approached the stand of tall growth, a curious thudding sensation reached Nile through the water, followed within seconds by another. She puzzled over that a moment, decided that beam-guns

stationed on the far side of the harvesters had opened fire on some assailant. The gang probably had been at work here for a week or two; by now the area would be swarming both with cloakfish and with other predators gathered to feed on cloaks the guns had crippled or killed.

Predators such as that twenty-foot snake shape which came eeling up over the edge of the shelf a few yards away! It might have picked up their scent in the water, for it darted at her instantly, jaws yawning wide.

Nile wasn't quite sure how it happened. She had pulled back slightly as the head struck past. Immediately afterwards, her legs were clamped about the slick, sinuous body, her arms locking her against it—

And her teeth were sunk into the thing! Not simply biting, but digging, slashing, cutting deeper through slimy hide that should have turned a knife, tearing the hide away and returning instantly to slice at unprotected flesh. The thicket of red luminants whirled about her, then open water; the section of snake body she gripped was knotting and twisting with monstrous strength. Bottom silt exploded in a dense cloud as they struck into it. For a moment, lifted high above her, she saw the thing's head, great jaws snapping wildly, Parrol leeched to its neck.

Those were blurred, remote impressions. The only clear impressions were the savage hunger that blazed up in her as the creature drove at them and the horrified delight with which she was satisfying it in quickly gulped bites of salty flesh until—almost as suddenly as it had awakened—the hunger feeling was gone. It was like a fog clearing from her mind.

She pushed away from the snake-like thing. It was still writhing, but for all practical purposes it was dead. The big head flopped loosely, seemed half torn from the body. They appeared to have rolled into the tall stand of luminants in the lower section of the Rift for which she had thought Parrol was heading when the creature attacked. Parrol floated a few yards away, looking at her. Nile glanced up the length of the sea thing again and saw that he had been feeding, too. His response must have been as immediate and violent as hers—they'd had their guns within reach and made no attempt to use them!

She looked at the mangled beast and tried to feel disgust for what had happened. But there was no disgust. Her changed body had demanded nourishment, and meeting the demand had been a wholly agreeable experience. When the hunger surge rose again, she would feed it again.

Three or four generations of children in the shallows settlements, Parrol thought, must have had

stories of Nandy-Cline's sea hags recounted to them by their elders. In the version he had heard when very young, the sea hags were anthropomorphic ogres who lived in the depths of the ocean but came to the surface for the specific purpose of eating small boys who swam out farther than grownups thought they should go. The legend was supposed to have been created by the sledmen who had settled to live on the ocean world fifty or sixty years before the first Hub colonists arrived.

It seemed it hadn't been entirely a legend. When the sledmen began to follow the fraya packs, an uncounted number of them would have come unknowingly into contact with the chalot spores and undergone this weird transformation —some to be slaughtered by their horrified companions when they climbed back on the sleds, maddened by the change hunger, others meeting death in one form or another in the rifts and trenches where the chalot grew, their disappearance charged off to the giant predators that prowled the breeding grounds during the season. The last such occurrence—before this—might lie many decades in the past. The sledmen nowadays regarded it as extremely bad luck to swim about in rift waters when the frayas bred and carefully refrained from it, although they weren't aware of the specific danger that had created the superstition.

At the moment, however, the sea hag shape was the one great advantage he had. And he couldn't have asked for a better companion than another of those watery bogy-men beside him, controlled by Nile Etland's intelligence. Flattened out and buried to the eyes in flowing ooze, they were edging forward toward a group of tall, golden luminants standing some thirty feet back of the guard on the floating beam-gun. These were plant-animals with some rudimentary intelligence, known to students of the fire forest fauna as starbursts. For several more minutes they remained undisturbed, the clusters of tentacle arms at their tips fanning the water with slow, rhythmic motions.

Then, on the far side of the group, one individual began to move off toward the beam-gun. While it was capable of gliding slowly along the ooze on the widened base of its stem, it was not moving of its own volition now but being half carried, half pushed through the silt. The starburst was in a state of considerable agitation. Its tip had opened out into something like an inverted umbrella, and from the edges of this hood the gleaming tentacles flailed anxiously through the water.

Parrol let it down suddenly, jabbed Nile. Both settled a little deeper into the silt. The gun was swinging around toward them, then stopped, pointing in their general direction. The guard's face couldn't be seen behind the headpiece of his suit, but presumably he was staring

a little suspiciously at the starburst. He might not remember how close the luminant had been to him, but the disturbed silt behind it indicated it had been moving.

However, it had stopped its advance now; and in spite of a vague resemblance to a fifteen-foot golden squid standing on end, starbursts were known to be utterly inoffensive creatures. The guard swung the gun around again, facing the nidith bed, to watch for cloakfish.

Parrol gripped the starburst, began climbing to his feet, lifting it clear of the mud. Nile rose with him. Together, in a plodding rush, they carried the writhing luminant up behind the guard. Its top end tilted forward and down, and an instant later the upper part of the guard's suit was enclosed in the widespread hood and thrashing arms of the alarmed creature. He was jerked out of the gun's saddle, pulled down into the ooze, the starburst knotting itself about him and clinging with grim desperation.

Parrol was immediately in the saddle, gripping the steering bar, while Nile swung herself into the lower part of the framework and found handholds there. The beam-gun swung around, darted off toward the rocky slope leading to the shelf from which they had come, up along it. Looking back, Nile saw guard and starburst roll together into another cluster of luminants where the entangled pair created considerable disturbance. No doubt the guard already was broadcasting his predicament over the suit communicator, but several minutes would pass before anyone could get over from the subs to release him.

A few hundred yards beyond the edge of the shelf, Parrol turned the gun's snout up, steering it into the darkness pressing down toward the Rift's floor. They would assume back there that the guard had inadvertently knocked over the acceleration switch when he was hauled out of the seat by his strange attacker, and that the gun was now roaming about the Rift on its own. It was unlikely that they'd waste any time trying to find it again.

The magic gleamings of the fire forest faded below and the ocean night closed in. Parrol slowed the gun's ascent, checked their position carefully in the green glow of the instrument panel. Nile came clambering up, groped through the gun's tool pockets, pulled a spotlight out of one, a heavy-duty UW handgun out of another. She settled down on the edge of the panel, and Parrol heard a click through the water as she readied the gun. Cloakfish were welcome to show up any time now!

They exchanged sea hag grins, which somehow no longer seemed at all grotesque. Now they had the beam-gun, there were several courses of action open. It wasn't merely a matter of trying to stay alive long enough to find out whether a human body which had under-

gone the chalot change could survive when the effect of the spores wore off. They should, Parrol thought, be able to do much better than that.

The nidith gang believed them drowned near the surface. The *Attris* wouldn't have opened fire on the PanElemental if they hadn't known who was in it and known, too, that if they disposed of Nile and Parrol their secret should still be safe. Which meant that Ilium Weldrow had succumbed to the big-money lure of the drug outfit, along with Captain Mace and the rest of the *Attris* crew. The assistant manager had been the logical one to buy to keep Giard from interfering with the operation. When the time came, he'd passed along the word that Parrol and Nile Etland had picked up the trail and were on their way to the Tuskason Rift to confirm their suspicions.

He and Nile almost had got killed because they hadn't thought of that possibility. But as a result, the nidith harvesters now felt secure and were open in turn to surprise attacks. Parrol steered the beam-gun up slowly, constantly checking his position and alert for signs of physical discomfort in himself or Nile. Others had returned alive to the surface in the sea hag form, long ago, but there were too many uncertainties about that to be at all hasty in their ascent. After a minute or two, Nile leaned forward, shaking her head, and moved the acceleration switch over. The gun surged upward. Parrol glanced at her, decided to go along with her judgment. He kept watching the depth gauge. When it showed them at a point four hundred feet below the surface, he halted the gun, brought it into a horizontal position, turning it slightly. The target-light above the muzzle stabbed out, disclosed a section of the Rift wall. Parrol played the beam up and along the wall. It sloped away here at an angle which indicated they might be approaching the top of the Rift.

Eighty feet farther up they were there. A dark sea floor stretched away before them to rise through a series of shelves toward the barely submerged shallows five miles to the east. Parrol began moving the machine horizontally back along the edge of the drop-off. When he stopped it again, it was at a point he calculated to be immediately above the submarine harvesters in the nidith bed.

Here might be the opportunity to strike the most telling blow of all. Nile knew by now what he was looking for. When he started forward again, gliding in slowly across the sea floor, she was leaning far out over the panel, head shifting this way and that, as she followed the sweep of the target-light. Suddenly she lifted a hand—

And this could be it, Parrol thought, excitement surging in him. A vertical dark ridge, some fifty

feet high, perhaps three hundred yards up the sloping floor. The surface behind it was smooth, flat, level with the top of the ridge—a lake of sediment and sand, drifted down from the upper shelves, blocked off from the Tuskason Rift by a wall of rock.

A few minutes later, he was sure of it. He backed the gun away twenty yards, set the energy beam to full power, flicked it on. Something smashed into the ridge, began to move along it, water and rock boiling off in thick clouds at its touch. The gun bucked and danced as shock waves poured back at it. Parrol cut the beam, rode back another twenty yards, turned it on again. Now the gun was steady. The beam ate a fifty-foot gash slowly across the face of the ridge, returned along it.

A little over half the gun's charge was spent when the upper section of the ridge at last toppled ponderously forward. A river of mud and sand spilled down through the opening, flowed along the sea floor to the edge of the Rift, rolled thickly into it . . .

Enough there, Parrol thought, watching the dark slop stream by beneath the swaying gun, more than enough, to bury not only the harvester stationed against the wall, but the two other ships in the nidith bed with it. And burying any one of them with a nidith load on board was all that was necessary. Some of the divers outside might get away if they moved fast enough. The rest of the work gang was caught. They'd live because ships and suits were designed to preserve life even under the smashing blow of a deep-water muck avalanche; but they'd stay exactly where they were until somebody came along to dig them out.

V

On the surface above the Tuskason Rift the cropper tender *Attris* rode the long, slow swells, anchor engines humming. Duse had set, and cloud banks were spread over half the night sky. To the north and west, fog was forming. For most of the past hour, the ship's communicator had been babbling excitedly. The *Attris*' captain looked distracted and harried.

From the edge of one of the nearby herds of pelagic croppers a single machine began moving toward the west, slowly at first but increasing speed as it drew farther away from the *Attris*.

Thirty minutes later, the wandering cropper reached a point eight miles west of the tender. In the *Attris*' chase-plane an automatic buzzer woke the pilot. He looked up at the glowing location chart above his bunk, saw the flashing red dot at the fringe of the eight-mile circle, swore sleepily, climbed out of the bunk and got on his direct line to the tender.

"What do *you* want?" his skipper's voice inquired hoarsely.

"Got a stray showing," the pilot began. "I—"

"Go after it, stupid! You know things are supposed to look right around here!" The line went dead.

The pilot scowled, yawned, sat down at the controls. The chase-plane slithered past the bow of the *Attris*, lifted into the air. Within a few minutes it was hovering above the cropping machine. The pilot directed an override beam at the cropper's engine shed, twisted the override control knobs and discovered that the cropper's automatic steering mechanisms were not responding. He muttered in annoyance. He'd have to reset them manually.

He brought the plane down, tethered the cropper to it, walked along a planking to the machine shed, opened the door and stepped inside. An instant later, there was a wild screech from within the shed, then a brief, violent splashing in the water beneath it. That ended, was followed presently by deep, croaking noises with odd overtones of human speech.

A sea hag appeared in the door of the shed, the unconscious and half-drowned pilot slung across its shoulder. Another hag came out behind it. They were breathing air with apparent difficulty, but they were breathing. The first one climbed into the plane with the pilot. The other detached the cropper, kicked it off, and joined its companion.

The plane swung about, rose from the surface and sped away, due west.

Shortly before daybreak, heavy fog rolled in over the shore ranches of the continental coast, drifted inland. The Giard Pharmaceuticals Station was thickly blanketed by it. Inside, most sections of the station were dark and deserted. But Parrol's office was lit; and in it a bulky figure with a grotesquely ugly, gray-mottled head, encased in a cloaklike garment which appeared to have been cut in haste out of a length of canvas, was painstakingly at work before a stenog machine. The screen above the machine showed the enlargement of a lengthy coded message. A number of minor deletions and revisions were being produced in it now. Finally, the cloaked shape switched off the machine. The screen disappeared, and a bloated-looking gray forefinger pushed at a tab on the side of the stenog. Two cards covered with microprint popped out on the table. The figure picked them up, glanced at them, came heavily to its feet.

From the open door to the office, a harsh, roughened voice, which nevertheless was recognizably the voice of Nile Etland, said, "I was finally able to contact Freasie, Dan. She's on her way to the hospital to set things up. Thirty minutes from now, we'll be able to get in quietly any time by the service entrance.

Nobody but Freasie and Dr. Tay will know we're there or what condition we're in."

Parrol said, "Half an hour is about what it should take here." His voice was as distorted as hers but also recognizable. "I'll tell Fiawa, of course, that we'll be at the hospital."

"Yes, he should know."

"Did you explain to Freasie what happened?"

"Not in detail." Nile came into the room. She, too, wore a makeshift cloak covering everything but her head yet not adequately concealing the fact that the body beneath it was a ponderous caricature of her normal shape. "I told her we picked up the infection that hit the sea beef herds, and that when she sees us we'll look as if we'd been dead and waterlogged for the past two weeks."

Parrol grunted. "Not a bad description! We were prettier as deep-water sea hags than in this half-way state!"

"Do you still seem to be swelling?"

He held up his deformed fingers, studied them. "Apparently. I don't believe they looked as bad as that half an hour ago. I also feel as if most of my innards were being slowly pulled apart."

"I have that, too," Nile said. "I'm afraid we may be in for a very unpleasant time, Dan. But we definitely are changing back."

"Trying to change back?"

"Yes. No way of knowing exactly what will happen. But the sea beef may have been able to reverse the process successfully. Perhaps we can, too. And perhaps we can't." She looked across the room to an armchair in which the chase-plane pilot sprawled. His clothing, the chair, and the carpet beneath were soaked with water, and his eyes were closed. "How's our trigger-happy friend doing?"

"I don't know," Parrol said. "I haven't paid him any attention since I dumped him there. He doesn't seem to have moved. I expect dragging him in through the shore swamps on the last stretch didn't do him much good."

Nile went over to the pilot, reached for his wrist, announced after a moment, "He's alive, anyway. I picked up some dope in the lab office. I'll give him a shot to make sure he stays quiet until the police come for him. Any immediate plans for Ilium Weldrow?"

"No," Parrol said. "I was hoping we'd find him still here. I would have enjoyed seeing his face when we walked in on him. But we'll leave him to Fiawa. Let's get out our reports and get the show on the road."

Nile brought a dope gun out from under her cloak, bent briefly over the pilot with it, replaced it and joined Parrol at the communicator. He was feeding the cards into the telewriting attachment.

"They're for Dabborn at Narcot-

ics," he said. "I used his personal code. I've warned him there may be a leak in the office and that if he tries to talk to me from there, the higher-ups in the nidith business could get the word immediately and take steps to avoid being implicated. We'll talk to Fiawa at his home. He and Dabborn can get together then and work out the details of the operation."

Nile nodded. Parrol turned on the communicator, dialed a number. The connection light went on immediately. He depressed the transmission button on the telewriter.

A woman's voice said quietly, "Message received. Do you want to wait for a reply?"

Parrol remained silent. Some ten seconds later, the connection light went out.

"Dabborn's secretary," he said. "So he's in the office. Now let's get our chief of police out of bed, and things should start moving." He flicked out the cards, dropped them into a disposer, dialed another number.

It took Fiawa about a minute to get to the communicator. Then his deep, sleep-husky voice announced, "Fiawa speaking. Who is it?"

"For a man," Machon observed, "who's just put in seven weeks in the hospital—too deathly ill to see visitors—you seem remarkably fit!"

Parrol grinned across the dinner table at him.

"I had a few visitors," he said. "Dabborn and Fiawa dropped in from time to time to let me know how they were coming along with the nidith operation."

"They've done a bang-up job of rounding up the Agenes gang!" the secretary of the Ranchers Association assured him. "A couple of the big shots just might get off. The rest of them are nailed down!"

"I know it—and I'm glad I'll be there as a prosecution witness." Parrol hesitated, added, "Strictly speaking, neither Nile nor I have been ill. We were extremely uncomfortable for a while, but we could have received visitors any time after the first two weeks in the hospital. But Nile insisted no one should see us until we were ready to be discharged, and except for talking to Dabborn and Fiawa I've gone along with her in that. I think I can tell you about it privately now. She's prepared a paper for her xenobiological society covering the whole affair, and the paper will be out in a few weeks. But I warn you Nile still wouldn't want the details of our experience to become general knowledge."

"Don't worry—I can keep my mouth shut," Machon told him. "Go ahead."

"Well, I'll give you Nile's theory. It seems essentially correct. There's that fraya-chalot symbiosis pattern. Temporarily it's a complete symbiosis in every sense. The fraya has to be adapted to underwater living

for a short period each year, then readapted promptly to surface living. And the frayas are pseudo-mammalian. Their bodies are no more capable of rearranging themselves suddenly to such a drastic extent than the sea beef's or our own."

"Wait a minute!" Machon said. "The way I got it, you did adapt—fantastically! You and Nile literally turned into sea hags, didn't you?"

"We did—but *we* didn't actually change. The chalot was building on to what was there. What we had to do was supply material for it to work with. In other words, we ate. When the changes are of a minor kind, you get hungry. When they're major ones, you find yourself periodically ravenous. The chalot builds its structures and maintains them. It has to be fed, or the structures collapse. If you don't supply it with extraneous food, it starts in on your body reserves. We found that out. You feel you're starving to death fast, which probably is exactly what would happen if you did nothing about it. So you eat compulsively.

"The chalot has to accomplish two things with its host animals. It has to enable them to get down into the fire forests and live there a time so they can eat the adult chalot plants and release the seeds of the plants by doing it. And it has to avoid killing or injuring the host, so the host can come back next year and repeat the process. It does nothing directly to the host body unless it has to draw on it for food. It turns itself into body supplements which combine with the host body to perform various functions. It's an unstable unit, but it's a unit which can exist for a while on the bottom of the ocean trenches.

"It remains a unit only as long as there is chalot around to keep it up. The frayas feed on the adult plants in the rifts, and they retain their underwater form throughout the breeding season. Then they've cleaned out the current crop of chalot and come back to the surface. The sea beef that got out into the Continental Rift here remained underwater breathers and feeders only for the days it took the cloud of chalot spores that had originated in the Tuskason Rift to pass through on the Meral. There are no chalot plants in the local fire forests, so up the beef came again. They were pretty plump animals when they were brought in, weren't they?"

"Yes," Machon said. "That fire forest diet didn't hurt them any. In fact, they seem to have thrived on it. But what they'd put on was mostly fat."

Parrol said wryly, "Uh-huh! Mostly fat . . . Nile and I picked up a load of the spores in one of the ranch farms here and probably another one in the water beyond the shelf. The spores added water-breathing equipment to our systems but nothing else, until we had to go down in the Tuskason Rift. We

needed a complete change then and got it. We turned into the chalot's human deep-water variant—sea hags—on the way. But we stayed sea hags only a few hours because the spores we'd originally absorbed here were being used up in maintaining the change structures, and there was no live chalot left in the Tuskason Rift to replace them.

"The chalot evidently has had genetic experience with a wide variety of hosts. The fraya is the only native host left, but Nandy-Cline was swarming once with pseudo-mammals of that class. We can assume that many of them had a similar symbiotic relationship with the chalot the fraya still has, because the adaptations the chalot performs vary with the species and are according to the needs of the species. The sea beef really showed much less change than the fraya does in its underwater form.

"On the other hand, the change from an air-breathing human to a deep-water sea hag is an extremely radical one. The chalot went all out on us, and at intervals during those hours we had to eat ravenously to give it what it needed to maintain the form. Lord, how we ate!

"And then we were up on the surface again and began to change back. Nile didn't mention it at the time, but she suspected what was happening when she saw the manner in which we were changing back."

"Yes?" said Machon.

"Fat," Parrol said. "When all that elaborate, dense chalot structure which keeps you alive and in action under a thousand feet of ocean begins to break down, it's converted into fat—the host body's fat! That's lovely if you're a fraya. For them, it's a kind of bonus they get out of their relationship with the chalot. They don't have to eat for a month afterwards. In the sea beef it wasn't too noticeable because the chalot hadn't added too much to them to start with.

"But Nile and I—!"

He shook his head. "I won't drag in all the grisly details, but Dr. Tay had to use plastiskin to hold us together. Literally. We were monstrous. He had us floating in tanks and kept whittling away at us surgically for the first ten days. After that, he figured a crash diet would see us through. It did, but it's taken almost two months to get back to normal—and it wasn't more than two weeks ago that Nile would let even me see her again.

"She's got that old figure back now, but her vanity's still hurt. She'll get over it presently. But if anyone happens to smile when they mention something overweight—like sea beef—to her for another month or so, my guess is they'll still be inviting a fast fist in the eye." ■

Planetfall

Mystery, romance, and delights are always unfamiliar—necessarily. And, therefore, unattainable!

JOHN BRUNNER

Illustrated by Alan Moyler

They saw each other at the same instant, and each failed to understand the expression on the other's face. The youth thought, "Why should she seem wistful? Or is it—? No! Surely she can't feel *bored!*" And the girl could not account for the look of wonder, unmistakable, which the youth wore.

Their faces changed. She smiled. He saw that and hesitantly smiled back. For long seconds neither moved. Then, absolutely without prior intention, she made a timid gesture at the ground beside her. His smile faded, returned; he began to look for a way up to the top of the grassy knoll on which she sat, while she awaited his arrival with her heart hammering, hammering at her ribs until she thought it would break free and fly out pulsing like a small warm bird into the smoky afternoon air.

This was not something she had foreseen when she made her way out here, to this place giving a view clear across the untidy landscape surrounding the spaceport. From the knoll, highest point in sight by fifty feet or more, she could just see the shallow concrete bowl of the landing-ground, dirty-gray, with the five-mile tunnels of the transport system reaching out invisibly to the limit of local blast effect and there surfacing, as though the port bowl were the dishlike blossom of some monstrous dry-land nenuphar extending blind roots in all directions. What she could not see, of course, was the orbiting city, stationary overhead at twenty-three thousand miles or so, the other side of the shredded blue and gray of the sky.

But it was that which had drawn her: not the prospect of a meeting.

She had been astonished to see him wander into sight so close to her. He wore the garb she had seen often in pictures and TV recordings—the plain off-white coverall marked from every angle with symbols that identified the wearer's exact function in the enclosed world of a flying city, on the chest, on the back, on buttocks and shins. He was tall and lean, clean-shaven, with his scalp cropped close. Now, with head bent while he looked for sure footholds on the steep slope of the knoll, she realized that she had not really seen his face—only a pattern of features identifiable as human and young.

The knowledge of her own lack of perception started a flock of associated ideas into consciousness, like a covey of frightened wild birds. How much had he actually seen her, from his side? Had he perceived as little as she: a human form in turquoise clothing, brown-haired? Or a pretty girl? She did not go quite so far as to wonder if he, from space, would think of her as not-pretty, using a different—alien—set of standards. But she did reflect that he might speak only Russian, so that their communication would be limited to a few halt-

ing words, and imagined frustration rose in her mind and became, on the instant, maddening. This miracle opportunity, lost!

He was carrying something. She strained to see what it was as he breasted the last rise and came into full view a dozen paces distant. And it was nothing more than a clump of wild plants, torn from the ground so that the roots shed crumbs of dry earth, and crowned at the other end with a few drab would-be-blue flowers.

Lips parted, to pass words which refused to form, she stared. Now finally she did see his face, and was relieved. It was just a face: neither handsome nor ugly, having deep-set eyes and a mouth with a suspicion of weakness.

He said, driving away another cloud of futile anxiety, "Hello. Ah . . . my name is Valeryk."

The frozen silence which had come over the world without her noticing melted and was gone. She scrambled to her feet, pony-awkward, wishing she had grace instead of this limbs-everywhere adolescent clumsiness. "My . . . my name's Lucy! You're from the starship, aren't you?"

"Yes." And more silence, somehow reassuring, during which she could tell herself that here was no superbeing, but a—well, a boy, perhaps eighteen or twenty at most, uncertain of what to say and do like any shy young stranger.

He turned, shading his eyes with the hand not holding the uprooted wild plants, to peer across the rolling off-green ground towards the port. "You can just see the ship which brought me down, if you look carefully," he told her. He made each word separate, as though he were not sure how correct his pronunciation might be. "On the left—do you see?"

Eager, she stared, but could not tell which of the dark bulky forms fringing the bowl of the port might be a ship and which a building. Uniformly they were metal-gray, and the cloudy sky threw down from them no shadows to emphasize the distant shapes.

"Are you . . . are you staying long on Earth?" she ventured. She had not seriously imagined a meeting with a starman, in all the long hours she had passed here over the years, gazing at the inscrutable sky and thinking of other worlds, but the legacy of the half-formed ideas related to such a meeting made her feel obscurely that it was wrong to spend this brief time in ordinary small talk. Yet nothing else offered itself to her tongue.

"We landed yesterday and must leave again tonight," Valeryk said. "But fortunately there has been a delay in the delivery of some supplies for us, and I have these hours to . . . to—" He made a vague gesture as though reaching into the air for a missing word.

"To spare?" It was the best she

could offer: banal and uninspired. She railed against her own incapacity with words.

Valeryk laughed very quickly. There was no unkindness in the sound, but it did seem hollow, as though merely polite. He said, "Not quite. More—to enjoy. To experience. To cram in."

To cram what in? The possibility that he regarded her as an interruption, an obstacle to some preformed plan, leaped up in Lucy's mind. But she did not voice that, out of pure selfishness; this was something she had never dared hope for, and something she was not going to cut short.

"But you . . . you must have been on Earth before," she said. "You speak beautiful English."

"No." He wasn't looking at her, particularly; his eyes were everywhere, on the ground, on the sky, shifting almost greedily from place to place. "This is the first time I have ever seen the Home."

"But . . . ah . . . but the news reports said yours was a Russian city, and—"

"It is, yes."

"Do you teach English in your . . . your schools?" Abruptly she discovered she had no idea whether there were schools in the flying cities. But there must be, or something equivalent; the question could not sound foolish for that reason.

"We have many kinds of people. We trade and exchange. Did you not know?" Valeryk turned a curious gaze on her. She seized the chance gift of his attention, not caring that it came from her own ignorance, and shook her head vigorously.

"No, I don't really know very much about life in the flying cities. What's it like?"

Valeryk shrugged. Already his eyes were roaming again. "Monotone," he said. "These few hours of escape are very precious."

Dismayed, Lucy cast around for some concrete question to lead into a proper conversation. This was all wasted time, so far. The badge-symbols on his coverall leaped to her eye.

"These . . . these marks you wear on your suit. What do they all mean?"

"Hm-m-m?" He shrugged up one shoulder as though to give himself a view of the colored shapes on his chest. "Why . . . they say what my position is within the community. The color is brown, to say I am apprentice; the upper symbol is of a house and the lower is of a blade of grass. You would say . . . ecologian. No, wrong. Ecologist."

He went on looking at the markings for several seconds after he finished explaining them, and inspiration told Lucy the reason. Here was something as much a part of himself as the nose on his face, and his conscious awareness had been drawn to it for the first time in years. She said, "You're

given your jobs very young, aren't you? I'm sure I heard . . . or maybe read—"

"Very young!" Valeryk's laugh was harsher this time. "When I was five it was decided that I and others shall be ecologists."

A stab of envy provoked Lucy's next words. "It must be wonderful," she whispered.

"What?"

"To . . . to *know*. To have a purpose all one's life."

"I don't quite understand." Valeryk drew his brows together.

"It makes me envy you, it really does!" The words came quicker now; she had tapped a source of emotion to power them. "How old are you? Eighteen? Oh . . . forgive my asking, but—"

"Nineteen."

"So am I! But I don't know what I'm going to do . . . I don't know what *to* do. Everything is so . . . so *loose*. I could do a dozen different things with my life, and there isn't any one of them where I'd know I was being valuable to anyone else. I guess I'll probably settle for some time-wasting little job somewhere, when I get out of college, and then I'll get bored with it, and I'll meet some man and he'll persuade me to marry him and I'll have a couple of kids and raise them—and then I'll be forty or forty-five and the kids will be independent and I'll face another fifty years. With nothing."

Astonishment was bright in Valeryk's eyes at this outburst. Disbelieving, he said, "Nothing? But you have—all this!" He swept his arm out to full stretch, and embraced the world.

"I guess it doesn't look that way to you," Lucy admitted tonelessly. "This is something . . . I don't know . . . romantic? Exotic? Didn't you call it 'the Home'? But it is my home, and I don't like what it offers me."

"How can you not?" He came a step closer. "Look! You said you envied me! Tell me why, tell me what you think I have that you do not!"

Challenged to put a vague sense of dissatisfaction into a neat package of explanation, Lucy could only shrug. She said, "Why . . . I thought I did tell you. It's the same thing most people . . . well, most *young* people, I guess . . . envy you starmen. The thing that makes us wait and wait by the TV when there's news of a flying city coming into the Solar System, and brings me out here to sit on the ground and just stare at the sky. I mean, I know I can't see your city except maybe at night if the sky's quite clear, and then all it is is a dot of light like any other star, not even moving because you go into this stationary orbit— But we wait, and hope and hope that it'll be our port you choose to orbit over, and not one in Australia or Siberia or the Sahara. Because what we want is what you've got: the ability to

know of what use your life is going to be! You've known ever since you were five years old you were going to be an ecologist for the city, a *useful* person, an indispensable person! I mean, I am right, aren't I? Without ecologists you couldn't keep people alive in a starship. You make the whole marvelous thing possible!"

At first Valeryk had continued to frown over the incomprehensible passion in her voice. By degrees, he had started to listen to what she was actually saying, and now he spoke in a serious tone.

"Yes . . . yes, I guess it's true that without ecologists you couldn't plan for a starship's people, you couldn't make it work. For I deal with food and water and air and the growing of the plants and the algae, and not just that but also the use of metals and salts and plastics and . . . and everything we have. A totality. Even the radiation we draw on for our power. Before I was permitted to come to Earth, it was necessary for me to help plot the courses of the solar accumulator ships we have sent towards the orbit of Mercury; they are bottling up the raw energy which will help us out of the Sun's gravitation, before we can turn on the interstellar ramjets and scoop up the hydrogen in sufficient quantities to power the city. That, too, is in my job."

"Well, then!" Heart aching to think that Valeryk was her own age, and already so tightly knit with the community to which he belonged, Lucy stared at him in search of understanding.

But he gave another of his harsh little laughs. "What you don't see, little friend, is that I'm *too* indispensable."

"I . . . I don't quite—"

"Obviously." But there was no sarcasm in the comment. "Listen, and I'll try to make it clear. Because there are so many things involved in being an ecologist, there must always be too many of us. Almost anyone else has a job for which in emergency two can do the usual work of three, and they will be tired out but the city will continue. An ecologist—no. We are permanently extended to the limit. So there must always be too many of us. I was chosen at five not because there weren't enough, but because there was a chance of one in about two thousand that when I was adult the city might be short of an ecologist. The computers said one in two thousand chances. I am not for a whole, for a tight organismlike entity; I am for a chance which did not occur."

Bewildered, she struggled as he had done, to understand the meaning behind the statement as well as the verbal form it took. She said, "Then . . . then you mean there isn't any work for you? But you just told me you were delayed, having to work, before you could come down to see Earth!"

"Oh yes, right now there is work for me. I am very good at the job, I am intelligent and learn easily. So I rather than another like me, somewhat less clever, was called to attend to that task. But consider when I do not have to work! What am I to do, where am I to go? For me there is no hill of grass to sit on! For me there is no place to go that I have not been ten thousand times! There is no *space*!"

That was the most shocking thing that had yet battered Lucy's preconceptions. She tried to object, and could not. Valeryk plunged on.

"Would you say this is nonsense? With a billion kilometers of it for me to enjoy?"

She gave a feeble nod.

"So what shall I do? Take a suit and go for a little stroll of a million kilometers, perhaps?" Valeryk paused, breathing heavily. "Ah, I see you begin to understand. A little while ago, you asked why I speak English. And I said that we have people of all kinds. We trade and exchange. And this is why. I learned my English from a girl . . . a woman now, she is married and has twin babies . . . who came from one of your people's ships." He hesitated, seeming to hunt the optimum words again.

"Because—" Lucy was making a valiant attempt to put her own ideas into perspective, drawing on the knowledge she had about the flying cities which she had pushed to the back of her mind because it did not square with her idealized vision. "Was it because there was a shortage of men?"

"Hm-m-m? Oh yes, partly, I believe. And this is another thing. I meet you and you are a stranger and it is wonderful! I have no strangers. I have only friends and acquaintances. I meet strangers when we trade crewmen with some other city—in my life to now, this has been four times, five times."

"You . . . you want to go to another city, yourself?" Lucy tossed the suggestion out almost at random, and was startled at the vigorous nod Valeryk gave.

"But shall I ever get the chance? I'm an ecologist! If I were in some other job, where the cities do not take such care to plan a surplus, then . . . perhaps. I might hope. But why should cities trade their ecologists? Each is unique, and I have learned my own, inside and out. Perhaps if there has been some disaster, some catastrophe, in another city— Disaster may strike my own as readily as any other!"

He was breathing heavily, staring at the horizon. "What most of all I think I should do is leave. Stop here. Why should I go back?"

The impact of his bitterness, so utterly different from what Lucy had looked forward to, had now darkened the girl's face as much as her mind, and he realized it abruptly and took another pace towards her in dismay.

"But I'm making you sad!" he exclaimed. "Forgive me! You should not be sad when you have so much that I would like."

"Such as?" Lucy retorted.

"Why . . . why—" He grew suddenly aware of the clump of wild plants still clutched in his hand, and thrust it towards her. "Why, that, to begin with!"

"It's only a weed," she said.

"Yes, to you it's 'only a weed', but to me—" He fumbled desperately. "Look, don't you see? It has flowers. For no purpose of mine, or yours!"

"Don't you know what flowers are? Don't you have any in your flying city?"

"Of course we do! But they're for a purpose, a reason! I go around the plants and count them, decide how many will be needed for seed, cut off the others in the bud. They're the organs of reproduction, to be selected and fertilized and *used*."

"You complain that in your city you've been everywhere ten thousand times," Lucy countered stonily. "I've seen those things ten thousand times."

Valeryk glanced at the now wilting stems and leaves, gave a hopeless shrug, and tossed the plant aside. The act seemed to cost him heavily.

"Very well, don't count that. But . . . but colors! I stand here and just turn my head, and suddenly from nowhere a bright gleam of color, without design—There!" He shot out his arm and pointed. Among the leaves of a bush nearby, a glare of red shone out.

"A tin can someone threw away," Lucy muttered. "Garbage. We make this whole planet a garbage heap."

Valeryk, not listening, had gone for it, picked it up, came back turning it over and over in his hands. The paint was scored away from the outside in random lines, and the protective layer of tin had gone with it, leaving the sheet steel beneath to corrode.

"See? The shift of color, the . . . the different tints! Not because someone said so, not because a man came by with a paint-spray and filled it in, but of its own accord."

"Not quite," Lucy said. "Because someone came along and threw it down there and didn't care whether it spoiled the place for someone else."

Blank, Valeryk let the can drop. "Then the air!" he suggested. "The air of which there is so much, not measured and metered, not recycled through a sterile machine!" He filled his lungs. "The scents, the smells!"

"Mostly smoke," Lucy answered. "We're a good two miles from the town here, but that's what I can smell most of."

"But the wealth, the sheer wealth!" Valeryk exploded, almost dancing in frustration at his inability to make her see his point. "To

have so much air you can *let* the smoke be there! I'm almost frightened by it! If I smell grass, or wet earth, or the odor of ripe fruit, I have to stop and think where I am, and unless I'm in hydroponics section I shout the alarm and go running to see what's wrong in purification! All I may smell is—nothing. For only nothing is safe."

Dazed, she felt the beginnings of comprehension.

"And the people in the town, too! You yourself, even! So bored with the choices open to you." For the first time an edge of sarcasm did sharpen Valeryk's voice. "Why, how can you be bored with so much time on your hands, so many places to go, so many people to take the chance of meeting at no greater cost than walking along the streets!"

"Yes . . . yes, but, surely—" Lucy had to check and swallow to gain fresh purchase on the elusive words. "You must have time free occasionally. You must have"—this she had to force out—"girl friends! What do you do together when you—? I mean, like going out!"

The narrowly-missed *double entendre* was not lost on Valeryk, and he gave a grin that made his face look like a wild beast's muzzle. But he answered the second-guess question.

"Out? Hardly! I wasn't serious when I spoke of taking a suit and making a million-kilometer stroll."

"You know what I mean!" Lucy's disappointment in her meeting with a starman was turning against her will into a personal dislike. She had to repress the impulse to stamp her foot. "Don't you have music, dancing, TV? No, I mean movies. Or acting. Live acting, maybe?"

"Sure we do. What do you think we're waiting for right now, over there at the port?"

"You . . . you said supplies—"

"Yes, but what kind of supplies? Have you never wondered why, after centuries and centuries, they've not made the starships self-sufficient? We could, I guess. We're effectively a closed system when we're traveling between the stars, just as Earth itself is—this is a spaceship, after all, carrying its billions through the void. Why bother with planetfall? Why not eat the interstellar hydrogen as the whales eat plankton, process it up to complex elements, make our own oxygen and carbon and iron and uranium and never venture closer to a sun than we need to go for extra stored power? Well, I'll tell you!"

His voice dropped. Without Lucy realizing, it had grown late; the sun was close to the horizon and red smears were leaking out of the bank of cloud concealing the western skyline. But it was not the cool of evening which made her shiver. Rather, it was the intensity of Valeryk's voice.

"We're waiting for some music. We're waiting for poetry spools, and pictures, and carvings, and taped plays, and symphonies and songs and something to think and talk about!"

"But there are supposed to be a million people in your city!" Lucy cried. "Have you no one who—?"

"A million? Where did you get that idea? Who told you?"

Confused, she shook her head. "I always thought—"

"With a million people we might live. That might be—it might be random enough. Just. But what would a million people do plying between the stars? Seeing maybe eight or a dozen planetary systems in a lifetime!"

"Eight or a dozen!" The dying vision in her mind rekindled. "You mean you may walk on a dozen different planets, under a dozen different suns? Oh, miracle!"

"Is it? For a few hours, a few days when I gain senior rank and can leave my underlings to do the work when we come into a solar gravitational field? If we had a million—But we don't. Our population is about two and a half thousand."

"Then there are more people in my town than you've ever met in your life!"

"You're finally catching on," Valeryk said somberly. His original hesitation had vanished by now; he was speaking as freely and almost as fluently as Lucy.

"In any case," he resumed, "what do I know, that would let me create a poem or a piece of music? Oh, we have musical instruments . . . I've learned to play the flute, and we have a little band—But perhaps I should tell you about Arkady Suslov. I never met him, but he's still famous although he went when I was—eight or nine, I guess."

"Went? Do you mean he died?"

"No— We were very proud of him. I guess we still are. He wrote a play, and my father was one of the people who acted it, and they talked about it for years. Just the one play," he interpolated, correctly interpreting Lucy's unspoken question. "It was about . . . oh, it would be hard to explain it to you. About an argument which followed a hypothetical accident in the power system of the city.

"Like I say, we were very proud of him. When we raised other starships, we reported this, flashed over a tape of the play being acted, asked if people on the other ship were going to act it too, and usually they said yes of course, because it was something made by our people—

"Then time went by and with so much thinking about this, we all . . . I mean, everyone: I was still a child . . . everyone began to see where he'd taken his ideas. There were so few sources. One of the characters that everyone hissed because he was the . . . you say villain, I think?"

He cocked his head for her silent nod. "This character, then, who was the villain, was a little like one person, and a little like another, and the resemblance grew plainer and plainer . . . And the idea of this accident affecting the power worried more and more people, until there had to be special precautions taken to make sure it never really happened, and fewer and fewer people were willing to talk to Suslov because he hadn't created anything, only rearranged it—"

"You said he 'went'," Lucy prompted, almost in a whisper.

"Yes." Valeryk seemed to come back from the very distant place to which his reminiscing carried him. "We traded him off to another city, which was delighted to have such a famous recruit—so delighted, I don't think they asked very loudly why we were anxious to be rid of him. And one hears occasionally that he's more successful there . . . third-hand gossip leaks back—Maybe because he can draw on people from my city for the other plays he's written, and the people where he's gone don't recognize themselves."

There was a long silence once more, into which the chill of approaching night stole like a ghost. At length Valeryk shook himself, dog-fashion, and turned to her.

"What gave you the idea we had a million people?" he demanded curiously.

"I don't really know." She had been asking that of herself and found no answer. "Except maybe just the size of the . . . the place."

"You're thinking by Earthly standards. You have the air—we must make ours and circulate it mechanically. You have the natural ground—we carry ours with us and must tend it every second. You have the oceans—all our water is in pipes and tanks." Valeryk made a summing-up gesture. "We are a perfect island."

"I see," Lucy confirmed slowly. "No wonder it's big. And I do now understand what you meant when you said there was so much space here. You meant *waste* space."

"And waste time, too," Valeryk murmured.

She gave him a sharp glance. "I . . . I'm so sorry! Here I'm keeping you talking, and you have only a few hours on Earth, and maybe . . . am I right? . . . you'll never come back!"

"Oh, don't mistake what I say!" Valeryk exclaimed. "My English is not so good, and when I said 'waste time' I didn't mean that here, now, I was wasting it. It is wonderful to have this time with nothing important to fill it! Here one can do nothing for a day, a week even, and still he will live and breathe and find food to eat. If I can see the Home only once—you are right, in my lifetime I shall not be back—what counts is to waste the time, throw it away. The experience is

unique. The smell of the air is unique, the feel of the grass and the dirt under it, the color of the sunset . . ."

His voice trailed away, as he turned and stared at the blurring reds and yellows marking the departure of the sun. Already Venus was just visible, through a chance gap in the darkling clouds.

Lucy sighed.

"What I lack," Valeryk said more to himself than her, "is courage."

"What?"

"Courage," he repeated. "If I had . . . there is a word I want . . . ah! If I had *guts*, I'd walk over the hill out of sight of the spaceport and never come back."

She sighed again, more forcefully, and put her hand absently towards his. "Come and see this Earth of ours," she said.

He stood uncertain, eying her outstretched hand. For a second puzzlement filled her.

"Do you not hold a girl's hand when you keep her company in your city?" she asked.

"Yes, but—" She never learned what the *but* implied, for he closed his fingers on hers and came passively after her.

At the beginning he exclaimed over everything. To see dogs on the street excited him tremendously. "The wealth!" he cried. "The richness of this place! Why, that one must weigh half as much as a man, and two such would consume his food, his drinking water, his air supply! And here they run by packs around the houses!"

Lucy said nothing, and he saw that the dogs were snuffling at the carcass of a dead bird; then, how they visited the corner of the nearest house, and how their soilings lay on the sidewalk and the road.

Over the people at leisure to do nothing, he exclaimed again, especially over those of his own age, free from the ceaseless responsibility to supervise the mere essentials of survival. That reaction lasted longer. Still she said nothing, waiting; then, when the night grew dark, the shadowy figures that came off doorsteps and whined towards them, begging money for wine or whisky, tarnished the glamour of idleness, and the human stink displaced the pleasantly remembered scent of wild grass.

The little things piled up. The fork had dirty stale food between its tines; from an environment where no least bacterium was permitted to live without human permission, he squirmed on his seat and turned pale. The drink he chose was mere sweetened and colored water with bubbles of CO_2 bursting in it; from an environment where diet was controlled down to the last daily calorie he had to frown and try and assign this to unlimited wealth also. But he knew he failed.

A fight began outside a bar.

From the other side of the street, still hand in hand, they watched. A crowd gathered. Its members stood by, unminded to interfere. Shouting encouragement, they only scattered when a police siren overhead announced the imminent descent of a patrol 'copter.

Valeryk shook his head in bewilderment. "The . . . the waste of energy—" he began, and got no further.

Not without malice, Lucy prompted him. "Don't you fight among yourselves in your flying city?"

"What for? How can we? The system depends—our very lives depend—on co-operative effort. This is one of the strange things about planetside dramas and stories which we pick up—this exciting violence, this sense of surplus energy ready to boil off in new and unexpected ways. But when it's reduced to—*that* . . . !"

"When it comes down to two drunks quarreling on a street corner," Lucy supplemented, "it's not so attractive."

"No—" And then, as though reminded by the reference to picking up what he had earlier called "supplies", he started. "What time is it, Lucy?"

It was the first time she had heard him use her name; she had half-believed he had failed to catch it when she spoke it first, and was far too shy to tell him her name again. The realization of being wrong brought a curious, inexplicable thrill.

"Almost eleven," she said.

"I must be back at half past midnight."

"Then let's start walking now."

"It won't take us an hour and a half to cover that distance, surely," he objected.

"No, of course not." Lucy took a deep breath, feeling her heart resume the violent pounding which had greeted Valeryk's first appearance. "But let's go anyway."

Exactly as when she put out her hand to him, he hesitated, seeming to question the implications of what she was inviting him to do. But now as then, he acceded without raising any opposition to the proposal.

They left the town behind and were absorbed in the night, going cautiously because the ground was rough, still with their hands linked, for a long time saying nothing. The clouds had blown over, and the stars looked down out of more than half the sky. When they had walked for twenty minutes or so, far enough to bring them into view of the lights at the spaceport, Lucy ceased her formless speculations about what was going to happen and halted abruptly, raising her face to the stars.

"Can you tell which is your city, up in orbit?" she asked. Her voice was thin and quiet, to suit the empty dark.

Puzzled, Valeryk copied her in

staring upward. He said, "No, I don't think so. I've never seen the stars from Earth before."

"Are they so very different anywhere else you've been?"

"Why . . . why, yes. Down here, under all this atmosphere, there are very few, and I don't know which are simply rather bright and drive their light down to the surface, and which has to be new and out of place because it's the city where I live."

"I never thought of that," Lucy confessed in a small voice, turning her head away. "I thought you'd be able to point out the one which is your home. I thought you'd—" She checked for a second, and found she could not withdraw the statement however absurd, however forward it might seem. "I thought you'd point, and I could pretend to make a mistake and have to look upward along your arm, and lean against you, and—"

Her breath ran out into gusty nothingness.

There followed an eternal pause. During it, Valeryk withdrew his hand from hers and began to link and unlink his fingers in front of his chest, over and over. When he spoke again, it was in a changed voice, gruff and somehow much older than himself.

"I'll tell you something," he said, the words coming painfully and at wide intervals. "I walked away from the port this afternoon, and my head was ringing with a million wild ideas. I thought, 'I can go on. I can just walk and walk, and sooner or later I'll meet someone, and I'll talk, and we'll go on talking, and it won't have to be by conscious decision that I stay—it'll happen by itself because here at the Home there is so much to say, so much to think of and so much to do of choice and not of crude necessity.' That's what I was thinking. And of course I hoped most of all"—he hesitated—"that the person I met would be a beautiful girl.

"So when I came in sight of you, and saw you smile at me, I felt—disconnected. Between two worlds. Isn't that the way it is with you, if something which has always been an imaginary fantasy suddenly turns into real life? I saw you like a flower on the hill, in that wonderful colored cloth you wear, your hair like the very natural earth itself, all brown and rich— I thought, 'It's going to be even better, it's going to be fantastic!' I . . . oh, I guess I shouldn't say this, but I can't stop it, I've got to! I thought maybe the way it would happen would be that we'd . . . we'd make love together, and it would be so good that I'd never have to face the moment when I said to myself, 'I stay. I don't go back to space, I remain on Earth.' "

"It . . . it could still happen," Lucy whispered, quavering.

"No."

The word had the finality of a

cracking whip. In horror Lucy listened to its echo in her memory, and after seconds had crawled by she felt a crawling on her cheeks. Two tears like insects, itching as they crept across her skin.

She could hardly see Valeryk, but she knew he had stopped working his hands back and forth and had dropped them calmly to his sides.

"I know you still want that," he said. "And you're wondering what's to stop it. Let's lie down in the grass and be together, and in an hour it will be too late and the ferry will have lifted and they'll be making ready to call in the accumulator ships from out there near Mercury— But—no."

"Why?" she whispered. "Why?"

"Because I came looking for flowers, and you rubbed my nose in the dirt which grows them."

"It's true," she said at last. The tears had gone; there were only those two, and now she felt hard and composed, as though a stone heart had been placed in her breast. "And do you know why?"

"I can guess," Valeryk said. But she would not let him guess; she had to tell him.

"Because I envied you what I thought was your purpose and dedication. As you dreamed of staying, not having to make a decision to change your life but letting it overtake you, I thought of the way I'd have been provided for if I'd been born into a starman's family. I wouldn't have been condemned to these agonies of indecision, these years of empty wondering about what I shall do with my life. You must understand that, Valeryk! You hoped to . . . to slide around even this single central decision. I have to make millions of decisions, and any single one of them can be so wrong that it leaves my life empty forever!"

Did he understand? She struggled to discern his face through the gloom. For a long time he did not answer, but finally he spoke.

"I thought you'd forgotten my name, or maybe not heard it clearly and not wanted to admit that and ask me to repeat it."

And I thought you'd forgotten mine . . . But she left that unsaid, needing to use the chance to utter something far more important.

"I'll never forget your name, Valeryk. I'll never forget *you*."

"Nor I you. Because in spite of everything I have this . . . this weird feeling. I feel I ought to be so grateful to you."

He was rock-still for a moment; then he moved, closed the gap between them in a single pace, and brushed her cheek with his lips. Convulsively her eyes closed; convulsively she raised her arms to enfold him, and she held only the air. When she looked, his back was already turned and he was striding across the uneven ground towards the distant lights of the spaceport. ■

magnetohyd

Tell an electrical engineer ten years out of school "You don't need those boilers, turbines and generators— all you need is a flame and a magnet to generate megawatts," and he'll know you're a crackpot. But— that's because he's ten years out of school! What they knew was impossible then, they apply in laboratories today!

BY BEN BOVA

All illustrations, courtesy of Avco-Everett Research Laboratory, a Division of Avco Corporation.

rodynamics

Let's begin, for a change, at the ending.

Magnetohydrodynamics will play —and is playing now—an important role in the eventual attainment of controlled nuclear fusion, in nuclear rocket systems, in electrical power generation, in radiation shielding for astronauts, in studies of astronomy, and the origins of both the solar system and the universe.

That's the conclusion that I hope you'll agree with at the end of this article. Now to give you some of the facts that will support such a sweeping statement.

Magnetohydrodynamics (MHD for short, mercifully) is a comparatively new field of study. Like most new fields, it is exciting; not only because there is so much to discover, but because there are already so many promising applications for this new knowledge. Applications that run the gamut from lighting electric lamps to unraveling the fundamental secrets of the stars.

Studies of MHD are underway in every technologically advanced nation in the world. Here in the United States, literally hundreds of university, industrial and Government laboratories are engaged in the many facets of MHD research and development. Some of the American private firms now working in the MHD field include Avco Corporation (Avco-Everett Research Laboratory), Westinghouse, General Electric, United Aircraft, Radio Corporation of America, Republic Aviation, Martin-Marietta, Ford Motors (Aeronutronic Division), ITT Federal Labs, General Motors (Allison Division), Raytheon and Sylvania. And these are merely the better-known entries.

All right, then: what is MHD? Why all the fuss?

Briefly, magnetohydrodynamics is concerned with the interactions between magnetic fields and conductive fluids such as ionized gases. Like most definitions, that one doesn't mean much by itself. But have patience, read on.

An ionized gas is one in which some of the gas atoms have been stripped of one or more of their orbiting electrons. Thus the gas contains free electrons, positive ions, and some un-ionized gas atoms that are still electrically neutral. An ionized gas is usually referred to as a *plasma,* a term coined by the Amer-

ican scientist Irving Langmuir. It was he, in the early 1900s, who probably recognized first that plasmas are distinctly different from ordinary gases.

You can see that the degree of ionization in a plasma can vary considerably. Plasmas may be only slightly ionized, such as a candle flame; or completely ionized, with no neutral particles at all, as is the thin plasma in interplanetary space. An excellent example of a completely ionized plasma is the sun—or almost any star, for that matter.

As you might begin to suspect by now, practically all of the known universe consists of plasma. Here on Earth, plasmas are fairly unusual—they exist in flames, fluorescent lamps, rocket exhausts and such. Physicists call plasma the "fourth state of matter," since plasmas are so different from gases. Judging from the less-biased viewpoint of cosmic abundance, though, we might call plasma the *first* state of matter, with gases, solids and liquids making up a small percentage of impurities in a plasma-filled universe. Earth is an unusual place!

When you combine a plasma with a magnetic field, you get MHD, and a whole host of phenomena that no one dreamed of until a few years ago. It is literally a new world, with its own rules of behavior and its own opportunities for usefulness.

Perhaps the best way to illustrate how different the world of MHD can be is to consider the element mercury. Quicksilver, it's called: elusive, shifting, ungraspable. But put a sample of mercury into a strong magnetic field and the quicksilver turns to sand. You can dig a hole into it and watch it ever-so-slowly slough together again. Something about the magnetic field holds back the fluidity, the *mobility*, of the mercury particles. Mercury is not a plasma, of course, but a metal. It is a rather good conductor of electricity, and magnetic fields can show dramatic effects on electrical conductors.

Now look a little deeper at plasmas. A plasma consists of free electrons and ions, usually with some percentage of un-ionized atoms. As a whole, the plasma is electrically neutral. Each negative electron is balanced by a positive ion. A doubly-ionized atom may give off two electrons, but then the net positive charge of the ion is also two. Over the bulk of the plasma there is charge neutrality.

But these free electrons in the plasma can, and do, carry electrical currents. Although the plasma is electrically neutral, it is still a conductor of electricity. The billion-degree-temperature plasmas of stellar cores are possibly the best electrical conductors in the universe. But the plasmas attainable on earth, limited to a few thousand degrees Kelvin for the most part, are much poorer conductors than most metals. Still, even these "low temperature" plasmas can be made to sit up and

do tricks when in the presence of a magnetic field. (And the tricks they do are much more interesting and practical than the mercury experiment described above.)

This is the key to MHD. Plasmas conduct electricity. They can be influenced, moved, shaped, controlled by electromagnetic forces. A whole new generation of possibilities opens up for the scientists and engineers when they move into plasma physics and MHD.

One of these exciting possibilities has already reached the stage of practical reality: MHD power generation.

Plasmas have been made to generate megawatts of electric power, and some practical uses for MHD power generation are now out of the research stage and into the domain of hard-hat engineering. MHD power generation offers many advantages of conventional generators. Chief among them is considerably higher efficiencies and, as a result, lower running costs: more kilowatts for your money.

To understand the advantages of MHD power generation, we should first take a quick look at conventional generators.

About one hundred thirty years ago Michael Faraday discovered that when a conductor of electricity was set in motion relative to a magnetic field, an electric current was generated. Years later, an enterprising American named Edison used this principle to electrify the world. Edison's generators—or dynamos, as they were dramatically dubbed—were built around a spinning bundle of copper wire, called an armature. The armature was spun rapidly in a magnetic field. This caused an electric current to flow in the copper. Brushes made intermittent contact with the rotating armature and tapped off the current. The current—D.C., you notice—was fed to loads, used for lighting lamps and changing the pattern of civilization.

Modern generators, after close to a century of development, are still based on Edison's design. The heart of a modern conventional generator is a turbine. In most generator systems, steam is used to turn the turbine. The steam comes from a heat source that can be a conventional furnace fed by fossil fuels—coal, oil, or gas—or the heat can come from a nuclear reactor. It makes little difference in the principle. The heat is needed to make steam, or some other hot gas.

Heat produces gas. The gas—usually steam—pushes turbine blades. The turbine is linked to the armatures in the generator. The armatures spin and generate electric current. In other words, chemical—or nuclear—energy is converted into heat, which is converted into mechanical energy, which is finally converted into electricity.

The generator is, then, an *energy conversion* device. It changes one

form of energy into another. For every change of energy-form, though, there are inevitable inefficiencies and energy losses. The best modern turbogenerators, for example, are little more than forty percent efficient. This, after nearly a century of intense development by some of the best engineers in the world. It is generally agreed that turbogenerators cannot be made significantly more efficient.

Now then, back to Faraday. That practical-minded genius did not discover that copper armatures rotating in a magnetic field will generate electricity. Most emphatically not. He made the much more profound discovery that *any* conductor of electricity that moves relative to a magnetic field will generate electricity.

Plasmas are conductors of electricity.

If you replace the mechanical system of turbine/armature with a flowing plasma, you eliminate one step in the ordinary energy conversion process. Heat energy produces a flowing plasma, from which electrical energy is tapped directly. In theory, at least, you have simplified the energy conversion process and eliminated a large source of inefficiency.

The MHD generator, then, is a direct-conversion device: it trans-

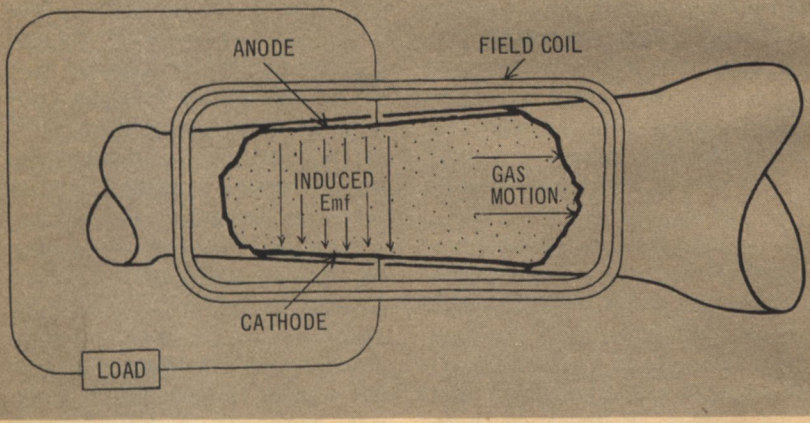


Figure 1. General features of the MHD generator. Gas (or plasma) flowing through magnetic field, represented by dots, generates electric current, identified in figure as "induced electromotive force." Note slightly diverging geometry of channel, to maintain proper plasma pressure ratio, and electrodes placed along channel walls to tap current and complete circuit.

forms heat energy directly into electricity, with no mechanical-energy-stage in the middle.

In principle, the MHD generator is quite simple. There are no mechanical moving parts. As Figure 1 shows, the MHD generator is basically a pipe, surrounded by a magnetic coil and lined on two sides by electrodes. Attach a heat source to one end and a smokestack to the other, and you have it. Note that the MHD generator produces D.C. only. Various schemes have been suggested for making an A.C. generator, but to date the simplest and cheapest method is to convert the MHD generator's D.C. output to A.C. by a conventional alternator.

Let's look at the MHD cycle a little more closely. The heat source produces a gas hot enough to be slightly ionized. (More on heat sources and ionization problems later.) The gas—or plasma, now—runs through the pipe, driven by simple gas pressure. To maintain the proper pressure ratio along the length of the channel, the pipe has a slightly diverging geometry. The magnetic field is arranged so that it runs perpendicularly to the direction of the plasma flow. Faraday predicted that an electric current would be generated in a direction perpendicular both to the magnetic field and the plasma flow. And he was right. In Figure 1 you see the plasma moving from left to right, the magnetic field heading into the paper, and the electric field—or induced electromotive force—running from the top of the channel to the bottom.

The MHD generator offers the possibility of much higher efficiencies than the forty-some per cent of modern turbogenerators. Calculations have shown that MHD generators could be at least fifty per cent efficient when the first full-scale power plants are built. Moreover, the MHD system will be wide open to improvements; the decades of its ultimate refinement are in the future, not the past.

Even better, though, is the advantage of scaling. By its nature, the MHD generator becomes more efficient as its size is scaled up. Losses in the MHD system are mostly associated with the channel walls—friction between the walls and the flowing plasma, heat transfer to the walls, electrode losses and other effects. The power output of the generator, on the other hand, is a product of the volume of plasma in the channel. This means that as the size of the MHD increases, losses rise with the square of size—two-dimensional wall effects—while power rises with the *cube* of size—three-dimensional volume effect. The bigger the generator, the higher its efficiency.

And still more. There's thermal efficiency to consider. For any heat engine—and that's what all generators are—the amount of energy you can extract is directly related to the temperature difference between the

hottest and the coldest ends of the system. In engineering practice, this means that it's desirable to operate with as high a peak temperature as possible.

Turbines are limited in the peak temperatures they can handle. If the gas blowing across the turbine blades is too hot, the blades will be destroyed. After all, the turbine itself is a comparatively delicate, finely-balanced mechanism. Despite the refinements of the toughest modern alloys, turbines are still limited to operating temperatures well below 1,000°F.

The MHD generators operating today run mostly at temperatures of about 5,000°F. They can easily achieve peak temperatures beyond the wildest dreams of the turbine engineers.

This is both the great strength and the main headache of MHD generators.

For the MHD generator *needs* these very high temperatures. Unless the gas fed into the generator is sufficiently ionized, the generator is useless. And the easiest way, by far, to ionize a large, continuous flow of gas is by heating it.

Ordinary air does not ionize very easily. It must be heated to nearly 8,000°F before a significant percentage of atoms begin to shed electrons. Conventional furnaces do not operate at this temperature. However, air can be "seeded" with a small amount of easily-ionized material such as potassium salts. The air-potassium combination will ionize sufficiently for MHD power generation purposes at temperatures of about 5,000°F. Fossil fuel furnaces can achieve such temperatures.

Nuclear reactors cannot. Or at least, none have yet been designed to. Therefore, the "first generation" of laboratory and practical MHD generators have been built around non-nuclear heat sources.

The earliest experimental MHD generators used an electric arc to heat and ionize the plasma going into the generator channel (see Figure 2). Avco-Everett's two large combustion-driven generators use a modification of the rocket engine (Figures 3 and 4).

Using a rocket engine as a heat source is a tip-off on the genesis of the MHD generator. For, while the basic principles of MHD power generation were known to Faraday, it was not until the space age unlocked a new domain of knowledge that the MHD generator became attainable. For example: a very thorough knowledge of high-speed aerodynamics is vitally necessary for the design of the central channel in the generator. And it was missile re-entry studies of the electrical properties of plasmas that led to a detailed understanding of the conductivity of air and other gases.

Re-entry studies also helped to develop the understanding of high-temperature materials that are needed for the MHD generator

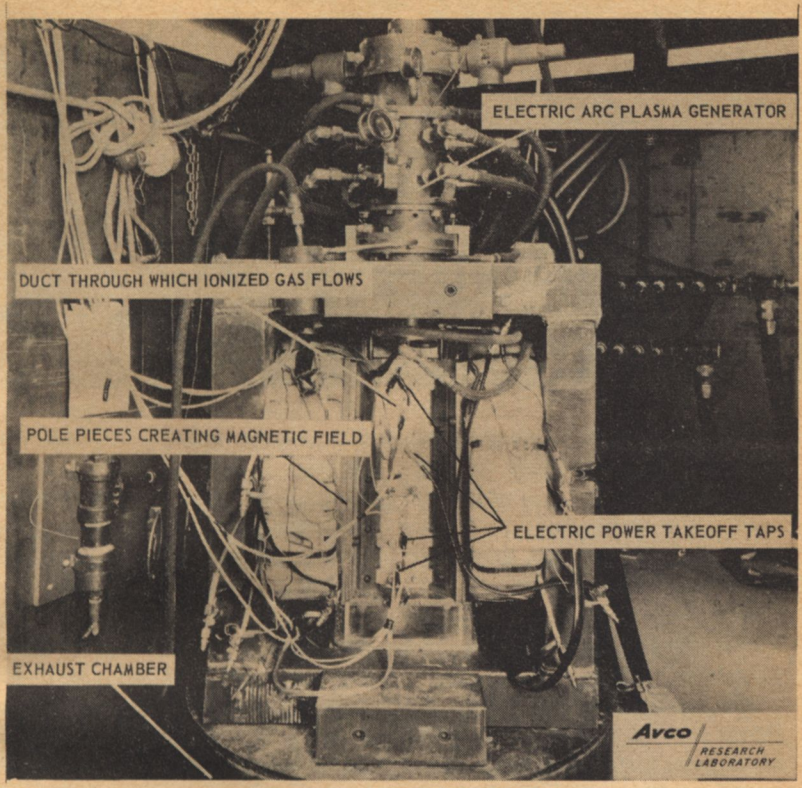
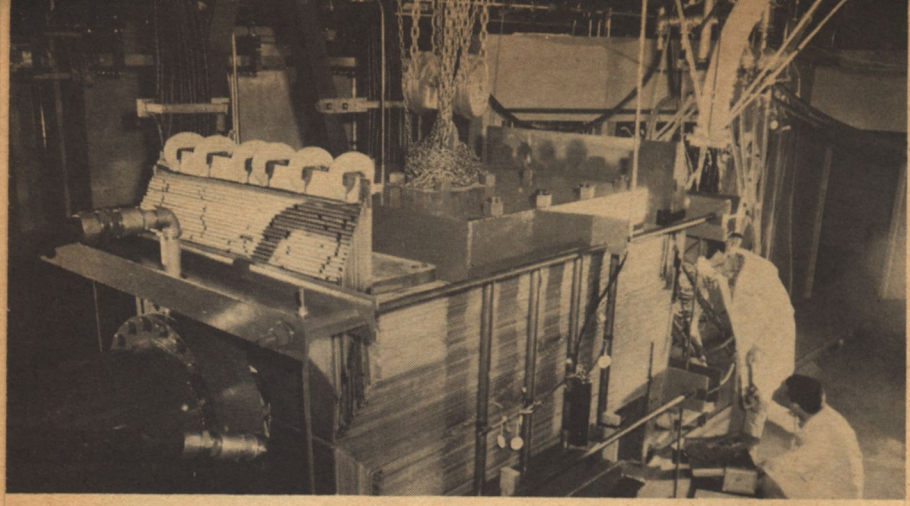


Figure 2. The first successful MHD generator, Avco-Everett's Mark I, which in 1959 achieved more than 10 kilowatts' output.

channel. The 5,000°F running temperatures inside the channel pose some intriguing materials problems. Not only must the channel withstand the stresses of high-speed plasma flow at such temperatures but the channels walls must also be electrically nonconducting, despite the strong electric currents flowing through the plasma. Those currents must flow to and from the electrodes only; current along the walls will lower the efficiency or even short-circuit the generator.

Two basic approaches have been used on the channel materials problem. Some researchers have tried a "brute force" method of using ceramic walls that can face the high plasma temperatures directly. A subtler approach is to use cooled



walls. The idea is to conduct the heat away from the walls and outside the channel . . . while still leaving the walls electrically insulating. A few years ago, most engineers would tell you that you can't conduct heat and not conduct electricity with the same material. And they were right.

The cooled channel walls designed at Avco-Everett are made of metal pegs, surrounded by a ceramic "filler." The metal conducts the heat away from the wall surface and into a cooling bath of flowing water, outside the channel. Thus the walls can operate at a temperature significantly lower than the main stream of the plasma in the channel. The ceramic between the metal pegs keeps the pegs electrically isolated; they do not carry electric currents. Walls of this type have been run for hundreds of hours with complete success.

The ultimate goal for MHD generators, of course, is to develop them to the point where they can be used for central station power plants. And there is a real need in the electric power industry for the better performance that MHD promises.

America's demand for electric power has been doubling about every ten years. Tie this rapidly-increasing demand for power together with the limited efficiencies of turbogenerators, and sooner or later the electric utilities face a serious crisis. They can't keep building new power plants forever; nor can they expect to use all the world's stores of fuel. They badly need a breakthrough in efficiency, and the MHD generator—alone of all the new space age ideas in energy conversion—offers the ability to deliver truly huge amounts of power at high efficiency.

Since nuclear reactors have not been developed to the point where they can produce gas temperatures high enough for the MHD process,

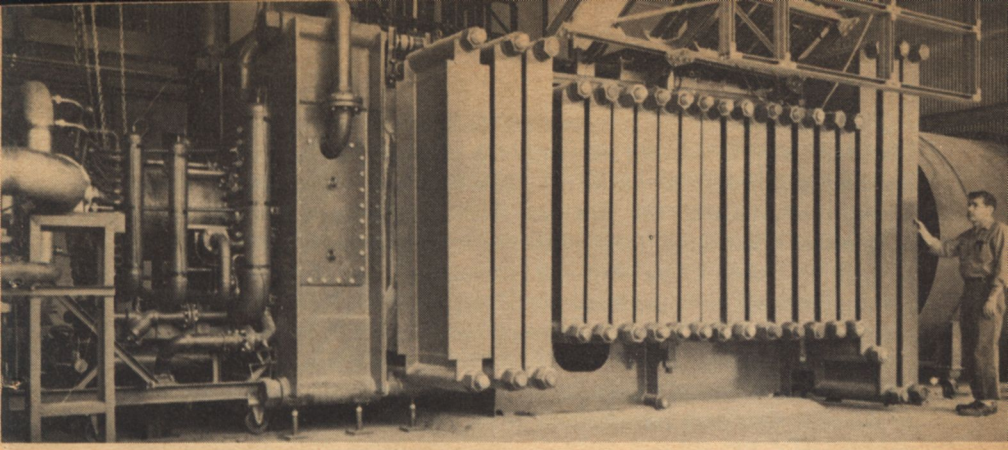


Figure 3 (opposite). The Mark II experimental MHD generator at Avco-Everett. As can be seen, most of the bulk of the generator is the copper-plate magnet. MHD channel runs through center of magnet, starting at rocketlike burner (hidden behind magnet, at right), and ending at large exhaust pipe on left. The Mark II has achieved about 1.5 megawatts, and has been used to check theoretical predictions of plasma behavior under high-power conditions within MHD generator.

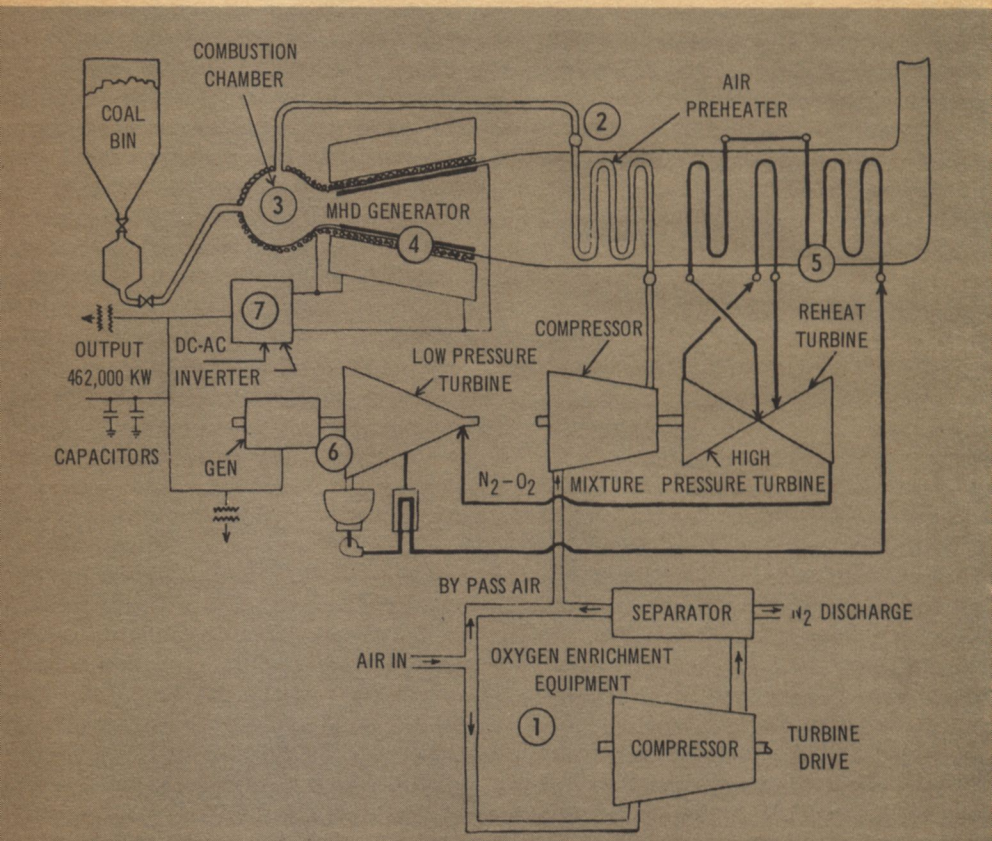
Figure 4. The largest known MHD generator in the world is Avco-Everett's Mark V, which has produced more than 11 megawatts. Burner is at left, magnet is hidden behind restraining steel beams, exhaust pipe on right. Mark V is first MHD generator built to achieve specific performance figures. Also, it is self excited: part of the generator's output maintains the magnet at a field strength of about 34,000 gauss.

it seems likely that the earliest MHD power plants will run on conventional fossil fuels. Ordinary combustion of coal, oil or gas will provide the hot plasma that the generator requires.

We can envision a commercial power plant such as the one shown schematically in Figure 5. This conceptual design was chosen with one main criterion in mind: all the components of the power plant must be conventional equipment, available today—except for the MHD generator itself. Thus, the actual construction of such a power plant depends on two factors: the successful development of a suitable MHD generator, and the economics of MHD power generation.

The power plant shown in Figure 5 is a combination of MHD generator and conventional steam turbine system. The cycle is based on using the MHD generator for high-temperature power generation, and then using the exhaust gases from the MHD section to raise steam for a low-temperature turbogenerator system. Thus the MHD

Figure 5. Schematic of a combination MHD/steam turbogenerator power plant. Air is enriched with oxygen (1) to allow hotter flame temperature, and then put through preheater (2). Combustion gases from burner (3) are seeded with potassium salt, and flow through MHD generator (4), where D.C. power is extracted. Exhaust gases from MHD section then flow back through preheater, where they heat incoming air and also raise steam (5) for conventional turbogenerator cycle (6). Inverter (7) turns MHD generator's output to A.C. Steam generator produces A.C. without inversion. Net output of MHD section is 462,000 kilowatts; steam section provides about 200 kilowatts additional. Over-all power plant efficiency for systems of this type have been calculated to be better than 50%.



generator is used as a "topping unit," in the parlance of power plant engineers—that is, it uses the top temperature in the system, a temperature that the turbogenerator could not handle.

The key technical problem facing the practical use of MHD generators is simply the question of long running times. No one has operated an MHD generator for months on end, night and day. Small test generators have been run for several days, and components of generators —such as the water-cooled channel walls discussed earlier—have been tested for hundreds of hours. But the entire system, full-scale, has not yet been tested in long duration runs. I believe the standard requirement in the power industry is that the equipment be proven capable of 10,000 hours continuous operation. That equals nearly fourteen months. No one has come close to that mark.

The two largest MHD generators known—Avco's Mark II and Mark V—are both specifically designed for *short* running times. The Mark II is an experimental generator, aimed at providing data on plasma behavior at power levels of about a megawatt. It is designed to run for about one minute, which is more than enough time for the plasma to reach steady-state conditions. The materials and components of the generator may change over the course of days or months, but the plasma itself will remain the same as it was in the first milliseconds.

The experiments run in the Mark II verified theoretical predictions of plasma behavior. Once it was determined that the performance of an MHD generator could be predicted on paper, the Mark V was designed and built.

The Mark V signifies a new level of confidence in MHD generators, from several points of view.

First, it is the first MHD generator to be designed for a specific performance. Previous generators were experimental, built largely on a "let's run it and see what happens" basis. The Mark V was specifically designed to achieve a net power output of twenty megawatts over a three-minute running time.

Second, the Mark V is self-excited. That is, the electrical power to run the magnetic field coil comes from the output of the generator itself. At peak field strength—34,000 gauss—the magnets consume nearly twenty megawatts. So the gross output of the generator is actually close to forty megawatts, about half of which is fed to the magnet. The magnet is initially excited by a bank of ordinary batteries. This gets the generator started. Within a minute, the batteries are disconnected and the generator is itself powering the magnet coil.

Third, the Mark V could run for much longer than three minutes at a time, if its copper magnet coil were cooled. Simple economics dictated that the advantages of longer

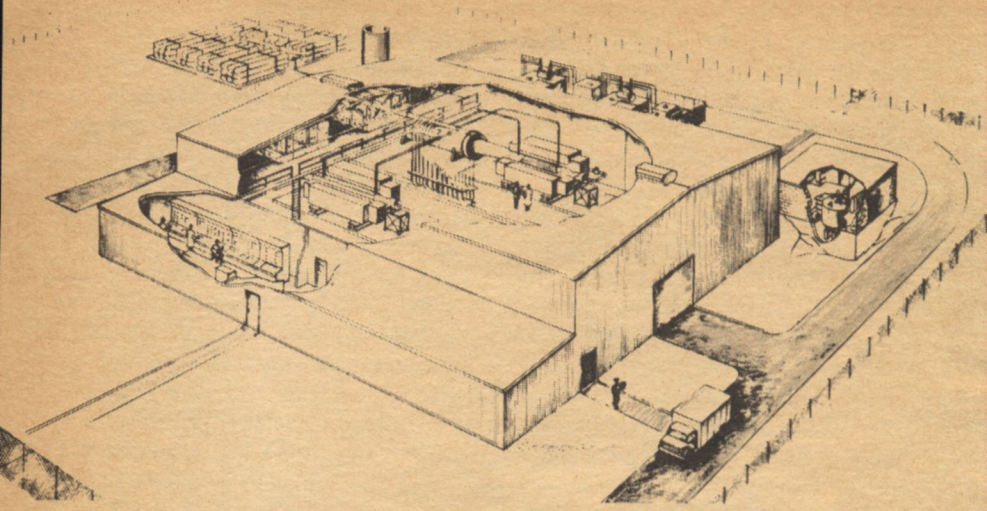


Figure 6. Artist's sketch of Air Force LORHO wind tunnel facility, which will use a 20-megawatt MHD generator/accelerator combination. Note relatively small size of MHD generator (upper right corner of building), which is many times more compact than steam turbogenerator station of comparable power output.

running times would be worth the costs of cooling the magnet. However, the plasma-bearing channel within the generator *is* cooled, along the lines of the water-wall discussed earlier. The heat generated by the magnet coil is simply the ordinary heat of electromagnetic dissipation: electromagnets get hot. It has nothing to do with the operation of the generator. If the magnet were cooled, the Mark V could run indefinitely.

Finally, the Mark V is the basis for the design of the first MHD generator to be put to practical use.

This practical use is at the Air Force's Arnold Engineering Development Center in Tennessee, where a new hypersonic wind tunnel is being built. The facility is called the LORHO wind tunnel. LORHO is shorthand jargon for "low rho," rho being the engineering notation for gas density. (Thus the name LORHO is actually a piece of jargon within a piece of jargon. An engineering first, perhaps?) The LORHO wind tunnel will be capable of simulating the flight of hypersonic vehicles at extremely high altitudes.

LORHO will require a huge jolt of electric power. To provide this power, the Air Force has contracted Avco-Everett to built a twenty-

megawatt generator—somewhat similar to the Mark V, but with refinements. Actually, the job includes building both the power generator and an MHD gas accelerator, which will take the electric power from the generator and use it to push the air through the wind tunnel at the required velocities and temperatures. More on MHD accelerators will be said shortly.

But now let's look at the economics of the situation. The Arnold Engineering Development Center is in the heart of the Tennessee Valley —TVA country. Why go to the expense of building an MHD generator when you can tap cheap TVA power? Because tapping twenty megawatts for a few minutes at a time is not only a headache for the local power distributor, it is a damned expensive way to do business. The MHD generator, on the other hand, is a relatively compact unit (see Figure 6), far smaller and cheaper to build than a conventional twenty-megawatt power station.

In terms of hard cash, then, the MHD generator will be more economical than using TVA power—for this short-burst power application.

And there is the real key to know how quickly MHD generators will become useful to industry and the electric utilities. It is mainly a matter of economics. MHD power generation will have to demonstrate its ability to get more kilowatts from a pound of fuel than conventional turbogenerators do; and the demonstration will have to include reliability and long running times, as well.

Consider this, though. The development of practical MHD generators is scarcely seven years old. Already the idea has proved economically attractive for at least some specialized uses—short bursts of high power. As development efforts show that MHD generators can run economically and efficiently for longer and longer times, more and more users will be found.

High-power wind tunnels and other experimental facilities, such as nuclear particle accelerators, require very high power levels for times of a day or less. Industrial uses will probably come along next. Finally, MHD generators will be used in central station power plants.

The sternest competition facing MHD power generators today comes from nuclear power. The attractive feature of the MHD generator is that it offers a simpler, more efficient replacement for the turbine-and-armature arrangement of conventional turbogenerators. MHD allows you to get more power per BTU of fuel.

But nuclear reactors eliminate the fuel problem almost completely. As of this writing, it has been estimated by the Government that nuclear reactors can now provide cheaper power than fossil-fueled

plants, over most of the continental United States. In certain areas, near the coal mines and the gas and oil fields, conventional fuels are still cheaper than nuclear. But elsewhere, nuclear fuel wins the battle of economics.

The obvious answer to this is that there is no fundamental reason why MHD generators cannot use a nuclear reactor instead of a fossil-fueled furnace. Remember, both the nuclear reactor and the conventional furnace simply provide heat. The MHD generator, just as the turbogenerator, converts heat into electricity.

But there is a very large rub in that last paragraph. Nuclear reactors cannot—as yet—achieve the high temperatures that the MHD generator needs. Conventional turbines, as we saw, can and do operate nicely at modest temperatures —compared to MHD. To date, nuclear power plants use turbine equipment to convert the heat into electricity.

There are two possible ways to solve this problem: (1) build nuclear reactors that operate at higher temperatures; or (2) build MHD generators that can work at lower temperatures.

The AEC and private reactor developers are approaching the first alternative rather cautiously. The hotter a reactor gets, the more dangerous it becomes. At high temperatures, the metallic jackets around the rods of fissionable uranium (or plutonium, et cetera), begin to break up, as does the fissionable material itself. The coolant gas or liquid running around the rods begins to pick up chunks of highly radioactive material and carry them out of the reactor. To date there has been no completely satisfactory answer to this problem: materials capable of handling high temperatures in a radioactive environment have not yet been developed.

Because of this problem, MHD researchers are pushing hard toward developing generators that will perform well at the comparatively modest temperatures at which nuclear reactors can today safely operate.

The problem is basically one of plasma conductivity. We saw earlier that plasmas must be sufficiently ionized before they can conduct electricity well enough to serve in an MHD generator. The simplest way to get this ionization is through heat—increase the thermal energy of the gas particles until collisions between them become frequent enough and violent enough to jar loose a sufficient number of electrons. We saw that for air, even when heated to 5,000°F, an easily-ionized seed such as potassium has to be added before the plasma conductivity is high enough to make the MHD system work.

For a nuclear-MHD system it would be possible to use an inert gas, such as argon, seeded with cesium. Still, to achieve the necessary

conductivity, the argon-cesium plasma would have to be heated to more than 3,000°F.

The hottest nuclear reactors in sight today will run at temperatures only slightly higher than 2,000°F: far too low for MHD. Some additional, extra-thermal, means of ionizing the gas must be employed.

Several schemes have been tried by various experimenters. You can fire electrons into the gas and thereby increase the conductivity. You can apply strong ultraviolet radiation to the gas; this will help to ionize it. Both these ideas, and others like them, require that outside sources of power be applied to the gas. This could be fatal to efficiency. The operation might be a success, but the patient could easily die.

Another scheme is to use the electric and magnetic fields already present in the MHD generator's plasma to produce additional, extra-thermal ionization.

This technique uses the magnetic field in the plasma to accelerate the few free electrons that have been produced by ordinary heating. The heavy particles in the plasma—ions and atoms—are relatively unaffected by the magnetic field. but the electrons can, under the proper circumstances, gain additional energy from the field, move faster, strike more atoms and shake loose still more electrons. In principle, the plasma is turned into two rather distinct gases: a relatively slow-moving group of heavy ions and neutral atoms, and an energetic collection of electrons. The electrons can be thought of as having a higher effective temperature than the main body of the plasma.

This is a terribly oversimplified explanation of a complex experiment. The main points are that by using the electric and magnetic fields already present in the plasma, the effective temperature of the electrons can be raised several hundred degrees above that of the ions and atoms. Thus, in a gas that is nominally 2,900 °F, electron temperatures of 3,600°F have been achieved. Plasma conductivity is raised by about a factor of 100 over that obtained by ordinary heating alone.

Several experimenters have reported using this technique, with varying amounts of success. At Avco-Everett, a small disk-shaped MHD generator was made to put out five watts, in the extra-thermal ionization mode. Admittedly, this is a tiny first step on a long road. But it is a successful step, and at the end of that road is the mating of nuclear reactors with MHD generators.

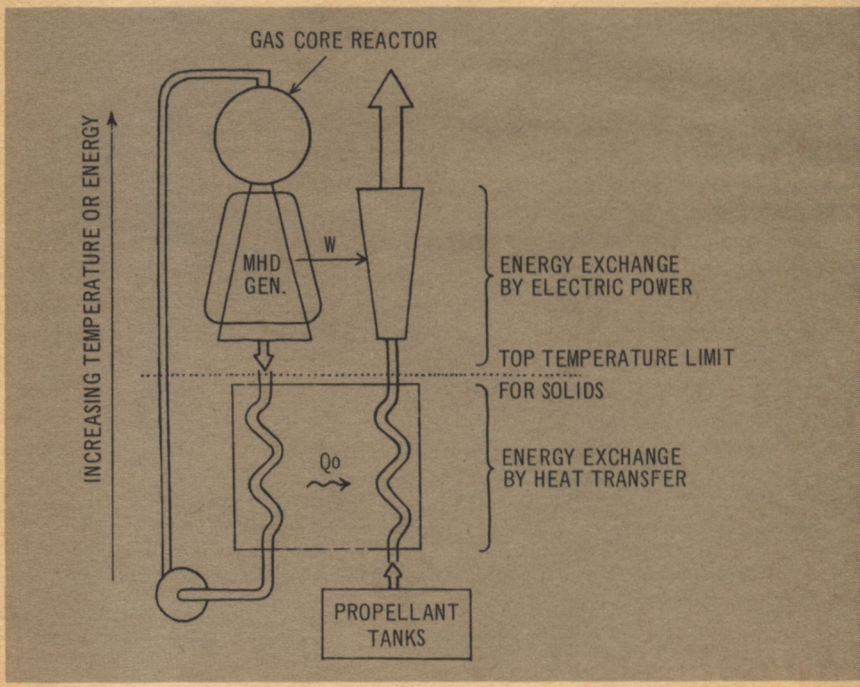
The nuclear reactors being developed today are of the solid-core variety. They use fissionable material that is in the solid state. However, gas-core reactors are also possible, calculations have shown. Possible, but practical considerations are another matter. A reactor using gaseous uranium would operate at

very high temperatures, temperatures so high that materials engineers and even nuclear physicists are doubtful about such reactors. But MHD people aren't afraid of high temperatures . . . they welcome them!

The gas-core reactor is an enticing goal, especially for nuclear rocket propulsion. And it may be that only the MHD generator will be able to handle the tremendous energy inherent in gaseous reactors and convert that energy into useful thrust.

As a rocket system, the gas-core reactor has a fundamental problem: the uranium, being gaseous, flies right out of the rocket nozzle! What is needed is a form of "closed loop" system, with the uranium gas cycling continuously and transferring its energy to another gas—the actual propellant—which is fired through the exhaust nozzle.

Figure 7 shows a conceptual design for a closed-loop nuclear-MHD rocket. Not only does the propellant gain heat energy from the gaseous uranium, it also gets electrical energy from the MHD generator. Even more important, though, the MHD generator serves to cool down the fissioning gas to a



temperature low enough so that it can be fed through a heat exchanger. The plasma coming directly from the reactor would be too hot for any foreseeable heat exchanger. The MHD generator, then, takes electrical energy from the reactor plasma and cools the plasma down to the point where it can transfer heat to the propellant in a heat exchanger. When the propellant is heated to its maximum allowable temperature, electrical energy from the generator is added, increasing the propellant's exhaust velocity without increasing its temperature.

Thus the temperature and materials problems of the gas-core nuclear rocket can be circumvented—on paper, at least—by incorporating an MHD generator. This type of nuclear-MHD rocket could be capable of SATURN-like thrust and efficiency much better than any nuclear or chemical rocket now on the drawing boards. The gas core, nuclear-MHD rocket may someday be the heavy-duty workhorse of our interplanetary transportation system.

An interesting sidelight on the development of MHD power generation involves the magnetic field coil.

When MHD generators first became the subject of serious study, late in the 1950s, it was quickly deduced that the system would need high magnetic field strengths. Conventional copper magnets, it was learned, would consume a considerable fraction of the power produced by a MHD generater. You recall that for the Mark V self-excited generator, the copper magnet takes nearly half the gross power output of the generator. For larger, more closely-designed systems the magnet's power consumption would be proportionately less, but still formidable.

Relatively high power consumption by the magnet reduces the economic efficiency of the MHD system. In effect, fuel—and money—is being spent to maintain the magnetic field. And since economics will determine the ultimate success of the MHD generator as much as technical considerations, it was quickly decided to investigate meth-

Figure 7. A nuclear propulsion concept that employs a gas-core reactor and MHD generator. Gaseous uranium undergoes fission in the reactor, producing an extremely hot plasma. The MHD generator taps electrical power from the plasma. Then the plasma runs through a heat exchanger, and finally is pumped back to the reactor. Thus the uranium is constantly recycled without loss. The rocket propellant is heated to the maximum temperature possible in the heat exchanger, then receives additional energy (electrical) from output of MHD generator. Thus final exhaust velocity of propellant is higher than would be possible by heating alone. Such a rocket is capable of thrust levels and efficiencies higher than now attainable.

ods of reducing the power consumption of the magnet.

If you cool a copper magnet to very low temperatures, it consumes less power, while still producing the same magnetic field strength. The cooled copper has less electrical resistance; electrical power fed into the magnet is not dissipated as much.

Other materials, such as sodium, show even less electrical resistance when cooled to cryogenic—near absolute zero—temperatures. A cryogenic sodium magnet could produce the same magnetic field strength as a room-temperature copper magnet, but at a fraction of the power consumption—and cost. Of course, the cost of refrigerating the cryogenic magnet enters the picture. But this can be done rather inexpensively with liquid helium and nitrogen, and special insulated *dewar* containers. An operating cryogenic magnet would probably be completely packaged inside a dewar—or several dewars, nested inside each other.

Then, late in 1960, came one of those completely unexpected breakthroughs that make science-fiction writers envious of real life. Bell Telephone Laboratories announced a superconducting magnet—a cryogenic magnet that could operate at field strengths near 100,000 gauss *with no electrical dissipation at all.*

No dissipation means that superconducting magnets, once energized, no longer need any electrical power. They behave like permanent magnets. Their only operating cost is that of replacing vaporized liquid helium, used for refrigerating them.

The economics of MHD power generation look better than ever when a superconducting magnet replaces the copper coil.

The whys and wherefores of superconductivity are somewhat complex, and not really the subject of this article. Suffice to say that the exact physical cause for superconductivity is still being argued by the quantum and solid-state physicists. Meanwhile, the engineers have gone ahead and built operating superconducting magnets.

Superconducting coils are devilish little beasts, capable of spectacular performance and heartbreaking irregularities in about equal proportion. But it seems inevitable that these early vagaries and bugs will be worked out, and superconducting magnets will soon take their place in man's storehouse of technology.

There are many other uses for superconductors in addition to providing high-field-strength, zero-power-consumption magnets for MHD generators. But what is interesting to us, in this article, is that the great demand for efficient powerful magnets—both from MHD researchers and others—has brought about what promises to be an entirely new industry, based on superconductivity. And a final point in the matter. Cryogenic and super-

conducting magnets have both benefited greatly from the easy availability of cryogenic refrigerants, such as liquid helium and nitrogen. These liquefied gases have become available in useful quantities only in recent years, because of the tremendous demand for them in rocketry work. Score another one for the space race.

Now then, back to MHD.

Power generation is only one aspect of MHD research. True, it is the one area that promises the most immediate impact on everyday life. It is already being put to practical use. But let us look at some of the other MHD studies underway today.

An MHD generator taps electric power from a plasma that is rushing through a magnetic field. Now, if you take a quiescent plasma and apply perpendicularly-crossed magnetic and electric fields to it, you make the plasma move. (For the jargon-happy, this is called j x B acceleration.) Thus an MHD accelerator, such as the one being built for the LORHO wind tunnel, is sort of the reverse of an MHD generator. The generator converts a plasma's kinetic energy into electric power; the accelerator converts electromagnetic energy into kinetic energy.

Many different experimenters have worked on a wide variety of MHD propulsion devices. Figure 8 shows one of Avco-Everett's developments, called a Magnetic Annular Arc Accelerator. In essence, the accelerator uses an electric arc to heat and ionize the working gas. The newly-formed plasma is also accelerated by the arc to a certain velocity. By placing a magnetic field in the proper orientation to the moving plasma, MHD forces can be induced which will accelerate the plasma even more—without causing additional heating. Thus a very high exhaust velocity—and specific impulse*—can be attained without running into the problems caused by equally high temperatures.

MHD accelerators, when used for space propulsion, fall into the general category of electrical rockets. That is, they use electromagnetic energy to accelerate the propellant, rather than chemical or nuclear energy. As a group, electrical rockets are capable of very high specific impulses, or efficiency. But their actual thrust is quite low, since they are accelerating only small quantities of propellants. Therefore, electrical rockets cannot be used to boost a vehicle from Earth. Once in space, though, electrical rockets are considerably more efficient that chemical, even though they need longer flight times to build up great speed. (All this is definitely not true for the nuclear-MHD rocket discussed earlier, which

*Specific impulse can be thought of as the number of seconds during which a pound of propellant will give a pound of thrust.

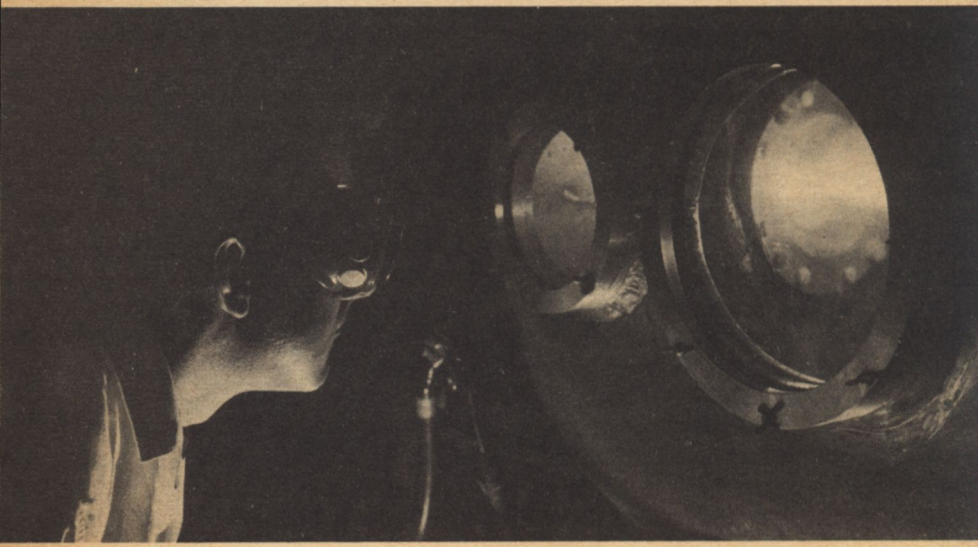
could give big thrusts as well as high specific impulse.)

Figure 9 shows a significant advantage of MHD accelerators over other electrical rockets. MHD rockets will be the most efficient of all electrical systems for flights between the Earth and Moon—from Earth-orbit to Moon-orbit. Ion rockets cannot perform efficiently at specific impulses much lower than 8,000 seconds. This means that their main advantage will be for the longer-range interplanetary missions.

While we're talking about space, we should consider the problem of shielding astronauts from the lethal doses of radiation that may come from solar flares or other sources. The dangerous radiation from a solar flare is mainly from very energetic protons. Several researchers have suggested that a magnetic field carried by a spacecraft could serve to protect it from these protons. This is essentially a problem in magnetohydrodynamics, and the chances are that interplanetary manned spacecraft will carry MHD radiation shields some day.

Actually, interplanetary space is filled with a very tenuous, fully ionized plasma, together with a weak magnetic field. This is truly the world of MHD. The Sun itself is a plasma, and the solar flares and sunspots are products of MHD inter-

Figure 8. Experimental operation of the Magnetic Annular Arc Accelerator, a low-thrust electrical rocket using MHD forces to accelerate propellant.



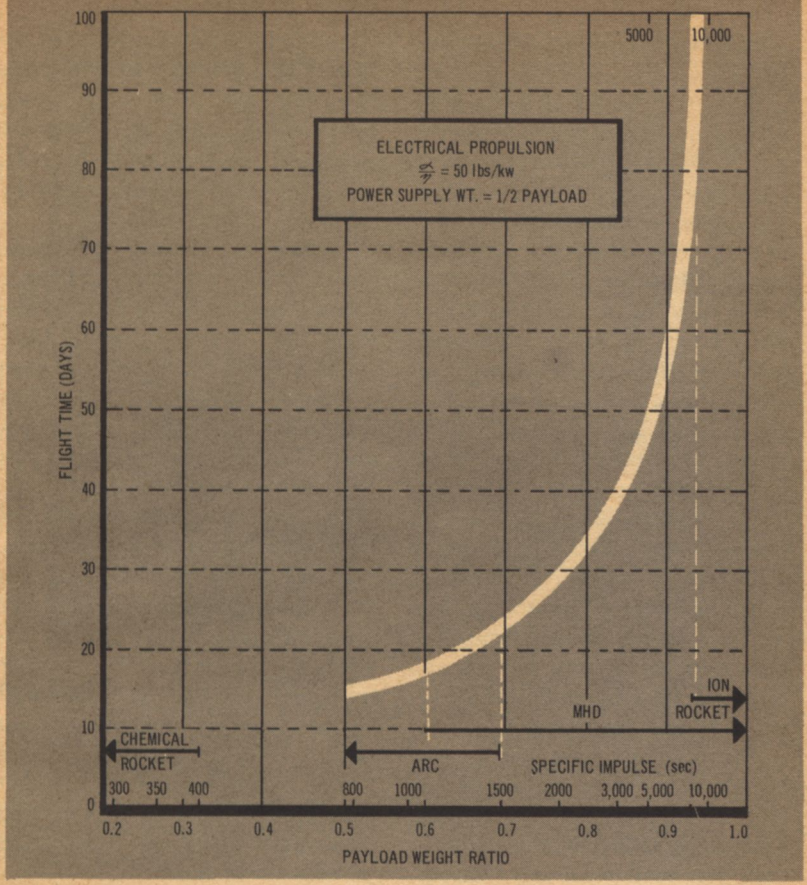


Figure 9. Comparison of several electric propulsions systems' efficiencies in placing a communications satellite into a "stationary" 24-hour orbit, starting from a circular 150-mile orbit. The electric power supply is included in the payload, since it is needed for the communications equipment. Specific impulses between 1500 and 5000 sec. offer the best combination of high payload ratio and short flight time. This condition exists for all missions between the Earth and Moon. Ion rockets do not become truly efficient until much higher specific impulses are reached; chemical rockets offer short flight times, but low payloads. α/η is a measure of the power supply's efficiency: in this case, the efficiency is assumed to be 50 pounds of weight for every kilowatt of power.

actions that are not yet fully understood.

It is very likely that among the first scientists in orbital laboratories will be plasma physicists, as well as astronomers. In fact, several astronomers, such as Thomas Gold of Cornell, are among the first-rank plasma physicists. As astronomers turn to physics to explain what they see, MHD is becoming increasingly important to astrophysics and cosmology. In an earlier article, "Origin of the Solar System" (July 1964), we spoke of how MHD forces are being invoked to unravel many problems that previously were unexplainable. This trend began with Hannes Alfven, of Sweden's Royal Institute of Technology, who was among the first to bring the knowledge of plasma physics and MHD to bear on problems of astronomy and cosmology.

Sunspots and solar flares cause trouble not only to astronauts, but to communications engineers. Long-range radio communication—even transcontinental and transoceanic cable links—are often disrupted when the effects of a particularly violent flare hit the Earth's magnetic field. And the solar wind, that constant outpouring of plasma from the Sun, constantly bathes the Earth's magnetosphere. As Figure 10 shows, the Earth is surrounded with a "magnetic bumper" that protects us from the full brunt of the solar wind. An MHD shock wave forms upstream of our planet, and something like a wake trails out behind. The situation is something like that of a sphere in a wind tunnel; but the wind is a plasma, the sphere is surrounded by a magnetic field, and the shock wave is caused by MHD, not aerodynamics.

Getting solidly back to Earth, there's another aspect of MHD that can and eventually will dwarf everything else: nuclear fusion. Controlled nuclear fusion will give man a limitless supply of power; its achievement will mark the beginning of a new era of history, the end of man's childhood.

The only controlled fusion devices man knows of are the stars, such as our Sun. Within a star, the tremendous pressure and density of some 10^{27} tons of sheer matter envelop the fusion reaction, feed it fresh fuel, and keep it "contained" at the necessary temperature and density to make it work.

The fusion reaction in the Sun converts hydrogen to helium, and incidentally yields the energy that permits us to live.

To build a thermonuclear reactor, man must simulate the conditions within a star's core. Obviously, we cannot use sheer matter to contain the fusion reaction. Nor can we use anything solid, since the reaction takes place at temperatures well above 10,000,000°K. The only alternative is to try to use magnetic fields, electromagnetic forces, to force the hydrogen into fusion and contain the reaction so that it can

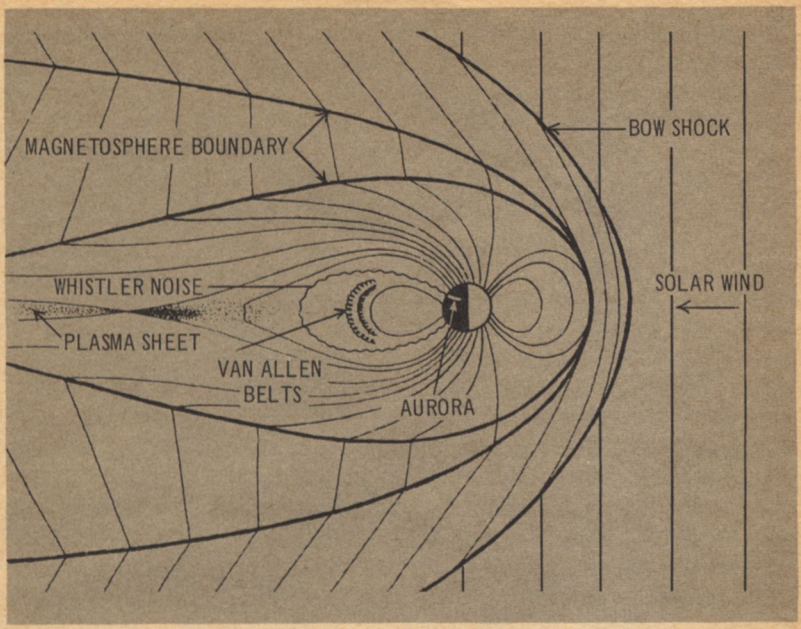


Figure 10. The plasma-filled environs of Earth. Interplanetary space is filled with a tenuous plasma that is pervaded by a weak magnetic field (thin lines in drawing). Solar wind is a plasma stream ejected constantly by the sun. Earth, surrounded by its own magnetic field, disturbs the flow of solar wind, causes an MHD "bow shock" and other complex effects. Note how interplanetary magnetic field and Earth's magnetosphere are bent and intermingle.

become self-sustaining. This is the ultimate aspect of MHD: the interaction of magnetic fields stronger than any man has yet produced, with a hydrogen plasma of millions of degrees temperature, to produce a sustained thermonuclear fusion reaction.

Man's entire history can be read as the gradual conquest of new sources of energy. Civilization has been the result of man's learning to tame and use energy sources of constantly-higher temperature. Man has learned to exploit the energy in liquids, solids and gases. Now he is beginning to tap the energies of plasmas. MHD is helping to unlock the treasures stored in this fourth state of matter. Plasma physics and magnetohydrodynamics will be the backbone of man's newest technology. And that technology is being built today. ■

The Captive Djinn

The difference between "magic" and "science" is strictly in the mind of the beholder—and in his knowledge.

CHRISTOPHER ANVIL

Illustrated by John Schoenherr

Guard Captain Skeerig Klith looked up as Senior Guard Lieutenant Ladigan Grul came in looking smug.

"Sir," said Grul, holding out a sheaf of papers, "the combat crews just dragged in an outworlder." Grul smiled, baring canine teeth an inch-and-a-half long.

Klith reached out for the report, and in his excitement ran his claws completely through the papers.

"It seems too good to be true," he said, flattening the report on his desk. "The cowardly vermin always use their magic powers to get away."

"This one slipped up somewhere. And with due respect, sir, it isn't *magic*. The best opinion is that all

they've got is a more advanced science than ours."

"When it gets that advanced, what's the difference?"

"Sir," protested Grul, "no matter *how* advanced it gets, Science is not sorcery."

Klith snorted. "These outlanders came down out of the sky. They go through the air at 16,500 laps to the sneeze. If they want something, they aim a rod at it and it comes. To get rid of it, they point a rod at it and it goes. We've seen them control their machines by *voice*. That's not sorcery?"

"By a perfectly natural process of scientific development, one step at a time—"

"Maybe wizards *get* their powers by a natural process of development, one step at a time. Anyway, what's the difference to me? If you don't understand something, it's magic, right?"

"Sir, in that case, basically everything is magic."

"Exactly," said Klith, "and in *that* case, as I said, what they use is *magic*. Now where's the prisoner?"

Grul opened his mouth, then

shut it. In a choked voice, he said, "The prisoner is in the Central Cell Block, New Tier, sir."

"Hm-m-m." Klith glanced through the report. "The vermin was captured at the foot of Mount Daggeredge. His vehicle had apparently malfunctioned, and was taken to the District Technological Laboratory for study." Klith looked up. "I suppose you know, Grul, that our offensive to smash the main nest of these clawless cowardly outworlders has run into a little embarrassment?"

Grul's ears swiveled around. "No, sir. All I know is that our bombardment is so intense it can be heard a hundred and twenty laps away."

"Unfortunately, it makes just as much noise when you miss as when you hit."

"But their base is in clear sight."

"And there's something like thick, elastic, invisible armor-glass between our artillery and their base."

Grul shook his head in disgust. "There's always something."

"This prisoner may be very useful to us."

"You mean, we can question him about the barrier?"

"Exactly. In fact, we can question him about *all* their arrangements. Possibly we can find out why they're really here. That business about the goroniuk mine is obviously a cover-up."

Grul nodded. "Who would want such worthless stuff? Merely to be around that goroniuk makes a man sick, and his fur falls out in patches. Shall I bring the outworlder up now?"

"Play zango with him for a while. It will put him in a co-operative frame of mind, and if Higher Headquarters should send for him, he is unhurt."

Grul grinned and displayed his canines. Zango was played with a dozen pieces on each side. All the men moved by jumping, and all the jumps were long.

Hedding was sitting in the cell sourly eying the furnishings. The cot was so short and wide he could only rest on it curled up. Beside the cot was a scratched-up post, obviously convenient for sharpening one's claws. In the corner was a box of sand. In the back wall of the cell was a neat round hole six inches across, covered by a small iron door. The function of this was a mystery to Hedding. For food, he'd received a small piece of some kind of ground-up fish and cheese, called *sznivtig,* with a powerful odor. He'd also been handed a bowl of water. Hedding drank the water, looked the food over closely, and buried it in the sand. He lay back on the cot with his feet hanging over the edge, and noticed the small dull bulb in the ceiling. The metallic deposit on the inside of the bulb suggested the stage of the planet's science. It occurred to Hedding that there ought to be

some kind of opportunity there. But what?

Just then, there was a rattle at the door.

A creature with large round pupils twitched its whiskers and pointed a gun at him. The gun had a bayonet that curved down at the end, like a claw.

Hedding, despite his conditioning, could barely understand the grating voice:

"Did you eat?"

"Not yet. I wasn't hungry."

"You had good luck, then?"

Hedding squinted around the cell. "Good luck? Not that *I* know of."

The jailer looked blank, then shrugged. "Bring your *sznivtig* and follow me."

"Where to?"

"Cell block 'C.' Get your claws out of the mat, and let's go."

Hedding followed the jailer through half-a-mile of dim corridors, and wound up inside an identical cell with exactly the same fittings. Fifteen minutes later, there was a rattle at the door and a new voice:

"You in there! Follow me!"

Grumbling to himself, Hedding followed the guard down a winding staircase for ten minutes, and found himself inside an identical cell fitted in exactly the same way. Twenty minutes later, there was a rattle at the door.

"Prisoner! *Attention!* Follow me!"

"What's wrong with this cell, for Pete's sake?"

"Silence! You will not question! *You will obey!"*

Cursing to himself, Hedding trailed off after the guard, tramped for twenty minutes along corridors lit with dim bulbs, then went around and around and around and around up a circular staircase, along another corridor and into a new cell, where the door clanged shut behind him, and fifteen minutes later a fresh voice spoke jovially:

"Prisoner. Ears up! We are taking you to a new cell. Get your *sznivtig* and follow me!"

Guard Captain Skeerig Klith shoved the message across the desk to Senior Lieutenant Grul, who read aloud, "Imperative prisoner be interrogated by scientific methods. Dismemberment, red-hot irons, hauling over the walls, and similar methods that impair clarity of mind are contraindicated. Only preliminary questioning is permissible pending my imminent arrival. Queel Snnorriz, Staff Psychologist."

"That boob," said Klith. "Obviously, he's going to baby the outworlder. You remember when they put the cretin in charge of that gang of hardcase prisoners? He was going to 'unlatch the bound memories that caused their amoral and antisocial behavior'."

"Who could forget it?" said Grul. "The prisoners made Central into a fortress, had this grass-eater Snnor-

riz hung up by his tail, and threatened to slice the guards up an inch at a time if they didn't get their way."

Klith nodded gloomily. "And then, when the Iron Division went in and straightened the mess out, the boob complained that his *therapy* had been interrupted."

"They should have accidentally finished him off in the fight."

Klith shrugged. "There's no getting around the fact that he's the Emperor's cousin, and also way up in the Scholastic Hierarchate."

"Regarding which," said Grul, "I say, get them all together in one place, and set off a good strong—"

"*Sh-h,*" said Klith, glancing around nervously. "None of that." He cleared his throat, dropped off the bench, and exercised his claws on the nearby sharpening post. "Our immediate problem is this prisoner. How's he coming along?"

Grul's lips stretched in a grin. "He was patient the first four or five . . . ah . . . moves in the game. But then he disarmed a guard, got laid out by the guard's mate, and is now trailing around in a bad frame of mind."

Klith nodded. "Except for that fight—which he started himself—none of it will leave any marks. Run him on down to the bottom floor of the Old Tier. Let him get a look at where we can put him if we feel like it. I'm going to take a nap. After I wake up, I'll want to have him up here."

Hedding, feeling of the bump on his head, followed the dim figure down the faintly-echoing corridor past the rows of silent cells. He cleared his throat, and tried to remember if this guard was friendly. There had been so many guards, and so many cells, that they were starting to run together in his mind.

"Say," he said, "are these cells occupied?" An echo bounced back from somewhere, then another, fainter, echo.

"*Arnh*?" said the guard.

Hedding waited till the echoes died down, and repeated the question.

The guard grunted. "Oh, most cells in this block are empty. Watch your head. We're going down lower."

They started down a spiral staircase, going around and around and around and around, and they went down so far into the gloom that Hedding began to suffer from the illusion that the staircase was circling upward under his feet and all he was doing was to move his legs and stay in the same place.

The guard coughed apologetically.

"No need to put your *sznivtig* out down here. They'll come right out after *you.*"

Hedding, traveling around and around in a daze, said stupidly, "They will?"

"Sure as death and demerits," said the guard. "See you don't go to sleep. Pick off a few now and then,

snap their necks, and toss them into the pack. Keep them busy. If it gets too thick in there, climb up the clawpost and take a breather. Be sure you get your tail up. These things can jump."

A little of this seeped through into Hedding's consciousness. He came awake, aware of the gritty rust underfoot, and the change in the occasional lighting fixtures. Down here, they had gas lamps, with wavering luminous flames.

Suddenly, there was a scuttling noise, the guard bent over, there was a squeak, a *snap,* a *thud,* and a multitudinous scurrying sound.

"Just a few levels more," said the guard.

By now, cold dew was dripping from the steps overhead, the air was dank, and the lights showed dark walls trickling moisture.

"Careful," said the guard, "watch this next step."

Hedding edged down warily. From up above came a thump. Behind them, the guard's mate was following, just in case Hedding should try anything.

The guard in front said, "Inside this tier of cells—what we call the Old Tier—the lights are gaslights. Watch your footing."

They stepped off the staircase with a splash. Directly in their path, a black hairy thing the size of a man's hand slid up on a thread.

The guard ducked aside, and led the way to a cell with water on the floor, a dead thing covered with orange mold in the water, a bare squarish cot with toadstools growing out of the wood, and the post leaning against the rear wall. Here and there in the dimness, eyes glowed. A cold dank draft smelling like garlic blew in the direction from which they'd come, and made the overhead gas flames waver, so that long shadows flickered over walls and floor.

Hedding looked around incredulously.

The guard scratched at a metal plate affixed to the bars, and glanced at a slip of paper. "It's the right cell, all right. But that's the worst mess I've seen since Snnorriz took over Central Prison."

The second guard was now standing just inside the corridor. "Stick him in, and let's get out of here."

"Look at those stobclers with their eyes glittering in the light."

"What do you think I *am* looking at."

"If we leave him here, what'll be left when we get back?"

"That's *his* lookout, not ours. We got our orders: Put him in Cell 6t42e, Old Tier. There's Cell 6t42e, Old Tier. Orders are orders."

The first guard frowned, and reluctantly shoved a large key in the lock. He turned it, to the squeal of rusty metal.

Hedding was now fully awake. A quick glance at the guards showed that he could only hope to overcome one, and would have to fight the other at a disadvantage, since

their weapons were long knives and he was unfamiliar with them. Victory would leave him inside a labyrinthine prison, where he could be recognized on sight. Escape didn't seem in the cards, but maybe talk would help.

"Sure as death and demerits," he said reasonably, "they're going to want to question me later."

The second guard had a knife out, and was looking around nervously.

"That's not *our* worry."

"No?" said Hedding. "If they want to question me and can't, who will they pin the blame on?"

There was a thoughtful quiet, in which could be heard the scratchings of many small claws.

Guard number one looked at number two. "What then?"

"We got our orders."

"To lock him up, not execute him."

"If we *don't* we're disobeying orders to lock him up."

Hedding said, "One of you stay here. The other go up and tell them."

"Regulations say we stick together. Otherwise, you might overpower one of us, get the short-sword and uniform, and get out."

"I'm an outworlder. I could never get past the guards."

"It wouldn't matter if you were a sixteen-legged crab with eyestalks. It's what regulations say, and you don't argue with regulations."

"Regulations must say something about putting prisoners in cells unfit for occupancy, and killing prisoners wanted for interrogation."

The first guard swore. He shoved Hedding into the cell, clicked the lock, and turned to the second guard. "Go out and start up the steps."

As soon as the second guard was out, the first grunted, "Ah, these stobclers are all *over* the place! I better kill a few to keep the rest busy." He whipped out his long knife, slashed here and there, then shouted, "There it goes! *Run for it! Here come millions of them!*"

As a matter of fact, the glowing eyes were at almost the same distance as before, though in continually increasing numbers. The knife, however, now lay inside Hedding's cell.

The guard shot out the door. The clatter on the staircase told Hedding the other guard needed no urging.

Gratefully, he picked up the knife and looked around.

Slithering wetly over each other, the things began to move in on him.

Guard Captain Skeerig Klith kept his hands flat on the desk, and sought to keep his claws from biting into the wood.

"Yes," he growled. "The prisoner is roughly our size, and has the same general build."

Senior Guard Lieutenant Grul added, "His fingers are longer and thinner, Learned Sir, and without

retractile claws. But he seems to handle things well just the same."

"I see." Their guest sprawled on the bench, hind paws thrust over the edge, holding in one forepaw a fume-generator stuck on the end of a large silver pin. This fume-generator was a black, waxy-coated cylinder, about as long and thick as a man's first finger. Wound around the outside were spiral strips of decorative silver and gold fabric, which burnt up slowly as the generator was consumed, and added their own peculiar fragrance to the general smudge.

Guard Captain Klith edged his bench back from the desk, and glanced around at the windows. They were open, but there wasn't the slightest suggestion of a breeze.

Klith cleared his throat.

"If you'd prefer to enjoy your generator outside by the parapet, Psychologist Snnorriz, we'd be glad to continue this later on."

Snnorriz didn't answer at once. Instead, he applied his pursed lips to the near end of the fume generator. A look of exquisite refinement appeared on his face as the far end glowed red, and silver and gold strips burned away in clouds of gray smoke.

Klith glanced around desperately. The room had a ventilator chimney, left over from the days when it, like the cells, was lit by acetylene, and the fumes had to be drawn up and out. But the ventilator got most of its draft from a jet of flame burning in the chimney. And this flame had to be lit. Klith groped under the desk till one extended foot found the dusty push-pedal that, assuming it was in working order, would ignite the ventilator flame.

The psychologist, meanwhile, with a look of ineffable wisdom, slowly exhaled a boiling gray-green cloud at the guard captain.

Klith shoved down hard on the pedal. There should be a little *pop* followed by a faint roar. Nothing happened. The valve might be stuck, or, worse yet, the valve could have opened, but the worn flint might have failed to strike the scratch-plate. He shoved again harder.

There was a flash.

BANG!

The room jumped. A cloud of dust particles intermingled with chips of stone and bits of mortar showered down, followed by a flaming nest the size of a man's two fists, and filled with odd bits of tin, old rings, and shiny coins, from which a small purple bird flew screaming out the nearest window. By a stroke of supreme good fortune, the burning nest and its load of trash landed on the psychologist's head.

In the chaos of the next few minutes, with Snnorriz bounding around the room like a madman, it was a simple job for Klith to get rid of the fume-generator, pin and all.

As he was congratulating him-

self, a guard corporal appeared in the doorway, regarded the screaming Snnorriz with amazement, then faced Klith and saluted.

"Sir, we've got a couple of guards out in the anteroom. According to them, that outworld sorcerer is down in the Old Tier getting eat up by hordes of stobclers. You want I should give 'em what-for for bothering you about it?"

Snnorriz hit the floor and screamed, "You *barbarians!* You prehistoric *reptiles!* You'll get that prisoner up here unhurt, or *my cousin the Emperor will hear of it!*"

Hedding by now was up sidewise on the bars, resting on the crosspiece of the heavy doorframe, his left arm and both legs hooked through the vertical bars, his right arm reaching down with the long knife as he picked off enough of the vermin to keep the rest happy.

Somewhere outside, he knew, the expedition would have automatic monitoring devices hunting for him. A tiny transmitter inside his bodycavity was giving off a faint signal that should be detected sooner or later. The trouble was that even after they found him, they had to *reach* him. If he could get outside, his chances of being spotted and picked up would be much better.

Just then, out in the stairwell, the shouted warnings and clank of metal told of the cautious descent of a sizable body of guards.

"Back there!" shouted a familiar voice. "You four in the rear, hold the entrance. In the lead, there! Shove past the sixth cell in the tenth row, kill as many of these vermin as you can reach, and pitch them down the corridor. Keep moving!"

The clank, splash, and jangle drew closer. Then, peering down the corridor, Hedding saw the feline guards in the wavering glare of the gaslights. His urge to escape took on urgency as he saw one of the guards pause to eat a large stobcler. Those holes in the cell walls were beginning to add up for Hedding.

"All right," shouted the familiar voice, "step out down that corridor!"

There was a rattle of keys, and the creak of the cell door.

"Now, where in—"

Hedding dropped to the floor. His cramped muscles nearly gave way, as he whispered, "Thanks for your knife," and handed it back.

The guard gave a quick glance around. "What a place," he muttered, and stepped forward to clang a small rusty door shut over a hole where several pairs of beady eyes were gleaming. "Agh! It's enough to spoil a man's appetite. So many at once make one's hide quiver. In the corridor there! Back toward the stairs. *Move!*" He guided Hedding out of the cell by the arm, and locked the door. "All right, mates, we've got the prisoner, and we may get out of this without a demerit. But nobody better panic on those

steps, or I'll turn him in myself! Let's go!"

Hedding looked overhead curiously.

"What do you use in those gas lamps. What kind of gas is that?"

"Glow-gas," said the guard. "They ship in drums of gasrock, and the engineers sink the stuff in big water tanks. When water hits the gasrock, it boils off glow-gas. They used to light the whole prison that way. You there, up ahead! Are you stuck to the steps? *Move!*"

The procession wound up toward the top floor.

There, in the guard captain's office, Queel Snnorriz flared up again.

"The Empress, herself, gave me that platinum pin. She's going to be *distressed* if I show up without it. Of course, I *can* tell her the circum—"

Guard Lieutenant Grul said earnestly, "When you jumped up, Learned Sir, it seems to me the generator and pin went out the window together."

Guard Captain Klith was relievedly breathing fresh air again, but Snnorriz's hints and threats about the Imperial Court were starting to get on his nerves.

The psychologist cleared his throat. "I was in the Throne Room the other day, when His Imperial Majesty was accepting the Semi-Annual Efficiency Lists from the Heads of Service. The Emperor put his thumb by one of the names and said, 'What do you think of this fellow?' I turned to him, and—"

A guard corporal stepped in, cast a fishy look at the psychologist, and saluted Klith. "Sir, they've got that outworlder out here."

"The Crown Prince," Snnorriz was saying, "admired that pin—"

Klith, normally a patriotic man, had never felt more like an anarchist. Angrily, he jumped to his feet, looked out the window, and pointed.

"Lying on the parapet there, one floor down is your precious pin. I'll just send a guard down to—" Klith blinked.

The pin, its faceted silvery head glittering, was obscured by a small purplish blur. A triumphant squawk sounded and the parapet was bare.

"Where is it?" shouted Snnorriz, at Klith's elbow. "You said—"

"A pack-bird just flew away with it. Can I help that?"

"Do you expect me to believe—"

In the background, Senior Lieutenant Grul could be heard speaking urgently to the corporal. "Get him in here, quick!"

Klith and Snnorriz were now shouting at each other.

"Sirs!" said the corporal, in a voice suited to an outdoor amphitheater, *"here is the ALIEN SORCERER, under guard!"*

Snnorriz and Klith turned as if on pivots.

Hedding was trying to deduce what was going on when the guards suddenly shoved him forward.

"The ALIEN SORCERER," roared a voice, *"under guard!"*

Hedding stared at a tough-looking feline in leather tunic, accompanied by an overbred dandy in scorched black velvet and white ruff, a slender dagger with jeweled hilt at his side, his whiskers upcurled at the ends, and a faint wisp of smoke drifting up from the fur just over his right ear.

Hedding glanced around the many-windowed room, looked up at a faint roar emanating from the ceiling, and was about to speak when a droning noise passed overhead. Hedding would have given a good deal to get to the window, but a guard had him by either arm.

The tough-looking feline glanced at the window. "What's that noise?"

A guard presented himself at the door. "The skywatch lookout just yelled down the voice-tube, sir. There's one of the outworlders' flying machines making slow circles high overhead."

Hedding congratulated himself that he'd been located so quickly. But the device couldn't come in and get him. He had to show himself.

The feline in leather tunic said, "Tell the lookout to let us know if it comes lower. You see, gentlemen, the outworlders are searching for this one here. The fact that they're just circling overhead shows they don't know exactly where he is. We want to keep it that way."

"That should be easy, sir," said a second feline in leather, with different insignia. "The fellow has no tools, equipment, or weapons. He doesn't even have claws, sir."

"Remember. He is a *sorcerer.*"

This time, it was the feline in velvet who spoke, after delivering himself of a condescending laugh. "You of the military may, of course, use such inaccurate terminology if it suits your natures. We of the Priestly Hierarchate of Scientific Wisdom speak more accurately." The thickening of the atmosphere following this little speech seemed to be lost on the speaker, who went on, "All that these outworlders have is merely our own knowledge, carried a bit further. They've just refined it some more. 'Sorcerer.' There is no such thing as a 'sorcerer'! Why, I wager you that this fellow here, common as he looks, would fit right into one of our own Lesser Guilds. Come, fellow, to which Great Branch of the Mother Tree do you cling—Matter, Energy, Body or Mind? Speak up, now."

Hedding decided a mining engineer was closer to matter than to the other three, and said obediently, "Matter, sir."

"And what might be your specialty?"

"Goroniuk mining."

The feline in velvet looked indulgent, "So you say. But what would anyone want goroniuk for?"

High overhead, there was a rumble. If Hedding could attract attention, the controller at his distant board would bring that spotter

down. Each spotter had a roomy passenger compartment, and carried food, water, and weapons.

But first he had to get its attention.

The tough-looking feline in leather tunic pulled out a length of strap with steel studs on one end.

"You are being questioned, Prisoner. The question was, 'What would anyone want goroniuk for?"

"Tush," said the feline in velvet. "Spare me this crudity. I have come prepared to handle this my way."

"You don't get anywhere by coddling prisoners. Raise a few welts, and they'll listen closer the next time you speak."

"Nonsense. That way you consolidate their opposition, or drive it underground. *My* method raises the submerged resistances to the surface where we can deal with them psychologically." He glanced at Hedding. "Which method seems more scientific to *you?"*

"Yours, unquestionably."

The feline in leather snorted contemptuously.

The feline in velvet turned to Hedding, a brotherly smile displaying his teeth to great advantage.

"Come with me, fellow. Regard me as your friend."

Guard Captain Skeerig Klith spent the next hour in a state of profound boredom. As he worked at his desk, he could hear Snnorriz carrying out his interrogation in an adjoining room. It was unlike any interrogation Klith had ever carried out. Instead of snappy questions and answers, with occasional screams from the prisoner, there was comradely laughter, and endless conversation. In short, Snnorriz was a good deal more friendly with the prisoner than he was with Klith. At one point, when Lieutenant Grul was with him, Klith commented on a peal of laughter from the other room:

"Listen to that. The fop is happier with an outworld alien than he is with us."

Grul grunted agreement, and glanced back through the doorway. "Now they're taking turns smoking through a *chomizar."*

Klith took a look. Sure enough, there was the bubbling glass pot, with its forty feet of flexible tubing lying in coils all over the place. The psychologist smoked through one mouthpiece as the outworlder admired the workmanship of another.

Klith growled, "It's enough to make a man sick. I will admit, though, that he's getting some information."

The outworlder's voice was saying, "Yes, the air on this planet *is* close to that on our home planet. There the composition is roughly twenty per cent oxygen, seventy per cent nitrogen, two per cent ammonia, and the rest carbon dioxide, water vapor, and inert gases."

"Interesting," said a strange voice, "we don't have any free ammonia. I wonder why—"

Grul squinted. "Who's that?"

Klith peered in, and saw a slender individual with discolored fur, and a badly singed ear, wearing a black robe covered with white planets, stars, and comets, with a silver chain around his neck from which dangled a gold distilling flask.

Klith growled. "It's some chemist. He looks high up in the Hierarchate."

The outworlder was saying, "It rises from volcanic fissures. I don't know why. I'm only a practical mining engineer, myself."

"Nevertheless," came the chemist's voice, "your testimony can be interesting to us. We, for instance, suffer tissue injury from a trace of ammonia."

"Strange," said the outworlder. "On this planet, we carry bottles of it around with us to sniff every now and then. The absence of it makes our mucous membranes dry up. Unfortunately, I got separated from mine when I was captured."

A droning noise passed overhead.

"That damned thing," said Klith.

"Sir," said a voice from the outer door, "the sky-watch reports the flying-machine circling overhead again."

"I hear it," said Klith shortly.

The chemist's voice drifted in. ". . . Glad to get you a bottle to carry around with you. I'll send for it now."

Klith shot off his bench, cursing.

"Listen, you," he snapped. "No bottles of ammonia are to be carried around by that outworlder. He could blind the lot of us with it, jump outside, and before we knew what was going on work some wizardry that would call down that flying machine!"

Snnorriz stood up angrily. "I'm sure such a thing would never occur to a *scientist*. Now you've mentioned it, of course—"

"But," cried the outworlder pathetically, "I'll dry up! We can't *exist* without ammonia!"

"Too bad," snarled Klith.

"This," said Snnorriz, his tail lashing, "is *inhuman*, an example of the military psychology that—"

"Oh," said Klith, sliding out his claws, "is that so?"

A colossal uproar took place, in the course of which it somehow came to be agreed that the alien could have a bottle of ammonia by his bed at *night*, but must surrender it each morning to the guard.

Klith returned, fur on end, to his bench, then got up and tore a section of the clawpost to splinters. Grul discreetly eased out the door. From the other room came the alien's voice:

". . . Can understand just what you're up against, dealing with a military mind like that. They're all so *suspicious*. But I must say, you've shown great foresight in combining the priesthood and the scientific community into one solid hierarchate—"

Klith leaned forward, gripping the desk with his claws.

The conversation, however, now drifted off down an obscure technical sidetrack, and Klith, bored, went back to work. Then Grul came in, looking serious.

"Sir, word just came from the District Technological Laboratory. They started to disassemble the outlander's flying machine—"

"*Started*? What happened?"

"The whole thing disintegrated into a pile of black dust."

Klith could feel his fur bristle.

"Oh," he growled sarcastically, "*they're* not sorcerers! All *they've* got is science, only a little bit more advanced! Double the guard outside the doors here. Bring up A Section of the Riot Platoon, and see that they're always in reach when that outlander is here. And when he's down below, keep them on the floor above him. Between him and us."

"Yes, sir. But he's completely disarmed, sir."

"How do you disarm a sorcerer? He's still got his knowledge, hasn't he? Do as I say!"

"Yes, sir."

From the other room came Snnorriz's proud voice ". . . *That* was devised in the early days of the Hierarchate. The runs are *built-in*, so the stobclers have easy access past each cell. The runs intercommunicate, so the prey soon catch the scent of the *sznivtig*. But of course, it's highly problematical just when a stobcler will pop out of any particular hole. This keeps the prisoners on edge, constantly crouched at the holes, waiting. That way, they don't have time to make trouble."

"An ingenious system," said the outworlder admiringly. "The . . . er . . . stobclers in *our* prisons are let in on a highly unsystematic basis."

"You see, in some things we are ahead of you! How do you like our stobclers? Are they congenial to your palate?"

The outworlder hesitated, possibly reluctant to give offense. "At first, the flavor seemed a trifle . . . ah . . . 'off' to us, but by adding plenty of 'lunar caustic' as seasoning—"

" 'Lunar caustic'?" Snnorriz sounded puzzled. "We may know it under some other name."

The chemist said, "How is it composed?"

"Three atoms of oxygen to one of nitrogen, and this combined with one atom of silver. I hope I've got your names for the elements right."

"Oh, yes. Let's see— *Angh!* What you are talking about is what we call 'burning chellery.' Now are you quite sure—"

"I'm almost certain—"

"We will get you some—"

As Klith erupted into the doorway, Snnorriz burst out, "All *right!* Only in his *cell!* You don't want him to *starve*, do you?"

After a violent exchange with Snnorriz, Klith got the prisoner to

promise on his word of honor not to throw ammonia or burning chellery in anyone's face, and to put the containers outside his cell in the morning. The prisoner then embarrassedly said that he had a favor to ask.

"*Now* what?" snarled Klith.

"My . . . er . . . claws . . . aren't very efficient for catching these stobclers—"

"You catch them at home, don't you? I mean, them or something similar?"

"But the thing is, *these* are so *fast!* Generally, we use some artificial means—"

"You want a *knife?* Nothing doing! We'll put you in the Old Tier where they're thicker—" Klith waved a hand to silence Snnorriz. "Not on the bottom floor. Higher up."

This satisfied everybody, and, cursing to himself, Klith went out to meet Grul coming into the office.

"The extra guards are outside, sir. A section of the Riot Platoon is on its way."

"Good." Klith spat out an angry epithet. "*Listen* to them in there! They're practically crawling into each other's pockets."

The friendly voices drifted out from the other room.

"Since you like the *chomizar* so much," said Snnorriz, "you can take it to your cell with you. It's soothing to smoke while you crouch at the stobcler hole. We Hierarchates, of course, aren't restricted to any such time-consuming method of feeding. But a little primitivism is healthy now and then."

The outworlder's voice rose in gratitude. "You are so considerate! Is there anything *I* can do for you?"

Snnorriz purred, "We *would* be interested, for purely . . . ah . . . industrial reasons . . . to have a few questions answered about that . . . ah . . . flexible force-screen you have outside your main base. If you could—"

"I'd be glad to tell you what I—" the outlander made a choking noise. "Excuse me. My tissues are suffering from lack of ammonia. Perhaps if you could prepare a list of questions . . . After I"—he choked again—"after a good rest, and a tasty stobcler seasoned with plenty of burning chellery—"

"Certainly," purred Snnorriz. "We understand exactly. We'll have the list ready for you in the morning."

The prisoner was led, proclaiming his gratitude, out into the corridor. Snnorriz appeared at Klith's door, tweaking his whiskers and looking superior. "Psychology, my boy. Just make them grateful to you."

"Listen," said Klith, ignoring Snnorriz, and taking the chemist by his robe. "Is there anything this outworlder can make out of a *chomiz*ar, a bottle of ammonia, and this burning chellery, or whatever it is?"

"Nothing whatever," snapped the scientist, glaring at Klith's hand on his arm.

Klith and Grul suddenly found themselves alone.

"Well," said Grul, "it *seems* to be working out all right."

Klith jabbed a pedal under his desk to shut off the ventilator. "If only it doesn't turn out like that time Snnorriz took over Central Prison."

Hedding was delighted to see that Snnorriz himself caught up with the guards and accompanied him to the cell in the echoing Old Tier.

"How's this one, Hedding, my boy?"

"Could I have one closer to a lamp? My night vision—"

"Certainly. How's this?" The gas lamp sent out twin plumes directly outside the cell door.

"Fine. Thank you, very much."

Snnorriz beamed, then waited solicitously till a water bowl, the *chomizar,* a good supply of burning chellery, and a large tightly-stoppered bottle of ammonia arrived. He opened the iron cover over the stobcler hole, and superintended the placing of the *sznivtig,* to give Hedding a good spring at the stobcler. Snnorriz and Hedding then clasped forepaws emotionally. Hedding coughed a few times as the cell door clanged shut, drew a deep breath, and removed the stopper from the ammonia bottle.

"Ah-h-" he murmured.

Snnorriz and the guards gagged and shot down the corridor.

Hedding hastily restoppered the bottle, looked around, and eyed the *chomizar* with its lengths of flexible hose. He picked up the amber bottle of "burning chellery" and thoughtfully unscrewed the lid.

Klith awoke after a fitful night's sleep, exercised, washed, brushed himself, ate breakfast, and walked down the hall to his office. He was scarcely inside when Grul showed up.

"What's wrong?" said Klith.

"Snnorriz's pet," said Grul, "was found replacing a fitting to the right-hand lamp-jet near his cell. He had a little rubber plug made from the *chomizar* head in place while he screwed on the first reducer to the jet."

"Plug? You mean he cut it from the *chomizar* stopper? What did he cut it *with?*"

"He broke off the end of one of the glass bar-handles and used that."

Klith could feel his fur tingle. "Why?"

"He claims the light bothered him."

"Get him up here. *Fast.*"

"He's on the way."

Klith took out his length of strap.

Hedding was marched in with a pair of curved bayonets hastening his steps.

Overhead, a droning sound traveled around patiently.

"Now," growled Klith, "you did *what?*"

"Cast a spell," said the outworlder, beaming. "And if the feet of *sznivtig*-seeking rats chance to cross the dried white powder made in the dark of the night by the light of a carbide lamp with a hose from a *chomizar* brewing glow-gas in spirits of ammoniacal moon silver then—"

A sudden jar shook the building.

There was a sound like a *chomizar* mouthpiece crushed underfoot and abruptly the room filled with ammoniacal vapors.

Hedding was out the window while they were still choking. He stood by the parapet and waved frantically.

The spotter dove, to hover nearby. Hedding jumped inside.

"How," said a voice from a small speaker, "did you work *that*? This place is built like a fortress."

"Don't talk. *Climb*. I got hold of the stuff to make a batch of silver acetylide—from ammoniacal silver nitrate the acetylene bubbled through it. You know how sensitive the dry stuff is. I piped some acetylene gas into closed runs, put the acetylide inside, and stuck in a kind of bait that brings rats in a hurry. Happily, I was away from there before a rat hit the acetylide."

"You made a big crack in their wall. They won't like you for it."

"Keep climbing. I don't think you appreciate this. Acetylene is great for lots of purposes. But here, they've got it *piped* into a big section of that building."

"So?"

"That explosion will crack some of the pipes."

"I still don't get it."

"A few of those lights should stay lit. And acetylene has an unusual property. Mixtures of anywhere from three to eighty per cent with air are explosive."

The spotter abruptly speeded up its climb.

Guard Captain Skeerig Klith crawled painfully out from the tangle of timbers, rocks, and hunks of plaster, and glared at the dazed Senior Lieutenant Ladigan Grul.

The emergency-aid workers were putting Grul's splinted left forearm into a sling. Here and there were others, plentifully covered with patches of shaved fur and bandages.

Klith eyed Grul balefully.

Grul sensed the stare.

"Sir?" croaked Grul.

Klith snarled, "Take a look at this mess and say it again."

"Say what, sir?"

" 'No matter how advanced, *science isn't sorcery*'."

Grul opened his mouth.

But he couldn't get the words out. ■

The Prophet of Dune

Conclusion.
It was inevitable
that the clash between
the Harkonnen power—
backed by the
Emperor's legendary
and dreaded
Sardaukar troops—
and the Fremen of Dune
would come.
The Prophet's problem
was to keep the
planetary war from
spreading to
ten thousand worlds!

FRANK HERBERT
Illustrated by John Schoenherr

Synopsis

It is now the third year since the Harkonnen-Sardaukar forces swooped on the desert planet of Arrakis with slaughter and treachery and stole that spice-rich prize from House Atreides.

Paul-Muad'Dib, once Paul Atreides and heir to the Ducal fief, still is a fugitive with his mother, Lady Jessica, among the wild Fremen who shelter them from their Harkonnen enemies. In payment for sanctuary, Paul-Muad'Dib and his mother have trained the Fremen into a fighting force of terrifying power. The total impact of that power is being held in check, however, awaiting the ideal moment to restore Paul to authority over Arrakis.

To succeed, Paul knows he must overcome not only the Harkonnens and the dread forces of the Em-

peror, but also the Spacing Guild which controls interstellar travel, and the Bene Gesserits, who have entangled both himself and his mother in their centuries-long plot to breed the initial male of a master race. Guild and Bene Gesserit both require the melange *spice unique to Arrakis. It is this spice that opens some human minds to powers over Time and Space.*

Now, Paul-Muad'Dib has gone raiding in the Arrakeen wasteland with his death commandos, and with only his own skills captured a giant worm of the desert and rode it. This final test gives him full equality among the Fremen, who want him to kill his benefactor Stilgar in the ancient way of the tribes and assume command over all the Fremen.

But Paul-Muad'Dib has matured in the prescience of his own space change. He is filled with knowledge-gained-out-of-its-Time. He has "walked the sand" and prayed at the shrine of his father's skull and he realizes at last: "I have the wisdoms of many lifetimes, yet I live only one lifetime in which to choose the right set of wisdoms." He knows now he must be as ruthless with his own life as with the lives of others —for this is kindness.

His mother, the Lady Jessica, is safe in a Fremen sietch *warren among the palmaries of the south, playing out her part as the tribe's Reverend Mother. With her are her daughter, Alia, a child born within the spice change and subject to its wild powers; Chani, Paul's concubine and mother of his first-born, Leto II; Harah, who was once wife to Jamis whom Paul-Muad'Dib slew in the tahaddi-challenge.*

In the tau *spirit of the warren, Jessica is growing more Fremen than she realizes, helping keep the tribe's ancient grief and hatreds fresh, yet she fears her son will tie himself too closely to Chani and lose the freedom to ally himself through marriage with another Great House.*

Before the dispute with Stilgar can reach a crisis, Paul-Muad'Dib captures a smuggler band. The band's leader is Gurney Halleck, who was a minstrel warrior in the service of Paul's murdered father. In the captured band are disguised Sardaukar who are overpowered by the Fremen, the first time in the memory of man that Sardaukar have been bested in open combat.

Paul-Muad'Dib learns now that many forces are focused on Arrakis, that Guildsmen are with Beast Rabban, the Harkonnen regent on Arrakis. Paul forces the crisis with Stilgar, dares the Fremen leader to kill him and makes Stilgar realize the old ways have changed.

Gurney Halleck, however, has learned here that the Lady Jessica still lives. He believes she was the traitor who destroyed his beloved Duke Leto, and Gurney plans to kill her.

Jessica, fearing the crisis with Stilgar, comes up from the south with a message cylinder captured from a Harkonnen courier. The cylinder reveals that Beast Rabban is ripe for destruction. This is the final link Paul has awaited. He puts on his father's Ducal signet, the ring he swore to wear only when ready to retake his fief.

Gurney Halleck, however, surprises Jessica, traps her with a knife at her back. And she knows that here is a man wary of every trick she knows, a killer she herself helped train—and he intends her death.

PART 5

"You thought you had escaped, eh, witch?" Gurney snarled.

Before she could turn the question over in her mind or try to answer, the curtains parted and Paul entered.

"Here he is, Moth—" Paul broke off, taking in the tensions of the scene.

"You will stand where you are, M'Lord," Gurney said.

"What—" Paul shook his head.

Jessica started to speak, felt the arm tighten against her throat.

"You will speak only when I permit it, witch," Gurney said. "I want only one thing from you for your son to hear it, and I am prepared to send this knife into your heart by reflex at the first sign of a counter against me. Your voice will remain in a monotone. Certain muscles you will not tense or move. You will act with the most extreme caution to gain yourself a few more seconds of life. And I assure you, these are all you have."

Paul took a step forward. "Gurney, man, what is—"

"Stop right where you are!" Gurney snapped. "One more step and she's dead."

Paul's hand slipped to his knife hilt. He spoke in deadly quiet: "You had best explain yourself, Gurney."

"I swore an oath to slay the betrayer of your father," Gurney said. "Do you think I can forget the man who rescued me from a Harkonnen slave pit, gave me freedom, life and honor . . . gave me friendship, a thing I prized above all else. I have his betrayer under my knife. No one can stop me from . . ."

"You couldn't be more wrong, Gurney," Paul said.

And Jessica thought: *So that's it! What irony!*

"Wrong, am I?" Gurney demanded. "Let us hear it from the woman herself. And let her remember that I have bribed and spied and cheated to confirm this charge. I've even pushed semuta on a Harkonnen guard captain to get part of the story."

Jessica felt the arm at her throat ease slightly, but before she could speak, Paul said: "The betrayer was Yueh. I tell you this once, Gurney. The evidence is complete, cannot be controverted. It was Yueh. I do

not care how you came by your suspicion—for it can be nothing else—but if you harm my mother" —Paul lifted his crysknife from its scabbard, held the blade in front of him—"I'll have your blood."

"Yueh was a conditioned medic, fit for a royal house," Gurney snarled. "He could not turn traitor!"

"I know a way to remove that conditioning," Paul said.

"Evidence," Gurney insisted.

"The evidence is not here," Paul said. "It's in Tabr sietch, far to the south, but if—"

"This is a trick," Gurney snarled, and his arm tightened on Jessica's throat.

"No trick, Gurney," Paul said, and his voice carried a note of terrible sadness. The sound of his voice tore at Jessica's heart.

"I saw the message captured from the Harkonnen agent," Gurney said. "The note pointed directly at—"

"I saw it, too," Paul said. "My father showed it to me the night he explained why it had to be a Harkonnen trick aimed at making him suspect the woman he loved."

"Ayah!" Gurney said. "You've not—"

"Be quiet," Paul said, and the monotone stillness of his words carried more command than Jessica had ever heard in another voice.

He has the Great Control, she thought.

Gurney's aim trembled against her neck. The point of the knife at her back moved with uncertainty.

"What you have not done," Paul said, "is heard my mother sobbing in the night over her lost Duke. You have not seen her eyes stab flame when she speaks of killing Harkonnens."

So he has listened, she thought. *Tears blinded her eyes.*

"What you have not done," Paul went on, "is remembered the lessons you learned in a Harkonnen slave pit. You speak of pride in my father's friendship! Didn't you learn the difference between Harkonnen and Atreides so that you could smell a Harkonnen trick by the stink they left on it? Didn't you learn that Atreides loyalty is bought with love while the Harkonnen coin is hate? Couldn't you see through to the very nature of this betrayal?"

"But Yueh?" Gurney muttered.

"The evidence we have is Yueh's own message to us admitting his treachery," Paul said. "I swear this to you by the love I hold for you, a love I will still hold even after I leave you dead on this floor."

Hearing her son, Jessica marveled at the awareness in him, the penetrating insight of his intelligence.

"My father had an instinct for his friends," Paul said. "He gave his love sparingly, but with never an error. His weakness lay in misunderstanding hatred. He thought anyone who hated Harkonnens could not betray him." He glanced at his mother. "She knows this. I've given

her my father's message that he never distrusted her."

Jessica felt herself losing control, bit at her lower lip. Seeing the stiff formality in Paul, she realized what these words were costing him. She wanted to run to him, cradle his head against her breast as she never had done. But the arm against her throat had ceased its trembling; the knife point at her back pressed still and sharp.

"One of the most terrible moments in a boy's life," Paul said, "is when he discovers his father and mother are human beings who share a love that he can never quite taste. It's a loss, an awakening to the fact that the world is *there* and *here* and we are in it alone. The moment carries its own truth; you can't evade it. I *heard* my father when he spoke of my mother. She's not the betrayer, Gurney."

Jessica found her voice, said: "Gurney, release me." There was no special command in the words, no trick to play on his weaknesses, but Gurney's hand fell away. She crossed to Paul, stood in front of him, not touching him.

"Paul," she said, "there are other awakenings in this universe. I suddenly see how I've used you and twisted you and manipulated you to set you on a course of my choosing . . . a course I had to choose—if that's any excuse—because of my own training." She swallowed past a lump in her throat, looked up into her son's eyes. "Paul . . . I want you to do something for me: choose the course of happiness. Your desert woman, marry her if that's your wish. Defy everyone and everything to do this. But choose your own course. I—"

She broke off, stopped by the low sound of muttering behind her.

Gurney!

She saw Paul's eyes directed beyond her, turned.

Gurney stood in the same spot, but had sheathed his knife, pulled the robe away from his breast to expose the slick grayness of an issue stillsuit, the type the smugglers traded for among the sietch warrens.

"Put your knife right here in my breast," Gurney muttered. "I say kill me and have done with it. I've besmirched my name. I've betrayed my own Duke! The finest—"

"Be still!" Paul said.

Gurney stared at him.

"Close that robe and stop acting like a fool," Paul said. "I've had enough foolishness for one day."

"Kill me, I say!" Gurney raged.

"You know me better than that," Paul said. "How many kinds of an idiot do you think I am? Must I go through this with every man I need?"

Gurney looked at Jessica, spoke in a forlorn, pleading note so unlike him: "Then you, My Lady, please . . . you kill me."

Jessica crossed to him, put her hands on his shoulders. "Gurney,

why do you insist the Atreides must kill those they love?" Gently, she pulled the spread robe out of his fingers, closed and fastened the fabric over his chest.

Gurney spoke brokenly: "But . . . I—"

"You thought you were doing a thing for Leto," she said, "and for this I honor you."

"My Lady," Gurney said. He dropped his chin to his chest, squeezed his eyelids closed against the tears.

"Let us think of this as a misunderstanding among old friends," she said, and Paul heard the *soothers,* the adjusting tones in her voice. "It's over and we can be thankful we'll never again have that sort of misunderstanding between us."

Gurney opened eyes bright with moisture, looked down at her.

"The Gurney Halleck I knew was a man adept with both blade and baliset," Jessica said. "It was the man of the baliset I most admired. Doesn't that Gurney Halleck remember how I used to enjoy listening by the hour while he played for me? Do you still have a baliset, Gurney?"

"I've a new one," Gurney said. "Brought from Chusuk, a sweet instrument. Plays like a genuine Varota, though there's no signature on it. I think myself it was made by a student of Varota's who—" He broke off. "What can I say to you, My Lady? Here we prattle about—"

"Not prattle, Gurney," Paul said. He crossed to stand beside his mother, eye to eye with Gurney. "Not prattle, but a thing that brings happiness between friends. I'd take it a kindness if you'd play for her now. Battle planning can wait a little while. We'll not be going into the fight 'till tomorrow at any rate."

"I . . . I'll get my baliset," Gurney said. "It's in the passage." He stepped around them and through the hangings.

Paul put a hand on his mother's arm, found that she was trembling.

"It's over, Mother," he said.

Without turning her head, she looked up at him from the corners of her eyes. "Over?"

"Of course. Gurney's—"

"Gurney? Oh . . . yes." She lowered her gaze.

The hangings rustled as Gurney returned with his baliset. He began tuning it, avoiding their eyes. The hangings on the walls dulled the echoes, making the instrument sound small and intimate.

Paul led his mother to a cushion, seated her there with her back to the thick draperies of the wall. He was suddenly struck by how old she seemed to him with the beginnings of desert-dried lines in her face, the stretching at the corners of her blue-veiled eyes.

She's tired, he thought. *We must find some way to ease her burdens.*

Gurney strummed a chord.

Paul glanced at him, said: "I've . . . things that need my attention. Wait here for me."

Gurney nodded. His mind seemed far away, as though he dwelled for this moment beneath the open skies of Caladan with cloud fleece on the horizon promising rain.

Paul forced himself to turn away, let himself out through the heavy hangings over the side passage. He heard Gurney take up a tune behind him, paused a moment outside the room to listen to the muted music.

"Orchards and vineyards,
And full-breasted houris,
And a cup overflowing before me.
Why do I babble of battles,
And mountains reduced to dust?
Why do I feel these tears?

Heavens stand open
And scatter their riches,
And my hands need but gather their wealth.
Why do I think of an ambush,
And poison in a molten cup?
Why do I feel my years?

Love's arms beckon
With their naked delights,
And all Eden's promise of ecstasies.
Why do I remember the scars,
Dream of old transgressions . . .
And why do I sleep with fears?"

A robed Fedaykin courier appeared from a corner of the passage ahead of Paul. The man had hood thrown back and fastenings of his stillsuit hanging loose about his neck, proof that he had come just now from the open desert.

Paul motioned for him to stop, left the hangings of the door and moved down the passage to the courier.

The man bowed, hands clasped in front of him the way he might greet a Reverend Mother or sayyadina of the rites, said: "Muad'Dib, leaders are beginning to arrive for the Council."

"So soon?"

"These are the ones Stilgar sent for earlier when it was thought—" He shrugged.

"I see." Paul glanced back toward the faint sound of the baliset, thinking of the old song that his mother favored—an odd stretching of happy tune and sad words. "Stilgar will come here soon with others. Show them where my mother waits."

"I will wait here, Muad'Dib," the courier said.

"Yes . . . yes, do that."

Paul pressed past the man toward the depths of the cavern, headed for the place that each such cavern had—a place near its water holding basin. There would be small Makers in this place, creatures no more than twenty feet long, kept stunted and trapped by surroundings of water ditches. For the Maker, after emerging from its Little Maker vector, avoided water for the poison it was. And the drown-

ing of a Maker was the greatest Fremen secret because it produced the substance of their union—The Water of Life, the poison that could only be changed by a Reverend Mother.

The thought had come to Paul while he faced the danger to his mother. Prescience had never shown him a phantom future with that particular action by Gurney Halleck. He had the partly-absorbed experiences of all those lives, yet even these had deserted him in the moment of peril to his mother . . . and he had been a child facing a kind of loss for which no preparations had been made.

The future with its feeling that the entire universe rolled and tumbled toward a boiling nexus surrounded Paul like a tornado cloud.

Even prescience had deserted him.

The present had presented him with a crisis he had never anticipated—a crisis the more terrible because every other element of his external world appeared on its surface to be working for his benefit. No outside observer could see this thing within him.

And now the vision was receding even from himself, blanketed by a slowly acquired spice tolerance and his own psychic-revulsions.

I will drown the Maker, Paul told himself. *Now, we shall see whether I'm the Kwisatz Haderach and can survive the test that even the Reverend Mothers fear!*

XXIII

And it came to pass in the third year of the Desert War that Paul-Muad'Dib lay alone in the Cave of Birds beneath the kiswa hangings of an inner cell. And he lay as one dead, caught up in the revelation of the Waters of Life, his being translated beyond the boundaries of Time by the-poison-which-gives-life. Thus was the prophecy made true that the Lisan al-Gaib might be both dead and alive.

"Collected Legends of Arrakis"
by The Princess Irulan

Chani came up out of the Habbanya basin in the pre-dawn darkness, hearing the 'thopter that had brought her from the south go *whirr-whirring* off to a hiding place in the vastness. Around her, the escort kept its distance, fanning out into the rocks of the ridge to probe for dangers—and giving the mate of Muad'Dib, the mother of his firstborn, the thing she had requested: a moment to walk alone.

Why did he summon me? she asked herself. *He told me before that I must remain in the south with Little Leto and Alia.*

She gathered her robe and leaped lightly up across a barrier rock and onto the climbing path that only the desert-trained could recognize in the darkness. Pebbles slithered underfoot and she danced across them without considering the nimbleness required.

The climb was exhilarating, easing the fears that had fermented in her because of her escort's silent withdrawal and the fact that a precious 'thopter had been sent for her. She felt the inner leaping at the nearness of reunion with Paul-Muad'Dib, her Usul. His name might be a battlecry over all the land: *"Muad'Dib! Muad'Dib! Muad'Dib!"* But she knew a different man by a different name—the father of her son, the tender lover.

A gray figure loomed out of the rocks above her, beckoning for speed. She quickened her pace. Dawn birds already were calling and lifting into the sky. A dim spread of light reached across the eastern horizon.

The figure above was not one of her own escort.

Otheym? she wondered, marking the familiarity of movement and manner. She came up to him, recognized in the growing light the broad flat features of Otheym, the Fedaykin lieutenant, his hood open and mouth filter loosely fastened the way one did sometimes when venturing onto the desert for only a moment.

"Hurry," he hissed, and led her down a crevasse into the secret cave. "It will be light soon," he whispered as he held a doorseal open. "The Harkonnens have been making desperation patrols over some of our region the past week. We dare not chance discovery now."

They emerged into the narrow side-passage entrance to Cave of Birds. Glowglobes came alight. Otheym pressed past her, said: "Follow me. Quickly, now."

They sped down the passage, through another valve door, another passage and hangings and into what had been the sayyadina's alcove in the days when this was an overday rest camp. Rugs and cushions now covered the floor. Woven hangings with the red figure of a hawk hid the rock walls. A low field desk at one side was strewn with papers which gave off the aroma of their spice origin.

The Reverend Mother sat alone directly opposite the entrance. She looked up without unmasking her inward stare.

Otheym pressed palms together, said: "I have brought Chani." He bowed, retreated through the hangings.

And Jessica thought: *How do I tell Chani?*

"How is my grandson?" Jessica asked.

So it's to be the ritual greeting, Chani thought, and her fears returned. *Where is Muad'Dib? Why isn't he here to greet me?*

"He is healthy and happy, my mother," Chani said. "I left him with Alia in the care of Harah."

My mother, Jessica thought. *Yes, she has the right to call me that in the formal greeting. She has given me a grandson.*

"I hear a gift of cloth has been

sent from Coanua sietch," Jessica said.

"It is a lovely cloth," Chani said. "Does Alia send a message?"

"No message. But the sietch moves more smoothly now that the people are beginning to accept the miracle of her status."

Why does she drag this out so? Chani wondered. *Something was so urgent that they sent a 'thopter for me. Now, we drag through the formalities!*

"We must have some of the new cloth cut into garments for little Leto," Jessica said.

"Whatever you wish, my mother," Chani said. She lowered her gaze. "Is there news of battles?" She held her face expressionless that Jessica might not see the betrayal—that this was a question about Paul-Muad'Dib.

"New victories," Jessica said. "Rabban has sent cautious overtures about a truce. His messengers have been returned without their water. Rabban has even lightened the burdens of the people in some of the sink villages. But he is too late. The people know he does it out of fear of us."

"Thus it goes as Muad'Dib said," Chani said. She stared at Jessica, trying to keep her fears to herself. *I have spoken his name, but she has not responded. One cannot see emotion in that glazed stone she calls a face . . . but she is too frozen. Why is she so still? What has happened to my Usul?*

"I wish we were in the south," Jessica said. "The oases were so beautiful when we left. Do you not long for the day when the whole land may blossom thus?"

"The land is beautiful, true," Chani said. "But there is much grief in it."

"Grief is the price of victory," Jessica said.

Is she preparing me for grief? Chani asked herself. She said: "There are so many women without men. There was jealousy when it was learned that I'd been summoned north."

"I summoned you," Jessica said.

Chani felt her heart hammering. She wanted to clap her hands to her ears, fearful of what they might hear. Still, she kept her voice even: "The message was signed Muad'Dib."

"I signed it thus in the presence of his lieutenants," Jessica said. "It was a subterfuge of necessity." And Jessica thought: *This is a brave woman, my Paul's. She holds to the niceties even when fear is almost overwhelming her. Yes. She may be the one we need now.*

Only the slightest tone of resignation crept into Chani's voice as she said: "Now you may say the thing that must be said."

"You were needed here to help me revive Paul," Jessica said. And she thought: *There! I said it in the precisely correct way.* Revive. *Thus she knows Paul is alive and knows there is peril, all in the same word.*

Chani took only a moment to calm herself, then: "What is it I may do?" She wanted to leap at Jessica, shake her and scream: *"Take me to him!"* But she waited silently for the answer.

"I suspect," Jessica said, "that the Harkonnens have managed to send an agent among us to poison Paul. It's the only explanation that seems to fit. A most unusual poison. I've examined his blood in the most subtle ways without detecting it."

Chani thrust herself forward onto her knees. "Poison? Is he in pain?"

"He is unconscious," Jessica said. "The processes of his life are so low that they can be detected only with the most refined techniques. I shudder to think what could have happened had I not been the one to discover him. He appears dead to the untrained eye."

"You have reasons other than courtesy for summoning me," Chani said. "I know you, Reverend Mother. What is it you think I may do that you cannot do?"

She is brave, lovely and ahhh so perceptive, Jessica thought. *She'd have made a fine Bene Gesserit.*

"Chani," Jessica said, "you may find this difficult to believe, but I do not know precisely why I sent for you. It was an instinct . . . a basic intuition. The thought came unbidden: *Send for Chani.*"

For the first time, Chani saw the sadness in Jessica's expression, the unveiled pain modifying the inward stare.

"I've done all I know to do," Jessica said. "That *all* . . . it is so far beyond what is usually supposed as *all* that you would find difficulty imagining it. Yet . . . I failed."

"The old companion, Halleck," Chani asked, "is it possible he's a traitor?"

"Not Gurney," Jessica said.

The two words carried an entire conversation, and Chani saw the searching, the tests . . . the memories of old failures that went into this flat denial.

Chani rocked back onto her feet, stood up, smoothed her desert-stained robe. "Take me to him," she said.

Jessica arose, turned through hangings on the left wall.

Chani followed, found herself in what had been a storeroom, its rock walls concealed now beneath heavy draperies. Paul lay on a field pad against the far wall. A single glow-globe above him illuminated his face. A black robe covered him to the chest, leaving his arms outside it stretched along his sides. He appeared to be unclothed under the robe. The skin that was exposed looked waxen, rigid. There was no visible movement to him.

Chani suppressed the desire to dash forward, throw herself across him. She found her thoughts, instead, going to her son—Leto. And she realized in this instant that Jessica once had faced such a moment —her man threatened by death,

forced in her own mind to consider what might be done to save a young son. The realization formed a sudden bond with the older woman so that Chani reached out and clasped Jessica's hand. The answering grip was painful in its intensity.

"He lives," Jessica said. "I assure you he lives. But the thread of his life is so thin it could easily escape detection. There are some among the leaders already muttering that the mother speaks and not the Reverend Mother, that my son is truly dead and I do not want to give up his water to the tribe."

"How long has he been this way?" Chani asked. She disengaged her hand from Jessica's, moved farther into the room.

"Three weeks," Jessica said. "I spent almost a week trying to revive him. There were meetings, arguments . . . investigations. Then I sent for you. The Fedaykin obey my orders, else I might not have been able to delay the—" She wet her lips with her tongue, watching Chani cross to Paul.

Chani stood over him now, looking down on the soft beard of youth that framed his face, tracing with her eyes the high browline, the strong nose, the shuttered eyes—the features so peaceful in this rigid repose.

"How does he take nourishment?" Chani asked.

"The demands of his flesh are so slight he does not yet need food," Jessica said.

"How many know of what has happened?" Chani asked.

"Only his closest advisers, a few of the leaders, the Fedaykin and, of course, whoever administered the poison."

"There is no clue to the poisoner?"

"And it's not for want of investigating," Jessica said.

"What do the Fedaykin say?" Chani asked.

"They believe Paul is in a sacred trance, gathering his holy powers before the final battles. This is a thought I've cultivated."

Chani lowered herself to her knees beside the pad, bent close to Paul's face. She sensed an immediate difference in the air about his face . . . but it was only the spice, the ubiquitous spice whose odor permeated everything in Fremen life. Still—

"You were not born to the spice as we were," Chani said. "Have you investigated the possibility that his body has rebelled against too much spice in his diet?"

"Allergy reactions are all negative," Jessica said.

She closed her eyes, as much to blot out this scene as because of sudden realization of fatigue. *How long have I been without sleep?* she asked herself. *Too long.*

"When you change the Water of Life," Chani said, "you do it within yourself by the inward awareness. Have you used this awareness to test his blood?"

"Normal Fremen blood," Jessica said. "Completely adapted to the diet and the life here."

Chani sat back on her heels, submerging her fears in thought as she studied Paul's face. This was a trick she had learned from watching the Reverend Mothers. Time could be made to serve the mind. One concentrated the entire attention.

Presently, Chani said: "Is there a Maker here?"

"There are several," Jessica said with a touch of weariness. "We are never without them these days. Each victory requires its blessing. Each ceremony before a raid—"

"But Paul-Muad'Dib has held himself aloof from these ceremonies," Chani said.

Jessica nodded to herself, remembering her son's ambivalent feelings toward the spice drug and the prescient awareness it precipitated.

"How did you know this?" Jessica asked.

"It is spoken."

"Too much is spoken," Jessica said bitterly.

"Get me the raw Water of the Maker," Chani said.

Jessica stiffened at the tone of command in Chani's voice, then observed the intense concentration in the younger woman and said: "At once." She went out through the hangings to send a waterman.

Chani sat staring at Paul. *If he has tried to do this,* she thought. *And it's the sort of thing he might try—*

Jessica knelt beside Chani, holding out a plain camp ewer. The charged odor of the poison was sharp in Chani's nostrils. She dipped a finger in the fluid, held the finger close to Paul's nose.

The skin along the bridge of his nose wrinkled slightly. Slowly, the nostrils flared.

Jessica gasped.

Chani touched the dampened finger to Paul's upper lip.

He drew in a long, sobbing breath.

"What is this?" Jessica demanded.

"Be still," Chani said. "You must convert a small amount of the sacred water. Quickly!"

Without questioning because she recognized the tone of awareness in Chani's voice Jessica lifted the ewer to her mouth, drew in a small sip.

Paul's eyes flew open. He stared upward at Chani.

"It is not necessary for her to change the Water," he said. His voice was weak, but steady.

Jessica, a sip of the fluid on her tongue, found her body rallying, converting the poison almost automatically. In the light elevation the ceremony always imparted, she sensed the life-glow from Paul—a radiation there registering on her senses.

In that instant, she knew.

"You drank the sacred water!" she blurted.

"One drop of it," Paul said.

"How could you do such a foolish thing?" she demanded.

"He is your son," Chani said.

Jessica glared at her.

A rare smile, warm and full of understanding, touched Paul's lips. "Hear my beloved," he said. "Listen to her, Mother. She knows."

"A thing that others can do, he must do," Chani said.

"When I had the drop in my mouth, when I felt it and smelled it, when I knew what it was doing to me, then I knew I could do the thing that you have done," he said. "Your Bene Gesserit proctors speak of the Kwisatz Haderach, but they cannot begin to guess the many places I have been. In the few minutes I—" He broke off, looking at Chani with a puzzled frown. "Chani? How did you get here? You're supposed to be— Why are you here?"

He tried to push himself onto his elbows. Chani pressed him back gently.

"Please, my Usul," she said.

"I feel so weak," he said. His gaze darted around the room. "How long have I been here?"

"You've been three weeks in a coma so deep that the spark of life seemed to have fled," Jessica said.

"But it was . . . I took it just a moment ago and—"

"A moment for you, three weeks of fear for me," Jessica said.

"It was only one drop, but I converted it," Paul said. "I changed the Water of Life." And before Chani or Jessica could stop him, he dipped his hand into the ewer they had placed on the floor beside him, and he brought the dripping hand to his mouth, swallowed the palm-cupped liquid.

"Paul!" Jessica screamed.

He grabbed her hand, faced her with a death's head grin, and he sent his awareness surging over her.

The rapport was not as tender, not as sharing, not as encompassing as it had been with Alia and with the Old Reverend Mother in the cavern . . . but it was a rapport: a sense-sharing of the entire being. It shook her, weakened her, and she cowered in her mind, fearful of him.

Aloud, he said: "You speak of a place where you cannot enter? This place which the Reverend Mother cannot face, show it to me."

She shook her head, terrified by the very thought.

"Show it to me!" he commanded.

"No!"

But she could not escape him. Bludgeoned by the terrible force of him, she closed her eyes and focused inward—the-direction-that-is-dark.

Paul's consciousness flowed through and around her and into the darkness. She glimpsed the place dimly before her mind blanked itself away from the terror. Without knowing why, her whole being trembled at what she had seen—a region where a wind blew and sparks glared, where rings of light expand-

ed and contracted, where rows of tumescent white shapes flowed over and under and around the lights, driven by darkness and a wind out of nowhere.

Presently, she opened her eyes, saw Paul staring up at her. He still held her hand, but the terrible rapport was gone. She quieted her trembling. Paul released her hand. It was as though some crutch had been removed. She staggered up and back, would have fallen had not Chani jumped to support her.

"Reverend Mother!" Chani said. "What is wrong?"

"Tired," Jessica whispered. "So tired."

"Here," Chani said. "Sit here." She helped Jessica to a cushion against the wall.

The strong young arms felt so good to Jessica. She clung to Chani.

"He has, in truth, seen the Waters of Life?" Chani asked. She disengaged herself from Jessica's grip.

"He has seen," Jessica whispered. Her mind still rolled and surged from the contact. It was like stepping to solid land after weeks on a heaving sea. She sensed the Old Reverend Mother within her . . . and all the Others awakened and questioning: *What was that? What happened? Where was that place?"*

Through it all threaded the realization that her son was the Kwisatz Haderach, the one who could be many places at once. He was the fact out of the Bene Gesserit dream. And the fact gave her no peace.

"What happened?" Chani demanded.

Jessica shook her head.

Paul said: "There is in each of us an ancient force that takes and an ancient force that gives. A man finds little difficulty facing that place within himself where the taking force dwells, but it's almost impossible for him to see into the giving force without changing into something other than man. For a woman, the situation is reversed."

Jessica looked up, found Chani was staring at her while listening to Paul.

"Do you understand me, Mother?" Paul asked.

She could only nod.

"These things are so ancient within us," Paul said, "that they're ground into each separate cell of our bodies. We're shaped by such forces. You can say to yourself, 'Yes, I see how such a thing may be.' But when you look inward and confront the raw force of your own life unshielded, you see your peril. You see that this could overwhelm you. The greatest peril to the Giver is the force which takes. The greatest peril to the Taker is the force which gives. It's as easy to be overwhelmed by giving as by taking."

"And you, my son," Jessica asked "are you one who gives or one who takes?"

"I'm at the fulcrum," he said. "I cannot give without taking and I cannot take without—" He broke off, looking to the wall at his right.

Chani felt a draft against her cheek, turned to see the hangings close.

"It was Otheym," Paul said. "He was listening."

Accepting the words, Chani was touched by some of the prescience that haunted Paul, and she knew a thing yet to be as though it already had occurred. Otheym would speak of what he had seen and heard. Others would spread the story until it was a fire over the land. Paul-Muad'Dib is not as other men, they would say. There can be no more doubt. He is a man, yet he sees through to the Water of Life in the way of a Reverend Mother. He is, indeed, the Lisan al-Gaib. He is . . . Him.

"You have seen the future, Paul," Jessica said. "Will you say what you've seen?"

"Not the future," he said. "I've seen the Now." He forced himself to a sitting position waved Chani aside as she moved to help him. "The space above Arrakis is filled with the ships of the Guild."

Jessica trembled at the certainty in his voice.

"The Padishah Emperor himself is there," Paul said. He looked at the rock ceiling of his cell. "With his favorite Truthsayer and five legions of Sardaukar. The old Baron Vladimir Harkonnen is there with Thufir beside him and seven ships jammed with every conscript he could muster. Every Great House has its raiders above us . . . waiting."

Chani shook her head, unable to look away from Paul. His strangeness, the flat tone of voice, the way he looked through her, filled her with awe.

Jessica tried to swallow in a dry throat, said: "For what are they waiting?"

Paul looked at her. "For the Guild's permission to land. The Guild will strand on Arrakis any force that lands without permission."

"The Guild's protecting us?"

"Protecting us! The Guild itself caused this by spreading tales about what we do here and by reducing troop transport fares to a point where even the poorest Houses are up there now waiting to loot us."

Jessica noted the lack of bitterness in his tone, wondered at it. She couldn't doubt his words—they had that same intensity she'd seen in him the night he'd revealed the path of the future that'd taken them among the Fremen.

Paul took a deep breath, said: "Mother, you must change a quantity of the Water for us. We need the catalyst. Chani, have a scout force sent out . . . to find a pre-spice mass. If we plant a quantity of the Water of Life above a pre-spice mass, do you know what will happen?"

Jessica weighed his words, suddenly saw through to his meaning. "Paul!" she gasped.

"The Waters of Death," he said. "It'd be a chain reaction." Paul pointed to the floor. "Spreading death among the Little Makers, killing a vector of the life cycle that contains the Makers . . . and the spice. Arrakis would become a true desolation—without spice or Maker."

Chani put a hand to her mouth, shocked to silence by the blasphemy pouring from Paul's lips.

"Who can destroy a thing controls it," Paul said.

"What stays the Guild's hand?" Jessica whispered.

"They search for me," Paul said. "Think of that! The finest Guild navigators, men who quest ahead through Time to find the safest course for the heighliners, these men seek me . . . and cannot find me. How they tremble! They know I hold their lives here!" He held out his fist. "Without the spice they're blind!"

Chani found her voice. "You said you see the . . . *now*."

Paul lay back, searching the spread-out *present*, its limits extended into future and past, holding onto the awareness with difficulty as the spice illumination faded. And even as that illumination faded, he saw that another factor did not fade —the phantom experiences of those other countless possible lives stayed with him! He realized with a terrifying exultation that he had *become* all those other lives, that he was an ancient being in a youthful shell, his every action monitored by ruthless wisdom.

"Go do as I commanded," he said. "There's little time. Everything focuses here where the spice is . . . where the Guild has never dared interfere before . . . because that was to lose the little they had. But now they're desperate. All their paths lead into darkness."

XXIV

And that day dawned when Arrakis lay at the hub of the universe with the wheel poised to turn.

"Arrakis Awakening"
by The Princess Irulan

"Will you look at that thing!" Stilgar whispered.

Paul lay beside him in a slit of rock high on the shield rim, eye fixed to the collector of a Fremen telescope. The oil lens was focused on a starship lighter exposed by dawn in the basin below them. The tall eastern face of the ship glistened in the flat light of the sun, but the shadow side still showed yellow portholes from glowglobes of the night. Beyond the ship, the city of Arrakeen lay cold and gleaming in the light of the northern sun.

It wasn't the lighter that excited Stilgar's awe, Paul knew, but the construction for which the lighter was only the centerpost. A single metal hutment many stories tall reached out in a thousand-meter circle from the base of the lighter—a

tent composed of interlocking metal leaves—the temporary lodging place for five legions of Sardaukar and His Imperial Majesty, the Padishah Emperor Shaddam IV.

From his position squatting at Paul's left, Gurney Halleck said: "I count nine levels to it. Must be quite a few Sardaukar in there."

"Five legions," Paul said.

"It grows light," Stilgar hissed. "We like it not, your exposing yourself, Muad'Dib. Let us go back into the rocks now."

"I'm perfectly safe here," Paul said.

"That ship mounts projectile weapons," Gurney said.

"They believe us protected by shields," Paul said. "They wouldn't waste a shot on an unidentified trio even if they saw us."

Paul swung the telescope to scan the far wall of the basin, seeing the pockmarked cliffs, the slides that marked the tombs of so many of his father's troopers. And he had a momentary sense of the fitness of things that the shades of those men should look down on this moment. The Harkonnen forts and towns across the shielded lands lay in Fremen hands or cut away from their source like stalks severed from a plant and left to wither. Only this basin and its city remained to the enemy.

"They might try a sortie by 'thopter," Stilgar said. "If they see us."

"Let them," Paul said. "We've 'thopters to burn today . . . and we know a storm is coming."

He swung the telescope to the far side of the Arrakeen landing field now, to the Harkonnen frigates lined up there with a Choam Company banner waving gently from its staff on the ground beneath them. And he thought of the desperation that had forced the Guild to permit these two groups to land while all the others were held in reserve. The Guild was like a man testing the sand with his toe to gauge its temperature for erecting a tent.

"Is there anything more to be seen here?" Gurney asked. "We should be getting under cover. The storm *is* coming, as you said yourself."

Paul kept his attention on the giant hutment now. "They've even brought their women," he said. "And lackeys and servants. Ahhh, my dear Emperor, how confident you are."

"Men are coming up the secret way," Stilgar said. "It may be Otheym and Korba returning."

"All right, Stil," Paul said. "We'll go back."

But he took one final look around through the telescope—studying the plain with its tall ships, the gleaming metal hutment, the silent city, the frigates of the Harkonnen mercenares. Then he slid backward around a scarp of rock. His place at the telescope was taken by a Fedaykin guardsman.

Paul emerged into a shallow depression in the shield wall's surface. It was a place about thirty meters

in diameter and some three meters deep, a natural feature of the rock that the Fremen had hidden beneath a transluscent camouflage cover. Communications equipment was clustered around a hole in the wall to the right. Fedaykin guards deployed through the depression waited for Muad'Dib's command to attack.

Two men emerged from the hole by the communications equipment, spoke to the guards there.

Paul glanced at Stilgar, nodded in the direction of the two men. "Get their report, Stil."

Stilgar moved to obey.

Paul crouched with his back to the rock, stretching his muscles, straightened. He saw Stilgar sending the two men back into that dark hole in the rock, thought about the long climb down that narrow man-made tunnel to the floor of the basin.

Stilgar crossed to Paul.

"What was so important that they couldn't send a cielago with the message?" Paul asked.

"They're saving their birds for the battle," Stilgar said. He glanced at the communications equipment, back to Paul. "Even with a tight beam, it is wrong to use those things, Muad'Dib. They can find you by taking a bearing on its emission."

"They'll soon be too busy to find me," Paul said. "What did the men report?"

"Our pet Sardaukar have been released near Old Gap low on the rim and are on their way to their master. The rocket launchers and other projectile weapons are in place. The people are deployed as you ordered. It was all routine."

Paul glanced across the shallow bowl, studying his men in the filtered light admitted by the camouflage cover. He felt Time creeping like an insect working its way across an exposed rock.

"It'll take the Sardaukar a little time afoot before they can signal a troop carrier," Paul said. "They are being watched?"

"They are being watched," Stilgar said.

Beside Paul, Gurney Halleck cleared his throat. "Hadn't we best be getting to a place of safety?"

"There is no such place," Paul said. "Is the weather report still favorable?"

"A great grandmother of a storm coming," Stilgar said. "Can you not feel it, Muad'Dib?"

"The air does feel chancey," Paul agreed. "But I like the certainty of poling the weather."

"The storm'll be here in the hour," Stilgar said. He nodded toward the gap that looked out on the Emperor's hutment and the Harkonnen frigates. "They know it there, too. Not a 'thopter in the sky. Everything pulled in and tied down. They've had a report on the weather from their friends in space."

"Any more probing sorties?"

"Nothing since the landing last night," Stilgar said. "They know we are here. I think now they wait to choose their own time."

"We choose the time," Paul said.

Gurney glanced upward, growled: "If *they* let us."

"That fleet'll stay in space," Paul said.

Gurney shook his head.

"They have no choice," Paul said. "We can destroy the spice. The Guild dares not risk that."

"Desperate people are the most dangerous," Gurney said.

"Are we not desperate?" Stilgar asked.

Gurney scowled at him.

"You haven't lived with the Fremen dream," Paul cautioned. "Stil is thinking of all the water we've spent on bribes, the years of waiting we've added before Arrakis can bloom. He's not—"

"Arrrgh," Gurney growled.

"Why's he so gloomy?" Stilgar asked.

"He's always gloomy before a battle," Paul said. "It's the only form of good humor Gurney allows himself."

A slow, wolfish grin spread across Gurney's face, the teeth showing white above the chin cup of his stillsuit. "It glooms me much to think on all the poor Harkonnen souls we'll dispatch unshriven," he said.

Stilgar chuckled. "He talks like a Fedaykin."

"Gurney was born a death commando," Paul said. And he thought: *Yes, let them occupy their minds with small talk before we test ourselves against that force on the plain.* He looked to the gap in the rock wall and back to Gurney, found that the troubador warrior had resumed a brooding scowl.

"Worry saps the strength," Paul murmured. "You told me that once, Gurney."

"My Duke," Gurney said, "my chief worry is the atomics. If you use them to blast a hole in the shield wall—"

"Those people up there won't use atomics against us," Paul said. "They don't dare . . . and for the same reason that they cannot risk our destroying the source of the spice."

"But the injunction against—"

"The injunction!" Paul barked. "It's fear, not the injunction that keeps the Houses from hurling atomics against each other. The language of the Great Convention is clear enough: 'Use of atomics against humans shall be cause for planetary obliteration.' We're going to blast the shield wall, not humans."

"It's too fine a point," Gurney said.

"The hairsplitters up there will welcome any point," Paul said. "Let's talk no more about it."

He turned away, wishing he actually felt that confident. Presently, he said: "What about the city people? Are they in position yet?"

"Yes they are," Stilgar muttered.

Paul looked at him. "What's eating you?"

"I never knew the city man could be trusted completely," Stilgar said.

"I was a city man myself once," Paul said.

Stilgar stiffened. His face grew dark with blood. "Muad'Dib knows I did not mean—"

"I know what you meant, Stil. But the test of a man isn't what you think he'll do. It's what he actually does. These city people have Fremen blood. It's just that they haven't yet learned how to escape their bondage. We'll teach them."

Stilgar nodded, spoke in a rueful tone: "The habits of a lifetime, Muad'Dib. On the Funeral Plain we learned to despise the men of the communities."

Paul glanced at Gurney, saw him studying Stilgar. "Tell us, Gurney, why were the cityfolk down there driven from their homes by the Sardaukar?"

"An old trick, My Duke. They thought to burden us with refugees."

"It's been so long since guerrillas were effective that the mighty have forgotten how to fight them," Paul said. "The Sardaukar have played into our hands. They grabbed some city women for their sport, decorated their battle standards with the heads of the men who objected. And they've built up a fever of hate among people who otherwise would've looked on the coming battle as no more than a great inconvenience . . . and the possibility of exchanging one set of masters for another. The Sardaukar recruit for us, Stilgar."

"The city people do seem eager," Stilgar said.

"Their hate is fresh and clear," Paul said. "That's why we use them as shock troops."

"The slaughter among them will be fearful," Gurney said.

Stilgar nodded agreement.

"They were told the odds," Paul said. "They know every Sardaukar they kill will be one less for us. You see, gentlemen, they have something to die for. They've discovered they're a People. They're awakening."

A muttered exclamation came from the watcher at the telescope. Paul moved to the rock slit, asked: "What is it out there?"

"A great commotion, Muad-Dib," the watcher hissed. "At that monstrous metal tent. A surface car came from rimwall West and it was like a hawk into a nest of rock partridge."

"Our captive Sardaukar have arrived," Paul said.

"They've a shield around the entire landing field now," the watcher said. "I can see the air dancing even to the edge of the storage yard where they kept the spice."

"Now they know who it is they fight," Gurney said. "Let the Harkonnen beasts tremble and fret themselves that an Atreides yet lives!"

Paul spoke to the Fedaykin at the telescope. "Watch the flagpole atop the Emperor's ship. If my flag is raised there—"

"It will not be," Gurney said.

Paul saw the puzzled frown on Stilgar's face, said: "If the Emperor recognized by claim, he'd signal by restoring the Atreides flag to Arrakis. We'd use the second plan then, move only against the Harkonnens. The Sardaukar would stand aside and let us settle the issue between ourselves."

"I've no experience with these offworld things," Stilgar said. "I've heard of them, but it seems unlikely the—"

"You don't need experience to know what they'll do," Gurney said.

"They're sending a new flag up on the tall ship," the watcher said. "The flag is yellow . . . with a black and red circle in the center."

"There's a subtle piece of business," Gurney said. "The Choam flag."

"It's the same as the flag on the other ships," the Fedaykin guard said.

"I don't understand," Stilgar said.

"A subtle piece of business indeed," Gurney said. "Had he sent up the Atreides banner, he'd have had to live by what that meant. Too many observers about. He could've signaled with the Harkonnen flag on his staff—a flat declaration that'd have been. But, no—he sends up the Choam rag. He's telling the people up there"— Gurney pointed toward space—"where the profit is. He's saying he doesn't care if it's an Atreides here or not."

"How long till the storm strikes the shield wall?" Paul asked.

Stilgar turned away, consulted one of the Fedaykin in the bowl. Presently, he returned, said: "Very soon, Muad'Dib. Sooner than we expected. It's a great-great grandmother of a storm . . . perhaps even more than you wished."

"It's my storm," Paul said, and saw the silent awe on the faces of the Fedaykin who heard him. "Though it shook the entire world it could not be more than I wished. Will it strike the shield wall full on?"

"Close enough to make no difference," Stilgar said.

A courier crossed from the hole that led down into the basin, said: "The Sardaukar and Harkonnen patrols are pulling back, Muad'Dib."

"They expect the storm to spill too much sand into the basin for good visibility," Stilgar said. "They think we'll be in the same fix."

"Tell our gunners to set their sights well before visibility drops," Paul said. "They must knock the nose off every one of those ships as soon as the storm has destroyed their shield." He stepped to a wall of the bowl, pulled back a fold of the camouflage cover and looked up at the sky. The horsetail twistings of blown sand could be seen against the dark of the sky. Paul restored

the cover, said: "Start sending our men down, Stil."

"Will you not go with us?" Stilgar asked.

"I'll wait here a bit with the Fedaykin," Paul said.

Stilgar gave a knowing shrug toward Gurney, moved to the hole in the rock wall, was lost in its shadows.

"The trigger that blasts the shield wall aside, that I leave in your hands, Gurney," Paul said. "You will do it?"

"I'll do it."

Paul gestured to one of his Fedaykin lieutenants, said: "Otheym, start moving the check patrols out of the danger area. They must be out of there before the storm strikes."

The man bowed, followed Stilgar.

Gurney leaned in to the rock slit, spoke to the man at the telescope: "Keep your attention on the south wall. It'll be completely undefended until we blow it."

"Dispatch a cielago with a time signal," Paul ordered.

"Some ground cars are moving toward the south wall," the man at the telescope said. "Some are using projectile weapons, testing. Our people are using body shields as you commanded. The ground cars have stopped."

In the abrupt silence, Paul heard the wind devils playing overhead—the front of the storm. Sand began to drift down into their bowl through gaps in the cover. A burst of wind caught the cover, whipped it away.

Paul motioned his Fedaykin to take shelter, crossed to the men at the communications equipment near the tunnel mouth. Gurney stayed right beside him. Paul crouched over the signalmen.

One of the men said: "A great-great-*great* grandmother of a storm, Muad'Dib."

Paul glanced up at the darkening sky, said: "Gurney, have the southwall observers pulled out." He had to repeat his order, shouting above the growing noise of the storm.

Gurney turned away to obey.

Paul fastened his face filter, tightened the stillsuit hood.

Gurney returned.

Paul touched his shoulder, pointed to the blast trigger set into the tunnel mouth beyond the signalmen. Gurney went into the tunnel. He stopped there, one hand on the trigger, his gaze fixed on Paul.

"We are getting no messages," the signalman beside Paul said. "Much static."

Paul nodded, kept his eye on the times-standard dial in front of the signalman. Presently, Paul looked at Gurney, raised a hand, returned his attention to the dial. The time counter crawled around its final circuit.

"Now!" Paul shouted, and dropped his hand.

Gurney depressed the blast trigger.

It seemed that a full second

passed before they felt the ground beneath them ripple and shake. A rumbling sound was added to the storm's roar.

The Fedaykin watcher from the telescope appeared beside Paul, the telescope clutched under one arm. "The shield wall is breached, Muad-Dib!" he shouted. "The storm is on them and our gunners already are firing."

Paul thought of the storm sweeping across the basin, the static charge within the wall of sand that destroyed every shield barrier in the enemy camp.

"The storm!" someone shouted. "We must get under cover, Muad-Dib!"

Paul came to his senses, feeling the sand needles sting his exposed cheeks. *We are committed,* he thought. He put an arm around the signalman's shoulder, said: "Leave the equipment! There's more in the tunnel." He felt himself being pulled away, Fedaykin pressing around him to protect him. They squeezed into the tunnel mouth, feeling its comparative silence, turned a corner into a small chamber with glowglobes overhead and another tunnel opening beyond.

Here, another signalman sat at his equipment.

"Much static," the man said.

A swirl of sand filled the air around them.

"Seal off this tunnel!" Paul shouted. A sudden pressure of stillness showed that his command had been obeyed. "Is the way down to the basin still open?" Paul asked.

A Fedaykin went to look, returned, said: "The explosion caused a little rock to fall, but the engineers say it is still open. They're cleaning up some with lasbeams."

"Tell them to use their hands!" Paul barked. "There may be shields active down there!"

"They are being careful, Muad-Dib," the man said, but he turned to obey.

The signalmen from outside pressed past them carrying their equipment.

"I told those men to leave their equipment!" Paul said.

"Fremen do not like to abandon equipment, Muad'Dib," one of his Fedaykin chided.

"Men are more important than equipment now," Paul said. "We'll have more equipment soon or have no need for any equipment."

Gurney Halleck came up beside him, said: "I heard them say the way down is open. We're very close to the surface here, M'Lord, should the Harkonnens try to retaliate in kind."

"They're in no position to retaliate," Paul said. "They're just now finding out that they have no shields and are unable to get off Arrakis."

"The new command post is all prepared, M'Lord," Gurney said.

"They've no need of me in the command post yet," Paul said. "The plan would go ahead without me. We must wait for the—"

"I'm getting a message, Muad-Dib," said the signalman at the equipment set up in their chamber. The man shook his head, pressed a receiver phone against his ear. "Much static!" He began scribbling on a pad in front of him, shaking his head, waiting, writing . . . waiting.

Paul crossed to the signalman's side, saw the Fedaykin step back, giving him room. He looked down at what the man had written, read:

"Raid . . . on sietch Tabr . . . captives . . . Alia (blank) families of (blank) dead are . . . they (blank) son of Muad'Dib . . ."

Again, the signalman shook his head.

Paul looked up to see Gurney staring at him.

"The message is garbled," Gurney said. "The static. You don't know that—"

"My son is dead," Paul said and knew as he spoke that it was true. "My son is dead . . . and Alia is a captive . . . hostage." He felt emptied, a shell without feelings. Everything he touched brought death and grief. And it was like a disease that could spread across the universe.

Yet he could feel the old-man wisdom, that accumulation out of the experiences of countless possible lives, seeming to chuckle and rub its wizened hands within him.

And Paul thought: *How little the universe knows about the nature of real cruelty!*

XXV

And Muad'Dib stood before them and said: "Though we deem the captive dead, yet does she live even if she were truly dead. For her seed is my seed and her voice is my voice. And she sees unto the farthest reaches of possibility, yea unto the vale of the unknowable does she see because of me."

"Arrakis Awakening"
by The Princess Irulan

The Baron Vladimir Harkonnen stood with eyes downcast in the Imperial audience chamber, the oval *selamlik* within the Padishah Emperor's hutment. With covert glances, the Baron had studied the metal-walled room and its occupants—noukkers, pages, guards, the troop of House Sardaukar drawn up around the walls beneath the bloody and tattered captured battle flags that were the room's only decoration.

Voices sounded from the right, echoing out of a high passage: "Make way! Make way for the Royal Person!"

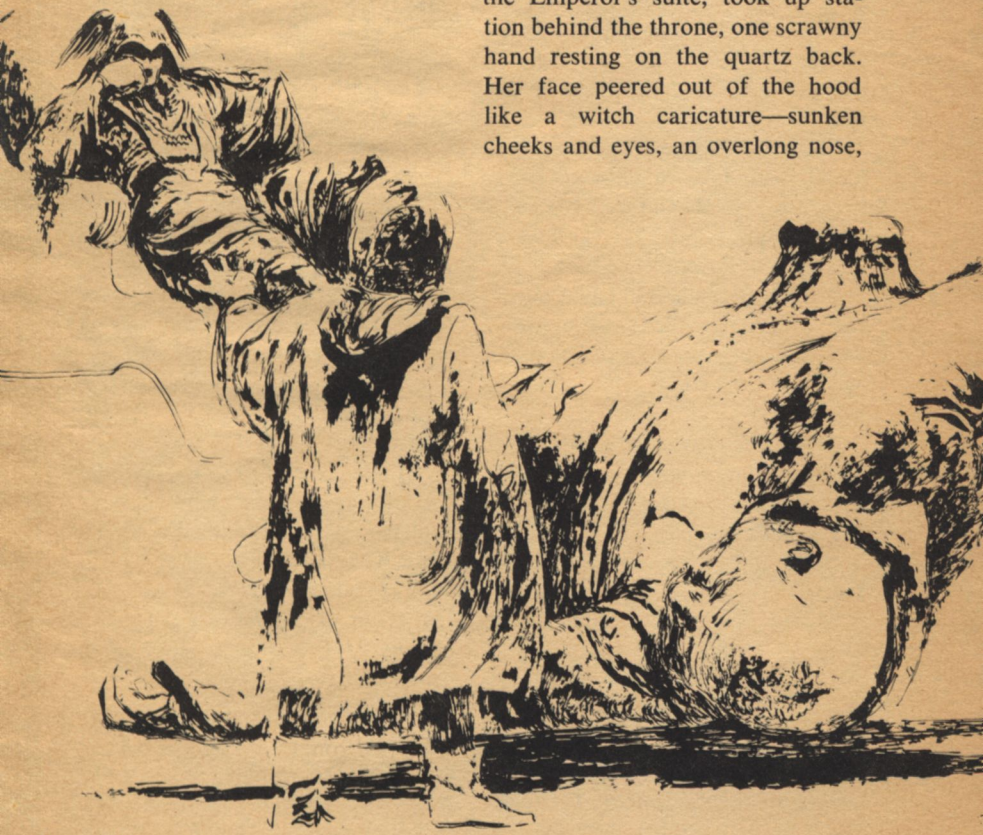
The Padishah Emperor Shaddam IV entered the audience chamber followed by his suite. He stood waiting, ignoring the Baron, seemingly ignoring everything about the room while his throne was brought.

The Baron found that *he* could not ignore the Imperial Person, and studied the Emperor for a sign, any clue to the purpose for this audi-

ence. The Emperor stood poised—a slim, elegant figure in a gray Sardaukar uniform with silver and gold trim. His thin face and cold eyes reminded the Baron of the Duke Leto long dead—that same look of the predatory bird. But the Emperor's hair was red, not black, and most of it concealed by a Burseg's ebon helmet with the Imperial crest in gold upon its crown.

Pages brought the throne. It was a massive chair carved from a single piece of Hagal quartz—blue green translucency shot through with streaks of yellow fire. They placed it on the dais and the Emperor mounted, seated himself.

An old woman in a black aba robe with hood drawn down over her forehead detached herself from the Emperor's suite, took up station behind the throne, one scrawny hand resting on the quartz back. Her face peered out of the hood like a witch caricature—sunken cheeks and eyes, an overlong nose,



skin mottled and with protruding veins.

The Baron stilled his trembling at sight of her. The presence of the Reverend Mother Gaius Helen Mohiam, the Emperor's Truthsayer, betrayed the importance of this audience. The Baron looked away from her, studied the suite for a clue. There were two of the Guild agents, one tall and fat, one short and fat, both with bland gray eyes. And among the lackeys stood one of the Emperor's daughters, the Princess Irulan, a woman they said was being trained in the deepest of the Bene Gesserit Ways, destined to be a Reverend Mother. She was tall, blond, with face of chiseled beauty, green eyes that looked past and through him.

"My dear Baron."

The Emperor had deigned to notice him. The voice was baritone and with exquisite control. It managed to dismiss him while greeting him.

The Baron bowed low, advanced to the required position ten paces from the dais. "I came at your summons, Majesty."

"Summons!" the old witch cackled.

"Now, Reverend Mother," the Emperor chided, but he smiled at the Baron's discomfiture, said: "First, you will tell me where you've sent your minion, Thufir Hawat."

The Baron darted his gaze left and right, reviled himself for coming here without his own guards, not that they'd be much use against Sardaukar. Still—

"Well?" the Emperor said.

"He has been gone these five days, Majesty." The Baron shot a glance at the Guild agents, back to the Emperor. "He was to land at a smuggler base and attempt infiltrating the camp of the Fremen fanatic, this Muad'Dib."

"Incredible!" the Emperor said.

One of the witch's clawlike hands tapped the Emperor's shoulder. She leaned forward, whispered in his ear.

The Emperor nodded, said: "Five days, Baron. Tell me, why aren't you worried about his absence?"

"But I *am* worried, Majesty!"

The Emperor continued to stare at him, waiting. The Reverend Mother emitted a cackling laugh.

"What I mean, Majesty," the Baron said, "is that Hawat will be dead within another few hours anyway." And he explained about the latent poison and need for an antidote.

"How clever of you, Baron," the Emperor said. "And where are your nephews, Rabban and the young Feyd-Rautha?"

"The storm comes, Majesty, I sent them to inspect our perimeter lest the Fremen attack under cover of the sand."

"Perimeter," the Emperor said. The word came out as though it puckered his mouth. "The storm won't be much here in the basin, and that Fremen rabble won't at-

tack while I'm here with five legions of Sardaukar."

"Surely not, Majesty," the Baron said, "but error on the side of caution cannot be censured."

"Ahhh," the Emperor said. "Censure. Then I'm not to speak of how much time this Arrakis thing has taken from me? Nor the Choam Company profits pouring down this rat hole? Nor the court functions and affairs of State I've had to delay —even cancel!—because of this stupid affair?"

The Baron lowered his gaze, frightened by the Imperial anger. The delicacy of his position here, alone and dependent upon the Convention and the dictum familia of the Great Houses, fretted him. *Does he mean to kill me?* the Baron asked himself. *He couldn't! Not with the other Great Houses waiting up there, aching for any excuse to gain from this upset on Arrakis.*

"Have you taken hostages?" the Emperor asked.

"It's useless, Majesty," the Baron said. "These mad Fremen hold a burial ceremony for every captive and act as though such a one were already dead."

"So?" the Emperor said.

And the Baron waited, glancing left and right at the metal walls of the *selamlik*, thinking of the monstrous fanmetal tent around him. Such unlimited wealth it represented that even the Baron was awed. *He brings pages*, the Baron thought, *and useless court lackeys, his women and their companions—hairdressers, designers, everything . . . all the fringe parasites of the Court. All here—fawning, slyly plotting, "roughing it" with the Emperor . . . here to watch him put an end to this affair, to make epigrams over the battles and idolize the wounded.*

"Perhaps you've never sought the right hostages," the Emperor said.

He knows something, the Baron thought. Fear sat like a stone in his stomach until he could hardly bear the thought of eating. Yet, the feeling was like hunger, and he poised himself several times in his suspensors on the point of ordering food brought to him. But there was no one here to obey his summons.

"Do you have any idea who this Muad'Dib could be?" the Emperor asked.

"One of the Umma, surely," the Baron said. "A Fremen fanatic, a religious adventurer. They crop up regularly on the fringes of civilization. Your Majesty knows this."

The Emperor glanced at his Truthsayer, turned back to scowl at the Baron. "And you have no other knowledge of this Muad'Dib?"

"A madman," the Baron said. "But all Fremen are a little mad."

"Mad?"

"His people scream his name as they leap into battle. The women throw their babies at us and hurl themselves onto our knives to open a wedge for their men to attack us. They have no . . . no . . .decency!"

"As bad as that," the Emperor murmured, and his tone of derision did not escape the Baron. "Tell me, my dear Baron, have you investigated the southern polar regions of Arrakis?"

The Baron stared up at the Emperor, shocked by the change of subject. "But . . . well, you know, Your Majesty, the entire region is uninhabitable, open to wind and worm. There's not even any spice in those latitudes."

"You've had no reports from spice lighters that patches of greenery appear there?"

"There've always been such reports. Some were investigated—long ago. A few plants were seen. Many 'thopters were lost. Much too costly, Your Majesty. It's a place where men cannot survive for long."

"So," the Emperor said. He snapped his fingers and a door opened at his left behind the throne. Through the door came two Sardaukar herding a girlchild who appeared to be about four years old. She wore a black aba, the hood thrown back to reveal the attachments of a stillsuit hanging free at her throat. Her eyes were Fremen blue, staring out of a soft round face. She appeared completely unafraid and there was a look to her stare that made the Baron feel uneasy for no reason he could explain.

Even the old Bene Gesserit Truthsayer drew back as the child passed and made a warding sign in her direction. The old witch obviously was shaken by the child's presence.

The Emperor cleared his throat to speak, but the child spoke first—a thin voice with traces of a soft-palate lisp, but clear nonetheless. "So here he is," she said. She advanced to the edge of the dais. "He doesn't appear much, does he—one frightened old fat man too weak to support his own flesh without the help of suspensors."

It was such a totally unexpected statement from the mouth of a child that the Baron stared at her, speechless in spite of his anger. *Is it a midget?* he asked himself.

"My dear Baron," the Emperor said, "be acquainted with the sister of Muad'Dib."

"The sist . . ." The Baron shifted his attention to the Emperor. "I do not understand."

"I, too, sometimes err on the side of caution," the Emperor said. "It has been reported to me that your *uninhabited* south polar regions exhibit evidence of human activity."

"But that's impossible!" the Baron protested. "The worms . . . there's sand clear to the—"

"These people seem able to avoid the worms," the Emperor said.

The child sat down on the dais beside the throne, dangled her feet over the edge, kicking them. There was such an air of sureness in the way she appraised her surroundings.

The Baron stared at the kicking feet, the way they moved the black

robe, the wink of sandals beneath the fabric.

"Unfortunately," the Emperor said, "I only sent in five troop carriers with a light attack force to pick up prisoners for questioning. We barely got away with three prisoners and one carrier. Mind you, Baron, my Sardaukar were almost overwhelmed by a force composed mostly of women, children and old men. This child here was in command of one of the attacking groups."

"You see, Your Majesty!" the Baron said. "You see how they are!"

"I allowed myself to be captured," the child said. "I did not want to face my brother and have to tell him that his son had been killed."

"Only a handful of our men got away," the Emperor said. "Got away! You hear that?"

"We'd have had them, too," the child said, "except for the flames."

"My Sardaukar used the attitudinal jets on their carrier as flame throwers," the Emperor said. "A move of desperation and the only thing that got them away with their three prisoners. Mark that, my dear Baron: Sardaukar forced to retreat in confusion from women and children and old men!"

"We must attack in force," the Baron rasped. "We must destroy every last vestige of—"

"Silence!" the Emperor roared. He pushed himself forward on his throne. "Do not abuse my intelligence any longer. You stand there in your foolish innocence and—"

"Majesty," the Truthsayer said.

He waved her to silence. "You say you don't know about the activity we found, nor the fighting qualities of these superb people!" The Emperor lifted himself half off his throne. "What do you take me for, Baron?"

The Baron took two backward steps, thinking: *It was Rabban. He has done this to me. Rabban has—*

"And this fake dispute with Duke Leto," the Emperor purred, sinking back into his throne. "How beautifully you maneuvered it."

"Majesty," the Baron pleaded. "What are you—"

"Silence!"

The old Bene Gesserit put a hand on the Emperor's shoulder, leaned close to whisper in his ear.

The child seated on the dais stopped kicking her feet, said: "Make him afraid some more, Shaddam. I should not enjoy this, but I cannot help it."

"Quiet, child," the Emperor said. He leaned forward, put a hand on her head, stared at the Baron. "Is it possible, Baron? Could you be as simple minded as my Truthsayer suggests? Don't you recognize this daughter of your ally, Duke Leto?"

"My father was never his ally," the child said. "My father is dead. This old beast has never seen me before."

The Baron was reduced to stupefied glaring. When he found his voice it was to rasp: "Who is she?"

"I am Alia, daughter of Duke Leto and Lady Jessica, sister of Duke Paul-Muad'Dib," she said. She pushed herself off the dais to the floor of the audience chamber. "My brother has promised to have your head on his battle standard, Harkonnen, and I think he shall."

"Be hush, child," the Emperor said. He sank back onto his throne, hand to chin, studying the Baron.

"I do not take the Emperor's orders," Alia said. She glanced up at the old Reverend Mother. "She knows."

The Emperor shot a hard stare at his Truthsayer. "Now, what does that prattle mean?"

"That child's an abomination!" the old woman said. "Her mother deserves punishment greater than anything in history. Death cannot come too quickly for that monster-child nor the one who spawned her!" The old woman pointed a finger at Alia. "Get out of my mind!"

"T-P?" the Emperor whispered. He snapped his attention back to Alia. "By the Great Mother!"

"You don't understand, Sire," the old woman said. "Not telepathy. She's in my mind. She's like the ones before me, the ones who gave me their memories. She stands in my mind! She cannot be there, but she is!"

"What others?" the Emperor demanded. "What's this nonsense?"

The old woman straightened, lowered her pointing hand. "I've said too much, but the fact remains that this *child* who is not a child must be destroyed. Long were we warned against such a one and how to prevent such a birth, but one of our own has betrayed us."

"You babble, old woman," Alia said. "You don't know how it was, yet you rattle on like a pureblind fool." Alia closed her eyes, took a deep breath and held it.

The old Reverend Mother groaned and staggered.

Alia opened her eyes. "That is how it was," she said. "A cosmic accident . . . and you played your part in it."

The Reverend Mother held out both hands, palms pushing the air toward Alia.

"What is happening here?" the Emperor demanded. "Child, can you truly project your thoughts into the mind of another?"

"That's not how it is at all," Alia said. "Unless I'm born as you, I cannot think as you."

"Kill her," the old woman muttered, and clutched the back of the throne for support. "Kill her!" The sunken old eyes glared at Alia.

"Silence," the Emperor said, and he studied Alia. "Child, can you communicate with your brother?"

"My brother knows I'm here," Alia said.

"Can you tell him to surrender as the price of your life?"

Alia smiled up at him with clear

innocence. "I shall not do that," she said.

The Baron stumbled forward to stand beside Alia. "Majesty," he pleaded. "I knew nothing of—"

"Interrupt me once more, Baron," the Emperor said, "and you will lose the powers of interruption . . . forever." He kept his attention focused on Alia, studying her through slitted lids. "You will not, eh? Can you read in my mind what I'll do if you disobey me?"

"I've already said I cannot read minds," she said, "but one doesn't need telepathy to read your intentions."

The Emperor scowled. "Child, your cause is hopeless. I have but to rally my forces and reduce this planet to—"

"It's not that simple," Alia said. She looked at the two Guildsmen. "Ask them."

"It is not wise to go against my desires," the Emperor said. "You should not deny me the least thing."

"My brother comes now," Alia said. "Even an Emperor may tremble before Muad'Dib, for he has the strength of righteousness and Heaven smiles upon him."

The Emperor surged to his feet. "This play has gone far enough. I will take your brother and this planet and grind them to—"

The room rumbled and shook around them. There came a sudden cascade of sand behind the throne where the hutment was coupled to the Emperor's ship. The abrupt flicker-tightening of skin pressure told of a wide-area shield being activated.

"I told you," Alia said. "My brother comes."

The Emperor stood in front of his throne, right hand pressed to right ear, the servo-receiver there chattering its report on the situation. The Baron moved two steps behind Alia. Sardaukar were leaping to positions at the doors.

"We will fall back into space and reform," the Emperor said. "Baron, my apologies. These madmen *are* attacking under cover of the storm. We will show them an Emperor's wrath, then." He pointed at Alia. "Throw her body into the storm."

As she spoke, Alia fled backward, feigning terror. "Let the storm have what it can take!" she screamed. She backed into the Baron's arms.

"I have her, Majesty!" the Baron shouted. "Shall I dispatch her noweeeeeeeeeh!" He hurled her to the floor, clutched his left arm.

"Regrets, grandfather," Alia said. "You've met the Atreides gom jabbar." She got to her feet, dropping a dark needle.

The Baron's eyes bulged as he stared at a red slash on his left palm. "You . . . you—" He rolled sideways in his suspensors, a sagging mass of flesh supported inches off the floor with mouth hanging open and head lolling.

"These Fremen are insane," the Emperor snarled. "Quick! Into the ship. We'll purge this planet of every—"

Something sparkled to his left. A roll of ball lightning bounced from the wall there, crackled as it touched the metal floor. Burned insulation odor swept through the selamlik.

"The shield!" a Sardaukar officer shouted. "The outer shield's down! They've—"

His words were drowned in a metallic roar as the ship wall behind the Emperor rocked and trembled.

"They've shot the nose off our ship!" someone shouted.

Dust boiled through the room. Under its cover, Alia darted around the Baron's body and ran toward the outer doors.

The Emperor whirled, motioned his people into an emergency door that swung open in the ship's side behind the throne. He flashed a hand signal to a Sardaukar officer leaping through the dust haze toward him. "We'll make our stand here!"

Another crash shook the hutment. The double doors at the far side of the chamber banged open to admit wind-blown sand and the sound of shouting. A small black-robed figure could be seen momentarily against the light then was gone. Alia had darted out into the battle to find a knife and, as fitted her Fremen training, to kill Harkonnen and Sardaukar wounded.

The Emperor saw his House Sardaukar charge through greened yellow haze toward the opening, their weapons ready, forming an arc there to protect the Royal Person as he retreated. "Save yourself, Sire!" an officer shouted. "Into the ship!"

But the Emperor stood alone on his dais now pointing a hand toward the doors. An entire section of the hutment had been blasted away there and the selamlik's doors stood open to the sand. A dust cloud hung low over the outside world blowing from pastel distances. Static lightning crackled from the cloud and spark flashes of shields being shorted out by the storm's charge could be seen through the haze. The plain surged with figures in combat—Sardaukar and leaping, gyrating robed figures who seemed to come down out of the cloud.

All this was as a frame for the target of the Emperor's pointing hand.

Out of the sand haze came an orderly mass of flashing shapes—great rising curves with crystal spokes that resolved into the gaping mouths of sandworms, a massed wall of them and each with its troops of Fremen riding to the attack. They came in a wedge, their robes whipping in the wind, and they cut through the disorder of the plain.

Onward toward the hutment

they came while the House Sardaukar stood awed for the first time in their history by an onslaught their minds could not accept.

But the figures leaping from the worm backs were men, and the blades flashing in that ominous yellow light were a thing the Sardaukar had been trained to face. They threw themselves into combat. And it was man to man on the plain of Arrakeen while a picked Sardaukar bodyguard pressed the Emperor back into the ship, sealed the door on him, and prepared to die at that door as part of his shield.

In the shock of comparative silence within the ship, the Emperor stared at the wide-eyed faces of his suite, seeing his eldest daughter with the flush of exertion on her cheeks, the old Truthsayer standing like a black shadow with her hood pulled about her face, finding at last the faces he sought—the two Guildsmen. They wore the Guild gray, unadorned, and it seemed to fit the calm they maintained despite the emotions around them.

The taller of the two, though, was holding a hand to his left eye. As the Emperor watched, someone jostled the Guildsman's arm, the hand moved, and the eye was revealed. The man had lost one of his masking contact lenses, the Emperor saw, and the eye stared out at him a total blue so dark as to be almost black.

The smaller of the pair elbowed his way a step nearer the Emperor, said: "We cannot know how it will go." And the taller companion, hand restored to eye, added in a cold voice: "But this Muad'Dib cannot know, either."

The words shocked the Emperor out of his daze. He checked the scorn on his tongue by a visible effort because it did not take a Guild navigator's single-minded focus on the main chance to see the immediate future out on that plain. Were these two so dependent upon their *faculty* that they had lost the use of their eyes and their reason, he wondered.

"Reverend Mother," he said, "we must devise a plan."

She pulled the hood from her face, met his gaze with an unblinking stare. The look that passed between them carried complete understanding. They had one weapon left and both knew it: Treachery.

XXVI

He was warrior and mystic, ogre and saint, the fox and the innocent, chivalrous, ruthless, less than a god, more than a man. There is no measuring Muad'Dib's motives by ordinary standards. In the moment of his triumph, he saw the death prepared for him, yet he accepted the treachery. Can you say he did this out of a sense of justice? Whose justice? Remember, we speak now of the Muad'Dib who ordered battledrums made from his enemies'

skins, the Muad'Dib who denied the conventions of his Ducal past with a wave of the hand, saying merely: "I am the Kwisatz Haderach. That is reason enough."

"Arrakis Awakening"
by The Princess Irulan

It was to the Arrakeen governor's mansion, the old Residence that the Atreides had first occupied on the planet, that they escorted Paul-Muad'Dib on the evening of his victory. The building stood as Rabban had restored it, virtually untouched by the fighting although there had been looting by townspeople. Some of the furnishing in the main hall had been overturned or smashed.

Paul strode through the main entrance with Gurney Halleck and Stilgar a pace behind. Their escort fanned out into the Great Hall, straightening the place and clearing an area for Muad'Dib. One squad began investigating that no sly trap had been planted here.

"I remember the day we first came here with your father," Gurney said. He glanced around at the beams and the high, slitted windows. "I didn't like this place then and I like it less now. One of our caves would be safer."

"Spoken like a true Fremen," Stilgar said, and he marked the cold smile that his words brought to Muad'Dib's lips. "Will you reconsider, Muad'Dib?"

"This place is a symbol," Paul said. "Rabban lived here. By occupying this place I seal my victory for all to understand. Send men through the building. Touch nothing. Just be certain no Harkonnen people or toys remain."

"As you command," Stilgar said, and reluctance was heavy in his tone as he turned to send men as Muad'Dib had ordered.

Communications men hurried into the room with their equipment, began setting up near the massive fireplace. The Fremen guard that augmented the surviving Fedaykin took up stations around the room. There was muttering among them, much darting of suspicious glances. This had been too long a place of the enemy for them to accept their presence in it casually.

"Gurney, have an escort bring my mother and Chani," Paul said. "Does Chani know yet about our son?"

"The message was sent, M'Lord."

"Are the Makers being taken out of the basin yet?"

"Yes, M'Lord. The storm's almost spent."

Paul crossed the hall, seeing a chair against the wall. The chair had once stood in the dining hall and might even have held his own father. At the moment, though, it was only an object to rest his weariness and conceal it from the men. He sat down, pulling his robes around his legs, loosening the fit of his stillsuit at the neck.

"The Emperor is still holed up

in the remains of his ship," Gurney said.

"For now, contain him there," Paul said. "Have they found the Harkonnens yet?"

"They're still examining the dead."

"What reply from the ships up there?" He jerked his chin toward the ceiling.

"No reply yet, M'Lord."

Paul sighed, resting against the back of his chair. Presently, he said: "Bring me a captive Sardaukar. We must send a message to the Emperor. It's time to discuss terms."

"Yes, M'Lord."

Gurney turned away, dropped a hand signal to one of the Fedaykin who took up close-guard position beside Paul.

Paul closed his eyes, turned over in his mind the accumulated strangeness of this day, the mixed futures that he had absorbed, and the abrupt *presence* of his sister, Alia, within his awareness.

"I have breasted the future to place my words where only you can hear them," she had said. "Even you cannot do that, my brother. I find it an interesting toy. And . . . oh, yes—I've killed our grandfather, the demented old Baron."

And she was gone.

Paul sensed Stilgar's presence, opened his eyes. The black bearded Fremen stood in front of him, eyes glaring with battle light.

"You've found the body of the old Baron," Paul said.

"We just found him in that great pile of metal the Emperor built," Stilgar said. "How did you know?"

Paul ignored the questioning, seeing Gurney return accompanied by two Fremen who supported a captive Sardaukar between them.

"Here's one of them, M'Lord," Gurney said as he signed for the bound captive to be held five paces in front of Paul.

The Sardaukar's eyes, Paul noted, carried a dazed expression. A blue bruise stretched down from the bridge of his nose to the corner of his mouth. He was one of the blond, chisel-featured ones with the look that seemed synonymous with rank among the Sardaukar, yet there were no insignia on his torn uniform except the gold buttons with the Emperial crest and the tattered braid of his trousers.

"I think this one's an officer, M'Lord," Gurney said.

Paul nodded, said: "I am the Duke Paul Atreides. Do you understand that, man?"

The Sardaukar stared at him unmoving.

"Speak up," Paul said, "or your Emperor may die."

The man blinked, swallowed.

"Who am I?" Paul demanded.

"You are the Duke Paul Atreides," the man husked.

He seemed too submissive to Paul, but then the Sardaukar had never been prepared for such hap-

penings as this day. They'd never known anything but victory which, Paul realized, could be a weakness in itself. He put that thought aside for later consideration in his own training program.

"I have a message for you to carry to the Emperor," Paul said. And he couched his words in the ancient formula: "I, a Duke of a Great House, an Imperial Kinsman, give my word of bond under the Convention. If the Emperor and his people lay down their arms and come to me here I will guard their lives with my own." Paul held up his left hand with the Ducal signet for the Sardaukar to see. "I swear it by this."

The man wet his lips with his tongue, glanced at Gurney.

"Yes," Paul said. "Who but an Atreides could command the allegiance of Gurney Halleck."

"I will carry the message," the Sardaukar said.

"Take him to our forward command post and send him in," Paul said.

"Yes, M'Lord." Gurney motioned for the guard to obey, led them out.

Paul turned back to Stilgar.

"Chani and your mother have arrived," Stilgar said. "The guard brought them to the rear. Chani has asked time to be alone with her grief. The Reverend Mother has gone to the weirding room that the beast Rabban restored."

"My mother's sick with longing for a planet she may never again see," Paul said. "Where water falls from the sky and plants grow so thick you cannot walk between them."

"Water from the sky," Stilgar whispered.

In that instant, Paul saw how Stilgar had been transformed from the Fremen Naib to a *creature* of the Lisan al-Gaib, a receptacle for awe and obedience. It was a lessening of the man, and Paul felt the ghost wind of the jihad brush him.

I have seen a friend become a worshiper, he thought.

In a rush of loneliness, Paul glanced around the room, seeing how proper and on-review his guards had become in his presence. He sensed the subtle, prideful competition among them—each hoping for notice from Muad'Dib.

Muad'Dib, from whom all blessings flow, he thought, and it was the bitterest thought of all his life.

"Rabban, of course, is dead," Paul said, addressing Stilgar.

"Yes . . . Muad'Dib."

Guards to Paul's right suddenly snapped aside, standing at attention to open an aisle for Jessica who entered from the rear of the Residency. She wore her black aba and walked with a hint of striding across sand, but Paul noted how this house had restored something to her of what she had once been here—concubine to a ruling Duke and mother of the Ducal heir.

There was an old assertiveness and command in her presence.

Jessica crossed to Paul, stood looking down at him. She saw his fatigue and how he hid it from the men, but found no compassion for him. It was as though she had been rendered incapable of *any* emotion for her son.

"Where is Alia?" she asked.

"Out doing what any good Fremen child should be doing in such times," Paul said. "She's killing enemy wounded and marking their bodies for recovery of the water."

"Paul!"

"One must understand that she does this out of kindness," Paul said. "Isn't it strange that we misunderstand how close kindness is to cruelty?"

Jessica glared at him, shocked into awareness of the profound change in him—a change deeply disturbing. "The men tell strange stories of you, Paul," she said. "They say you have all the powers of their legend—that nothing is hidden from you, that you see where others cannot."

"A Bene Gesserit should wonder about legends?" he asked.

"I know I've had a hand in whatever you are," she said, "but I can still—"

"How would you like to live a billion billion lives in just a few years?" Paul asked. "There's a fabric of legends for you! Think of all those experiences, the possibilities, and the wisdom they'd bring. But wisdom tempers love, doesn't it? And it puts a new shape on hate. How can you tell what's ruthless unless you've been both cruel and kind? I am the Kwisatz Haderach, Mother. You should fear me."

"Once you denied to me that you were the Kwisatz Haderach," Jessica said.

Paul shook his head. "I can deny nothing anymore." He looked up into her eyes. "The Emperor and his people come now. They will be announced any moment. Stand beside me. I wish a clear view of them for my future bride will be among them."

"Paul!" Jessica snapped. "Don't make the mistake your father made!"

"She's a princess," Paul said. "She's my key to the throne, and that's all she'll ever be. Mistake? You think because I'm what you made me that I cannot feel the need for revenge?"

"Even on the innocent?"

"There are no innocent anymore."

"Tell that to Chani," Jessica said, and gestured toward the passage from the rear of the Residency.

Chani entered the Great Hall there, walking between the Fremen guards as though unaware of them. Her hood and stillsuit cap were thrown back, face mask fastened aside. She walked with a fragile uncertainty as she crossed the room to stand beside Jessica.

Paul saw the marks of tears on her cheeks—*She gives water to the dead.* He felt a pang of grief strike through him, but it was as though he could only feel this thing through Chani's presence.

"He is dead, beloved," Chani said. "Our son is dead."

Holding himself under stiff control, Paul got to his feet. He reached out, touched Chani's cheek, feeling the dampness of her tears. "He cannot be replaced," Paul said, "but there will be other sons. It is Usul who promises this." Gently, he moved her aside, gestured to Stilgar.

"Muad'Dib," Stilgar said.

"They come from the ship, the Emperor and his people," Paul said. "I will stand here. Assemble the captives in an open space in the center of the room. They will be kept at a distance of ten meters from me unless I command otherwise."

"As you command, Muad'Dib."

As Stilgar turned to obey, Paul heard the awed muttering of Fremen guards: "You see? He knew! No one told him, but he knew!"

The Emperor's entourage could be heard approaching now, his Sardaukar humming one of their marching tunes to keep up their spirits. There came a murmur of voices at the entrance and Gurney Halleck passed through the guard, crossed to confer with Stilgar, then moved to Paul's side, a strange look in his eyes.

Will I lose Gurney, too? Paul wondered. *The way I lost Stilgar—losing a friend to gain a creature?*

"They have no throwing weapons," Gurney said. "I've made sure of that myself." He glanced around the room, seeing Paul's preparations. "Feyd-Rautha Harkonnen is with them. Shall I cut him out?"

"Leave him."

"There're some Guild people, too, demanding special privileges, threatening an embargo against Arrakis. I told them I'd give you their message."

"Let them threaten."

"Paul!" Jessica hissed behind him. "He's talking about the Guild!"

"I'll pull their fangs presently," Paul said.

"There's also a Bene Gesserit Reverend Mother says she's a friend of your mother."

"My mother has no Bene Gesserit friends."

Again, Gurney glanced around the Great Hall, then bent close to Paul's ear. "Thufir Hawat's with 'em, M'Lord. I had no chance to see him alone, but he used our old hand signs to say he's been working with the Harkonnens, thought you were dead. Says he's to be left among them."

"You left Thufir among those—"

"He wanted it . . . and I thought it best. If . . . there's something wrong, he's where we can control him. If not—we've an ear on the other side."

Paul thought then of a prescient glimpse into this possible future, knowing that Thufir carried a poisoned needle which the Emperor hoped would be used against "the upstart Duke."

Gurney signaled Stilgar who nodded.

Guards at the entrance stepped aside, formed a short corridor of lances. There came a murmurous swish of garments, feet rasping on sand that had drifted in from the entrance.

The Padishah Emperor Shaddam IV led his people into the hall. His burseg helmet had been lost and the red hair stood out in disarray. His uniform's left sleeve had been ripped along the inner seam. He was beltless and without weapons, but his presence moved with him like a force-shield bubble that kept his immediate area free of people.

A Fremen lance dropped across his path, stopped him where Paul had ordered. The others bunched up behind, a montage of color movement, shuffling and staring at Paul and the room.

Paul swept his glance across the group, saw women who hid signs of weeping, saw the lackeys who had come to enjoy the sights of a Sardaukar victory and now stood choked to silence by defeat. And Paul saw the bird bright eyes of the Reverend Mother Gainus Helen Mohiam glaring beneath her black hood, and beside her the narrow furtiveness of Feyd-Rautha Harkonnen.

He saw, too, the remnants of the Sardaukar men and officers with bitterness on their faces and desperation. Here and there among them, a face caught Paul's attention briefly: Sardaukar officers measuring the preparations within this room, planning and scheming yet for a way to turn defeat into victory.

Paul's attention came at last to a tall blond woman, green eyed, a face of patrician beauty, classic in its hauteur, untouched by tears, completely undefeated. Without being told it, Paul knew her—a Princess Royal, Bene Gesserit-trained.

There's my key, he thought.

Then he saw movement in the clustered people, a face and figure emerged—Thufir Hawat, the seamed old face with darkly stained lips, the hunched shoulders, the look of fragile age about him that Paul knew to be carefully cultivated deception.

"There's Thufir Hawat," Paul said. "Let him stand free, Gurney."

"M'Lord," Gurney said.

"Let him stand free," Paul repeated.

Gurney nodded.

Hawat shambled forward as a Fremen lance was lifted and replaced behind him. The rheumy eyes peered at Paul, measuring, seeking.

Paul stepped forward one pace, sensed the tense, waiting move-

ment of the Emperor and his people.

Hawat's gaze stabbed past Paul, and the old man said: "Lady Jessica, I but learned this day how I've wronged you in my thoughts. You needn't forgive."

Paul waited, but his mother remained silent.

"Thufir, old friend," Paul said, "as you can see, my back is toward no door."

"The universe is full of doors," Hawat said.

"Am I my father's son?" Paul asked.

"More like your grandfather's," Hawat rasped. "You've his manner and the look of him in your eyes."

"Yet I'm my father's son," Paul said. "For I say to you, Thufir, that in payment for your years of service to my family you may now ask anything you wish of me. Anything at all. Do you need my life now, Thufir? It is yours." Paul stepped forward a pace, hands at his side, seeing the look of awareness grow in Hawat's eyes.

He realizes that I know of the treachery, Paul thought.

Pitching his voice to carry in a half-whisper for Hawat's ears alone, Paul said: "I mean this, Thufir. If you're to strike me, do it now."

"I but wanted to stand before you once more, my Duke," Hawat said. And Paul became aware for the first time of the effort the old man exerted to keep from falling. Paul reached out, supported Hawat by the shoulders, feeling the muscle tremors beneath his hands.

"Is there pain, old friend?" Paul asked.

"There is pain, my Duke," Hawat agreed, "but the pleasure is greater." He half turned in Paul's arms, extended his left hand, palm up, toward the Emperor, exposing the tiny needle cupped against the fingers. "See Majesty?" he called. "See your traitor's needle? Did you think that I who've given my life to service of the Atreides would give them less now?"

Paul staggered as the old man sagged in his arms, felt the death there, the utter flaccidity. Gently, Paul lowered Hawat to the floor, straightened and signed for guardsmen to carry the body away.

Silence held the hall while his command was obeyed.

A look of deadly waiting held the Emperor's face now. Eyes that had never admitted fear admitted it at last.

"Majesty," Paul said, and noted the jerk of surprised attention in the tall Princess Royal. The word had been uttered with the Bene Gesserit controlled atonals, carrying in it every shade of contempt and scorn that Paul could put into it.

Bene Gesserit-trained, indeed, Paul thought.

The Emperor cleared his throat, said: "Perhaps my respected kins-

man believes he has things all his own way now. Nothing could be more remote from fact. You have violated the Convention, used Atomics against—"

"I used atomics against a natural feature of the desert," Paul said. "It was in my way and I was in a hurry to get to you, Majesty, to ask your explanation for some of your strange activities."

"There's a massed armada of the Great Houses in space over Arrakis right now," the Emperor said. "I've but to say the word and they'll—"

"Oh, yes," Paul said, "I almost forgot about them." He searched through the Emperor's suite until he saw the faces of the two Guildsmen, spoke aside to Gurney. "Are those the Guild agents, Gurney, the two fat ones dressed in gray over there?"

"Yes, M'Lord."

"You two," Paul said, pointing. "Get out of there immediately and dispatch messages that will get that fleet on its way home. After this, you'll ask my permission before—"

"The Guild doesn't take your orders!" the taller of the two barked. He and his companion pushed through to the barrier lances which were raised at a nod from Paul. The two men stepped out and the taller leveled an arm at Paul, said: "You may very well be under embargo for your—"

"If I hear any more nonsense from either of you," Paul said, "I'll give the order that'll destroy all spice production on Arrakis . . . forever."

"Are you mad?" the tall Guildsman demanded.

"You grant that I have the power to do this thing, then?" Paul asked.

The Guildsman seemed to stare into space for a moment, then: "Yes, you could do it, but you must not."

"Ahhh," Paul said and nodded to himself. "Guild navigators, both of you, eh?"

"Yes!"

The shorter of the pair said: "You would blind yourself, too, and condemn us all to slow death. Have you any idea what it means to be deprived of the spice liquor once you're addicted?"

"The eye that looks ahead to the safe course is closed forever," Paul said. "The Guild is crippled. Humans become little isolated clusters on their isolated planets. You know, I might do this thing out of pure spite . . . or out of ennui."

"Let us talk this over privately," the taller Guildsman said. "I'm sure we can come to some compromise that is—"

"Send the message to your people over Arrakis," Paul said. "I grow tired of this argument. If that fleet over us doesn't leave soon there'll be no need for us to talk." He nodded toward his communications men at the side of the hall. "You may use our equipment."

"First we must discuss this," the

tall Guildsman said. "We cannot just—"

"Do it!" Paul barked. "The power to destroy a thing is the absolute control over it. You've agreed I have that power. We are not here to discuss or to negotiate or to compromise. You will obey my orders or suffer the *immediate* consequences!"

"He means it," the shorter Guildsman said.

Slowly, the two crossed to the Fremen communications equipment.

"Will they obey?" Gurney asked.

"They have a narrow vision of Time," Paul said. "They can see ahead to a blank wall marking the consequences of disobedience. Every Guild navigator on every ship over us can look ahead to that same wall. They'll obey."

Paul turned back to look at the Emperor, said: "When they permitted you to mount your father's throne, it was only on the assurance that you'd keep the spice flowing. You've failed them, Majesty. Do you know the consequences?"

"Nobody *permitted* me to—"

"Stop playing the fool," Paul barked. "The Guild is like a village beside a river. They need the water, but can only dip out what they require. They cannot dam the river and control it, because that focuses attention on what they take, it brings down eventual destruction, attack. The spice flow, that's their river, and I have built a dam. But my dam is such that you cannot destroy it without destroying the river."

The Emperor brushed a hand through his red hair, glanced at the backs of the two Guildsmen.

"Even your Bene Gesserit Truthsayer is trembling," Paul said. "There are other poisons the Reverend Mothers can use for their tricks, but once they've used the spice liquor, the others no longer work."

The old woman pulled her shapeless black robes around her, pressed forward out of the crowd to stand at the barrier lances.

"Reverend Mother Gaius Helen Mohiam," Paul said. "It has been a long time since Caladan, hasn't it?"

She looked past him at his mother, said: "Well, Jessica, I see that your son is indeed the one. For that you can be forgiven even the abomination who is your daughter."

Paul stilled the anger rising in him cold and sudden, said: "You never had the right or cause to forgive my mother anything!"

The old woman locked eyes with him.

"Try your tricks on me, old witch," Paul taunted. "Where's your gom jabbar? Try looking into that place where you cannot see! You'll find me staring out at you!"

The old woman was the first to break, dropping her gaze to the floor.

"Have you nothing to say, old witch?" Paul demanded.

"I welcomed you to the ranks of humans," she muttered. "Don't besmirch that."

Paul raised his voice: "Observe her, comrades! This is a Bene Gesserit Reverend Mother, patient in a patient cause. She could wait with her sisters—ninety generations for the proper combination of parents and environment to produce a single person their scheming required. Observe her! She believes now that the ninety generations have culminated in success, but I will not do her bidding!"

"Jessica!" the old woman screamed. "Silence him!"

"Silence him yourself," Jessica said.

"For your part in all this I could gladly have you strangled," Paul said. "You couldn't evade it!" he snapped as the old woman stiffened in rage. "But I think it better punishment that you live out your years never able to touch me or bend me to a single thing that your scheming desires."

"Jessica, what have you done?" the old woman demanded.

"I'll give you only one thing," Paul said. "You saw part of what the Race needs, but how poorly you saw it. You think to control human breeding and intermix a select few according to your master plan! How little you understand of—"

"You mustn't speak of these things!" the old woman hissed.

"Silence!" Paul roared. The word seemed to take substance as it twisted through the air between them under Paul's control.

The old woman reeled back into the arms of those behind her, face blank with shock at the power with which he had seized her psyche. "Jessica," she whispered.

"I remember your gom jabbar," Paul said. "You remember mine. I can kill you with a word."

The Fremen around the hall glanced knowingly at each other. Did the legend of the Lisan al-Gaib not say: *"And his word shall carry death eternal to those who stand against righteousness."*

Paul turned his attention to the tall Princess Royal standing beside her Emperor father. Keeping his eyes focused on her, he said: "Majesty, we both know the way out of our difficulty."

The Emperor glanced at his daughter, back to Paul. "You dare? You! An adventurer without family, a nobody from—"

"You've already admitted who I am," Paul said. "Royal kinsman. Let's stop this nonsense."

"I am your ruler," the Emperor said.

Paul glanced at the Guildsmen standing now at the communications equipment and facing him. One of them nodded.

"I could force it," Paul said.

"You will not dare!" the Emperor grated.

Paul merely stared at him.

The Princess Royal put a hand on her father's arm. "Father," she said, and her voice was silky soft, soothing.

"Don't try your tricks on me," the Emperor said. He looked at her. "You don't need to do this, daughter. We've other resources that—"

"But here's a man fit to be your son," she said.

The old Reverend Mother, her composure regained, forced her way to the Emperor's side, leaned close to his ear and whispered.

"She pleads your case," Jessica said.

Paul continued to look at the golden-haired Princess. Aside to his mother, he said: "That's Irulan, the eldest, isn't it?"

"Yes."

Chani moved up on Paul's other side, said: "Do you wish me to leave, Muad'Dib?"

He glanced at her. "Leave? You'll never again leave my side."

"There's nothing binding between us," Chani said.

Paul looked down at her for a silent moment, then: "Speak only truth with me, my Sihaya." As she started to reply, he silenced her with a finger to her lips. "That which binds us cannot be loosed," he said. "Now, watch these matters closely for I wish to see this room later through your wisdom."

The Emperor and his Truthsayer were carrying on a heated, low-voiced argument.

Paul spoke to his mother: "She reminds him that it's part of their agreement to place a Bene Gesserit on the throne, and Irulan is the one they've groomed for it."

"Was that their plan?" Jessica said.

"Isn't it obvious?" Paul asked.

"I see the signs!" Jessica snapped. "My question was meant to remind you that you should not try to teach me those matters in which I instructed you."

Paul glanced at her, caught a cold smile on her lips.

Gurney Halleck leaned between them, said: "I remind you, M' Lord, that there's a Harkonnen in that bunch." He nodded toward a dark-haired youth pressed against a barrier lance on the left. "The one with the squinting eyes there on the left. As evil a face as ever I saw. You promised me that—"

"Thank you, Gurney," Paul said.

"It's the na-Baron . . . Baron now that the old man's dead," Gurney said. "He'll do for what I've in—"

"Can you take him, Gurney?"

"M'Lord jests!"

"That argument between the Emperor and his witch has gone on long enough, don't you think, mother?"

She nodded. "Indeed."

Paul raised his voice, called out to the Emperor: "Majesty, is there a Harkonnen among you?"

Royal disdain revealed itself in

the way the Emperor turned to look at Paul. "I believe my entourage has been placed under the protection of your Ducal word," he said.

"My question was for information only," Paul said. "I wish to know if a Harkonnen is officially a part of your entourage or if a Harkonnen is merely hiding behind a technicality out of cowardice."

The Emperor's smile was a calculating one. "Anyone accepted into the Imperial company is a member of my entourage."

"You have the word of a Duke," Paul said, "but Muad'Dib is another matter. *He* may not recognize your definition of what constitutes an entourage. My friend Gurney Halleck wishes to kill a Harkonnen. If he—"

"Kanly!" Feyd-Rautha shouted. He pressed against the barrier lance. "Your father named this vendetta, Atreides. You call me coward while you hide among your women and offer to send a lackey against me!"

The old Truthsayer whispered something fiercely into the Emperor's ear, but he pushed her aside, said: "Kanly, is it? There are strict rules for Kanly."

"Paul, put a stop to this," Jessica said.

"M'Lord," Gurney said, "you promised me my day against the Harkonnens."

"You've had your day against them," Paul said. He slipped his robe and hood from his shoulders, handed them to his mother with his belt and crysknife, began unstrapping his stillsuit.

"There's no need for this," Jessica said. "There are easier ways."

Paul stepped out of his stillsuit, slipped the crysknife from its sheath in his mother's hands. "I know," he said. "Poison, an assassin, all the old familiar ways."

"You promised me a Harkonnen!" Gurney hissed, and Paul marked the rage in the man's face, the way the inkvine scar stood out dark and ridged. "You owe it to me, M'Lord!"

"Have you suffered more from them than I?" Paul asked.

"My sister," Gurney rasped. "My years in the slave pits—"

"My father," Paul said. "My good friends and companions, Thufir Hawat and Duncan Idaho, my years as a fugitive without rank or succor . . . and one more thing: it is now Kanly and you know as well as I the rules that must prevail."

Halleck's shoulders sagged. "M'Lord, if that swine . . . he's no more than a beast you'd spurn with your foot and discard the shoe because it'd been contaminated. Call in an executioner, if you must, or let me do it, but don't offer yourself to—"

"Muad'Dib need not do this thing," Chani said.

He glanced at her, saw the fear for him in her eyes. "But the Duke Paul must," he said.

"This is a Harkonnen animal!" Gurney rasped.

Paul hesitated on the point of revealing his own Harkonnen ancestry, stopped at a sharp look from his mother, said merely: "But this being has human shape, Gurney, and deserves human doubt."

Gurney said: "If he so much as touches—"

"Please stand aside," Paul said. He hefted the crysknife, gently pushed Gurney aside.

"Gurney!" Jessica said. She touched Gurney's arm. "He's like his grandfather in this mood. Don't distract him. It's the only thing you can do for him now."

The Emperor was studying Feyd-Rautha, seeing the heavy shoulders, the thick muscles. He turned to look at Paul—a stringy whipcord of a youth, not as dessicated as the Arrakeen natives, but with ribs there to count, and sunken in the flanks so that the ripple and gather of muscles could be followed under the skin.

Jessica leaned close to Paul, pitched her voice for his ears alone: "One thing, son. Sometimes a dangerous person is prepared by the Bene Gesserits, a word implanted into the deepest recesses of such a one by the old pleasure/pain methods. The word-sound most frequently used is Uroshnor. If this one's been prepared, and I strongly suspect it, that word uttered in his ear will render his muscles flaccid and—"

"I want no special advantage for this one," Paul said. "Step back out of my way."

Gurney spoke to her: "Why is he doing this? Does he think to get himself killed and achieve martyrdom? This Fremen religious prattle, is that what's on his mind?"

Jessica hid her face in her hands, realizing that she did not know fully why Paul took this course. She could feel death in this room and knew that Paul was capable of doing such a thing as Gurney suggested. Every talent within her focused on the need to protect her son, but she knew there was nothing for her to do.

"Is it this religious prattle?" Gurney insisted.

"Be silent," Jessica whispered. "And pray."

The Emperor's face was touched by an abrupt smile. "If Feyd-Rautha Harkonnen of my entourage so wishes," he said, "I relieve him of all restraint and give him freedom to choose his own course in this." The Emperor waved a hand toward Paul's Fedaykin guards. "One of your rabble has my belt and short blade. If Feyd-Rautha wishes it, he may meet you with my blade in his hand."

"I wish it," Feyd-Rautha said, and Paul saw the elation on the man's face.

He's overconfident, Paul thought. *There's a natural advantage that I can accept.*

"Get the Emperor's blade," Paul

said, and watched as his command was obeyed. "Put it on the floor there." He indicated a place with his foot. "Clear the Imperial *rabble* back against the wall and let the Harkonnen stand clear."

A flurry of robes, scraping of feet, low-voiced commands and protests accompanied obedience to Paul's command. The Guildsmen remained standing near the communications equipment. They frowned at Paul in obvious indecision.

They're accustomed to seeing the future, Paul thought. *In this place and time they're blind . . . even as I am.* And he sampled the Timewinds, sensing the turmoil, the storm nexus that focused on this moment/place. Here was the unborn Jihad, he knew. Here was the Race Consciousness that he had known once as his own Terrible Purpose. Here was reason enough for a Kwisatz Haderach or a Lisan al-Gaib or even the halting scheme of the Bene Gesserits. The Race of humans had felt its own dormancy, sensed itself grown stale and knew now only the need to experience turmoil in which it knew the genes would mingle and the strong new mixtures survive. All humans were alive as an unconscious single organism in this moment, experiencing a kind of sexual heat that could override any barrier.

And Paul saw how futile were any efforts of his to change any smallest bit of this. He had thought to oppose the Jihad within himself, but the Jihad would be. His legions would rage out from Arrakis even without him. They needed only the legend he already had become. He had shown them the way, given them mastery even over the Guild which must have the spice to exist.

A sense of failure pervaded him, and he saw through it that Feyd-Rautha Harkonnen had slipped out of the torn uniform, stripped down to a fighting girdle with a mail core.

This is the climax, Paul thought. *From here, the future will open, the clouds part onto a kind of glory. And if I die here, they'll say I sacrificed myself that my spirit might lead them. And if I live, they'll say nothing can oppose Muad'Dib.*

"Is the Atreides ready?" Feyd-Rautha called, using the words of the ancient Kanly ritual.

Paul chose to answer him in the Fremen way: "May thy knife chip and shatter!" He pointed to the Emperor's blade on the floor, indicating that Feyd-Rautha should advance and take it.

Keeping his attention on Paul, Feyd-Rautha picked up the knife, balancing it a moment in his hand to get the feel of it. Excitement kindled in him. This was a fight he had dreamed about—man against man, skill against skill with no shields intervening. He thought he could see a way to power opening before him because the Emperor

surely would reward whoever killed this troublesome Duke. The reward might even be that haughty daughter and a share of the throne. And this yokel Duke, this backworld adventurer could not possibly be a match for a Harkonnen trained in every device and every treachery by a thousand arena combats, honed sharp by Thufir Hawat. And the yokel had no way of knowing he faced more weapons than a knife here.

Let us see if you're proof against poison! Feyd-Rautha thought. He saluted Paul with the Emperor's blade, said: "Meet your death, fool."

"Shall we fight, cousin?" Paul asked. And he cat-footed forward, eyes on the waiting blade, his body crouched low with his own milk-white crysknife pointing out as though an extension of his arm.

They circled each other, bare feet grating on the floor, watching with eyes intent for the slightest opening.

"How beautifully you dance," Feyd-Rautha said.

He's a talker, Paul thought. *There's another weakness. He grows uneasy in the face of silence.*

"Have you been shriven?" Feyd-Rautha asked.

Still, Paul circled in silence

And the old Reverend Mother, watching the fight from the press of the Emperor's suite felt herself trembling. The Atreides youth had called the Harkonnen cousin. It could only mean he knew the ancestry they shared, easy to understand because he was the Kwisatz Haderach. But the words forced her mind to focus on the only thing that mattered to her here.

This could be a major catastrophe for the Bene Gesserit breeding scheme.

She had seen something of what Paul had seen here, that Feyd-Rautha might kill but not be victorious. Another thought, though, almost overwhelmed her. Two end products of this long and costly program faced each other in a fight to the death that might easily claim both of them. If both died here that would leave only Alia and Feyd-Rautha's daughter—one a baby, the other an unknown and unmeasurable factor.

"Perhaps you have only pagan rites here," Feyd-Rautha said. "Would you like the Emperor's Truthsayer to prepare your spirit for its journey?"

Paul smiled, circling to the right, alert, his black thoughts suppressed by the needs of the moment.

Feyd-Rautha leaped, feinting with right hand, but with the knife shifted in a blur to his left hand.

Paul dodged easily, noting the shield-conditioned hesitation in Feyd-Rautha's thrust. Still, it was not as great a shield conditioning as some Paul had seen, and he sensed that Feyd-Rautha had fought before against unshielded foes.

"Does an Atreides run or stand

and fight?" Feyd-Rautha asked.

Paul resumed his silent circling. Idaho's words came back to him, the words of training from the long-ago practice floor on Caladan: *"Use the first moments in study. You may miss many an opportunity for quick victory this way, but the moments of study are an insurance of success. Take your time and be sure."*

"Perhaps you think this dance prolongs your life a few moments," Feyd-Rautha said. "Well and good." He stopped the circling, straightened.

Paul had seen enough for a first approximation. Feyd-Rautha led to the left side, presenting the right hip as though the mailed fighting girdle could protect his entire side. It was the action of a man trained to the shield and with a knife in both hands.

Or, and Paul hesitated, *the girdle was more than it seemed.*

The Harkonnen seemed too confident against a man who'd this day led his forces to victory against Sardaukar legions.

Feyd-Rautha noted the hesitation, said: "Why prolong the inevitable? You but keep me from exercising my rights over this ball of dirt."

If it's a flipdart, Paul thought, *it's a cunning one. The girdle shows no signs of tampering.*

"Why don't you speak?" Feyd-Rautha demanded.

Paul resumed his probing circle, allowing himself a cold smile at the tone of unease in Feyd-Rautha's voice, evidence that the pressure of silence was building.

"You smile, eh?" Feyd-Rautha asked. And he leaped in midsentence.

Expecting the slight hesitation, Paul almost failed to evade the downflash of blade, felt its tip scratch his left arm. He silenced the sudden pain there, his mind flooded with realization that the earlier hesitation had been a trick —an overfeint. Here was more of an opponent than he had expected. There would be tricks within tricks within tricks.

"Your own Thufir Hawat taught me some of my skills," Feyd-Rautha said. "He gave me first blood."

And Paul recalled that Idaho had once said: *"Expect only what happens in the fight. That way you'll never be surprised."*

Again, the two circled each other, crouched, cautious.

Paul saw the return of elation to his opponent, wondered at it. Did a scratch signify that much to the man? Unless there were poison on the blade! But how could there be? His own men had handled the weapon.

"That woman you were talking to over there," Feyd-Rautha said. "The little one. Is she something special to you?"

Paul remained silent, probing with his inner senses, examining the

blood from the wound, finding a trace of soporific from the Emperor's blade. He realigned his own metabolism to match this threat and change the molecules of the soporific, but felt a thrill of doubt. They'd been prepared with soporific on a blade. A soporific. Nothing to alert a poison snooper, but strong enough to slow the muscles it touched. His enemies had their own plans within plans, their own stacked treacheries.

Again, Feyd-Rautha leaped.

Paul, the smile frozen on his face, feinted with slowness as though inhibited by the drug and at the last instant dodged to meet the down-flashing arm on the crysknife's point.

Feyd-Rautha ducked sideways and was out and away, his blade shifted to his left hand, and only a slight paleness of jaw betrayed the acid-pain where Paul had cut him.

Let him know his own moment of doubt, Paul thought.

"Treachery!" Feyd-Rautha shouted. "He's poisoned me!"

Paul dropped his cloak of silence, said: "Only a little acid to match the soporific on the Emperor's blade."

Feyd-Rautha began closing the space between them, edging in, knife held high, anger showing itself in squint of eye and set of jaw. He feigned right and under, and they were pressed against each other, knife hands gripped, straining.

Paul, cautious of Feyd-Rautha's right hip where he suspected a poison flip-dart, forced the turn to the right. He almost failed to see the needle point flick out beneath the belt line. A shift and a giving in Feyd-Rautha's motion warned him.

On the left hip!

Treachery within treachery within treachery, Paul reminded himself. Using Bene Gesserit-trained muscles, he sagged to catch a reflex in Feyd-Rautha, but the necessity of avoiding the tiny point jutting from his opponent's hip threw Paul off just enough that he missed his footing and found himself thrown hard to the floor, Feyd-Rautha on top.

"You see it there on my hip?" Feyd-Rautha whispered. "Your death, fool." And he began twisting himself around, forcing the poisoned needle closer and closer.

Paul strained, hearing the silent screams in his mind, his cell-stamped ancestors demanding that he use the secret word to slow Feyd-Rautha, to save himself.

"I will not say it!" Paul gasped.

Feyd-Rautha gaped at him, caught in the merest fraction of hesitation. It was enough for Paul to find the weakness of balance in one of his opponent's leg muscles, and their positions were reversed. Feyd-Rautha lay partly underneath with right hip high, unable to turn because of the tiny needle point caught against the floor beneath him.

Paul twisted his left hand free, aided by the lubrication of blood from his arm, thrust once hard up

underneath Feyd-Rautha's jaw. The point slid home into the brain. Feyd-Rautha jerked and sagged.

Breathing deeply to restore his calm, Paul pushed himself away and got to his feet. He stood over the body, knife in hand, raised his eyes with deliberate slowness to look across the room at the Emperor.

"Majesty," Paul said, "your force is reduced by one more. Shall we now shed sham and pretense? Shall we now discuss what must be? Your daughter wed to me and the way opened for an Atreides to sit on the throne."

"I sit on the throne," the Emperor said.

"You shall have a throne on Salusa Secundus," Paul said.

"I put down my arms and came here on your word of bond!" the Emperor shouted. "You dare threaten—"

"Your person is safe in my presence," Paul said. "An Atreides promised it. Muad'Dib, however, sentences you to your prison planet. But have no fear, Majesty. I will ease the harshness of the place with all the power at my disposal. It shall become a garden world, full of gentle things."

As the hidden import of Paul's words grew in the Emperor's mind, he glared across the room at Paul. "Now we see true motives."

"Indeed," Paul said.

"And what of Arrakis?" the Emperor asked.

"The Fremen have the word of Muad'Dib," Paul said. "There will be flowing water here open to the sky and green oases rich with good things. But we have the spice to think of, too. Thus, there will always be desert on Arrakis . . . and fierce winds, and trials to toughen a man. We Fremen have a saying: 'God created Arrakis to train the faithful.' One cannot go against the word of God."

The old Truthsayer, the Reverend Mother Gaius Helen Mohiam, had her own view of the hidden meaning in Paul's words now. She glimpsed the Jihad and said: "You cannot loose these people upon the universe!"

"You will think back to the gentle ways of the Sardaukar!" Paul snapped.

"You cannot," she whispered.

"You're a Truthsayer," Paul said. "Review your words." He glanced at the Princess Royal, back to the Emperor. "Best it were done quickly, Majesty."

The Emperor turned a stricken look upon his daughter. She touched his arm, spoke soothingly: "For this I was trained, father."

"You cannot stay this thing," the old Truthsayer muttered.

The Emperor looked at Paul, standing stiffly with a look of remembered dignity. "Who will negotiate for you, kinsman?"

Paul turned, saw his mother, her eyes heavy-lidded, standing with Chani in a squad of Fedaykin

guards. He crossed to them, stood looking down at Chani.

"I know the reasons," Chani whispered.

Paul, hearing the secret tears in her voice, touched her cheek. "My Sihaya need fear nothing, ever," he whispered. He dropped his arm, faced his mother. "You will negotiate for me, Mother, with Chani by your side. She has wisdom and sharp eyes. And it is wisely said that no one bargains tougher than a Fremen. She will be looking through the eyes of her love for me and with the thought of her sons to be, what they will need. Listen to her."

"What are your instructions?" Jessica asked.

"The Emperor's entire Choam Company holdings as dowry."

"Entire?"

"He is to be stripped. I'll want an earldom and Choam directorship for Gurney Halleck, and him in the fief of Caladan. There will be titles and attendant power for every surviving Atreides man, not excepting the lowliest trooper."

"What of the Fremen?" Jessica asked.

"The Fremen are mine," Paul said. "What they receive shall be dispensed by Muad'Dib. It'll begin with Stilgar as Governor on Arrakis, but that can wait."

"And for me?" Jessica asked.

"Is there something you wish?"

"Perhaps Caladan," she said, looking at Gurney. "I need a time of peace in which to think."

"*That* you shall have," Paul said, "and anything else that Gurney or I can give you."

Jessica nodded, feeling suddenly old and tired. She looked at Chani. "And for the royal concubine?"

"No title for me," Chani whispered. "Nothing I beg of you."

Paul stared down into her eyes, remembering her suddenly as she had stood once with little Leto in her arms, their child now dead in this violence. "I swear to you now," he whispered, "that you'll need no title. That woman over there will be my wife and you but a concubine because this is a political thing and we must weld peace out of this moment, enlist the Great Houses of the Landsraad. We must obey the forms. Yet that princess shall have no more of me than my name. No child of mine nor touch nor softness of glance, nor instant of desire."

"So you say now," Chani said.

"Do you know so little of my son?" Jessica whispered. "See that princess standing there, so haughty and confident. They say she has pretentions of a literary nature. Let us hope she finds solace in such things; she'll have little else." A bitter laugh escaped Jessica. "Think on it, Chani: that princess will have the name, yet she'll live as less than a concubine—never to know a moment of tenderness from the man to whom she's bound. While we, Chani, who carry the name of concubine, history will call us wives." ■

WAAAAY OUT

It should be no news to readers of this department that science fiction is being reabsorbed into the main body of fiction. To be more exact, themes that are so well known as to be hackneyed in science fiction—some no more than gimmicks—are being "discovered" by mainstream novelists and used with more or less proficiency. If these books had come out of the science-fiction field, they would have had no attention; as it is, they are greeted with an acclaim that they frequently do not deserve. For every masterpiece like Anthony Burgess' "A Clockwork Orange," there are a dozen lame attempts to be cute.

Not many of these pseudo-SF books are written by major literary figures, but in the past year or more there have been three—a play, a poem and a "novel"—that have been ushered in with tremendous fanfare, and that have earned international fame. I came to them late, and possibly I shouldn't have come at all, but for what it's worth, here is my report.

Friedrich Dürrenmatt is a Swiss novelist and playwright who takes a wryly distorted view of our world and its people. He would say that the distortion is not in the mirror he holds up, but in the world itself. You may have seen either the masterful production of his play, "The Visit," staged by the Lunts, or the pretty dismal screen version. A newer play, "The Physicists," (Grove Press, $1.75) was a success in London but died early in New York last fall.

The three physicists of the play appear in the first act as homicidal madmen who strangle their nurses. One imagines himself Einstein, another is Newton, while the third is visited by King Solomon. Then, in the second act, we find that Mö-

bius, screened by his Solomon delusion, has been working out a Principle of Universal Discovery that will rationalize the elementary particles, explain and control gravitation, and unleash unimaginable forces. He feels his work is too dangerous for the world: he intends to destroy it. But "Einstein" and "Newton" are agents of two great powers, sent to steal the great secret. Both are physicists of note; both feel the Principle must be used, though for contrasting reasons. "Newton" believes that science must never be fettered; what society does with a discovery is its own responsibility, not the scientist's. "Einstein" is as sure that scientists must use this great power to take over and remake a worthless world.

In the end, in its way as hopeless as "Dr. Strangelove," the mad world engulfs them. None of these high-minded principles is valid, Dürrenmatt is saying: the world is too ruthless.

A grimmer, filthier, more hopeless world can be seen vaguely in the distorting mirror of William S. Burroughs' "Nova Express" (Grove Press, $5.00). Burroughs is considered by some *avant garde* critics the foremost American writer of the day; others call him the "elder statesman of the beat fad." His "Naked Lunch," long a banned classic, was written in a private kind of gibberish out of fifteen years as a drug addict; it portrays the schizoid addict's conviction that the world and everyone in it are foul, depraved, ravening, feeding ruthlessly on each other, cannibals of filth. In "Nova Express," a kind of sequel, he extends his principle to the universe: the Nova Police are ruthlessly fighting the Nova Mob, from the Crab Nebula to the streets of Earth—Arisia against Eddore, but an Eddore that would turn "Doc" Smith's stomach. The galaxy is dissolving in its own innate corruption, and the Nova Police must be as foul as the Nova Mob if they are to win.

Burroughs—a grandson of the adding machines, not of Tarzana—uses the clichés of science fiction smoothly and well. His special techniques of putting worlds and words through a Waring Blendor, lubricated with manure, may be more than you can stomach or even read. You are more likely to feel the author obscene than the world. Yet there's a fascinating "straight" SF idea on page 57 . . .

Our third book is a long poem, "Aniara" by a Swedish poet, Harry Martinson (Alfred A. Knopf, $4.00). The Swedish original sold some thirty-five thousand copies and was made into an opera—real space opera, for the setting is the runaway starship, *Aniara,* carrying eight thousand people hopelessly toward Lyra. The time is thousands of years in the future, after another Ice Age that lasted sixteen thousand years. Nations and cities

have grown up and blasted each other down. A refugee ship bound for Mars goes astray and speeds off into infinity, day after day, year after year. Their Mima—their computer/oracle/goddess—amuses and inspires them for a time, then collapses as the last city of Earth is vaporized. (This was apparently the climax of the opera.) One by one, in their own ways, Mima's people also go to pieces.

Theodore Sturgeon found the poem a crowning achievement in the communication of galactic immensity, in a degree hitherto achieved only by abstract mathematics. I think many an ordinary SF writer, notably Cordwainer Smith in recent times, has done this more movingly and more poetically. The trouble may be in the translation—I wonder what Poul Anderson might have done with it—but Martinson's synthetic words for technical terms of the future are clumsy and flat; they don't sing in English, whatever they may have done in Swedish. Nor—to me—does the poem as a whole.

In this inning the "real" writers have struck out—or maybe we'll allow Dürrenmatt to be caught out at first, and Martinson in a foul tip. Burroughs simply fanned.

LONCON TWO—WORLDCON TWENTY-THREE

I can at last give you some accurate information on the Twenty-third World Science Fiction Convention, which for the second time will be held in London. Since Labor Day—the traditional weekend for U.S. conventions—means nothing in England, the dates are August 27th through 30th, the weekend before Labor Day. The place: the Mount Royal Hotel, Marble Arch, London, W. 1. Guest of honor: Brian Aldiss. Thoroughly outdoing any American convention, the British will have closed-circuit TV from the convention hall to the conventioneers' rooms.

It is already too late, when you read this, to make your nominations for the "best SF" awards—the "Hugo's" for 1964. However, if you join the Convention you do have a vote in the balloting on the "short list" of nominees.

Even if you can't attend, but would like to keep in touch and have a vote, you can join the Convention by sending $2.00 to Bill Evans, Box 86, Mt. Rainier, Maryland 20822, or directly to J. A. Groves, Treasurer, 29 Lathom Road, London, E. 6, England. If you attend, another dollar will be due when you register.

The English conventions aren't as big as the biggest U.S. gatherings, but from all accounts they do things very, very well.

PREVIEW

Collectors and bibliographers will be glad to know that the MIT Science Fiction Society—yes, of Massachusetts Institute of Tech-

nology: is there another?—is publishing an index to the major American science-fiction magazines for the period from January, 1951 through December, 1964. It will be in 8½ by 11 inch sheets, punched for a looseleaf binder. Prepublication price is $2.00, but since this notice can't appear until months after publication, it may have gone up by then.

MIT being MIT, the SF Society has gone at its indexing in a technological manner that will be the envy of every fan who ever published an index—most of all Brad Day, whose great 1926-1950 *Index* this will supplement. Author, title and other bibliographical information on every published story in eight magazines (including Astounding/Analog) have been entered on punch cards. Machines—robots—at the MIT Computation Center are converting the index cards directly to mimeograph stencils: one title index, one author index.

By using the punched-card format, the Society hopes to be able to add information for later editions whenever it comes to hand, without having to laboriously remake the whole book each time. The machines will do that.

Checks for the $2.00 prepublication price should be made out to Wayne B'Rells, Treasurer, MIT Science Fiction Society, Room 50-020, 77 Massachusetts Avenue, Cambridge 39, Massachusetts.

MISSION TO A STAR

By Frank Belknap Long • Avalon Books, New York • 1964 • 192 pp. • $2.95

This isn't one of Avalon's occasional standout books, but it does have an interesting theme that Frank Long develops well, using his detective story techniques to good effect in building suspense and mystery in the early chapters.

The Scorpions, seemingly noble geniuses from the stars, land on Earth and in customary friendliness offer to help mankind overcome its psychological and social handicaps while their "scientific mission" is here. After seven years, Earth is getting a little nervous about these weekend guests, and is trying to find out what they are really up to. Jim Lawrence, whose story this is, is of course the agent who does get through and does get the answer—and gratifyingly, it is not at all what you'd suppose from the time-honored formulae for such stories.

The supermen are not entirely supermen . . . but that is the story and the theme. If you like, you can apply it to our own superior civilization which is so generously willing to export its custom and values to "underdeveloped" peoples.

THE POISON BELT

By Sir Arthur Conan Doyle • Macmillan Company, New York • 1964 • 158 pp. Ill. • $4.50

This is probably the most overpriced of Macmillan's new series of science-

fiction classics. "The Poison Belt" is a very minor member of the Professor Challenger series that began with "The Lost World." Earth is about to pass through a comet's tail. Challenger is convinced that all life will be destroyed, and gathers his friends around him for the countdown. Men begin dropping in their tracks; birds fall out of the sky; the End arrives . . . and then they wake up again. Climax collapses in anticlimax.

This edition warrants this much space only because of the special features of the Macmillan series. Apparently intended for juvenile readers—though one could hardly say that of David Lindsay's "A Voyage to Arcturus" that preceded it—there is an introduction by Doyle's biographer, John Dickson Carr, which discusses Doyle's troubles with his readers and his world, and an epilogue by Harlow Shapley, which reduces the astronomy to nonsense in a constructive sort of way. The illustrations by William Pene du Bois burlesque Challenger and the story, which scarcely needed it.

THE REPRINTS

ECHO X

By Ben Barzman • Paperback Library, New York • No. 52-329 • 1964 • 252 pp. • 50¢

Pb edition of the 1960 novel, "Twinkle, Twinkle Little Star." It's by a mainline author who rediscovered the parallel worlds concept and handled it well.

PLANET OF THE APES

By Pierre Boulle • Signet Books, New York • No. D-2547 • 128 pp. • 50¢

A rather obvious satire by the French author of "The Bridge Over the River Kwai." On a far world, the apes are civilized, men are only animals.

ROGUE MOON

By Algis Budrys • Gold Medal Books, Greenwich, Conn. • No. L-1474 • 1964 • 176 pp. • 45¢

Reissue of the author's best SF novel—and a very strange one, too.

THE WANTING SEED

By Anthony Burgess • Ballantine Books, New York • No. U-5030 • 1964 • 223 pp. • 60¢

This isn't the masterpiece that the author's "Clockwork Orange" was, but it's a chilling vision of a future in which population pressure has forced the Western world into homosexuality, cannibalism and other grim adjustments.

GALACTIC PATROL

By E. E. Smith, Ph.D. • Pyramid Books, New York • No. R-1103 • 1964 • 237 pp. • 50¢

With which Pyramid begins to reprint "Doc" Smith's classic "Lensman" series, the saga of Kim Kinnison, Arisia and Eddore. It was the highlight of Astounding in 1937.

astt

continued from page 7

For some three months, these great machines ran day and night; over 50,000 photographic plates were accumulated, and electronic computers were programmed to sort out, from the resultant millions of particle tracks, the significant ones.

Two plates were found which showed the expected events.

And the physical scientists say that Dr. Rhine selects *his* evidence?

The discovery plates themselves are highly interesting, too. They were reproduced in a copy of the *Scientific American* last year—considering our crossover readership I can expect that you saw them there.

An essential part of the proof of discovery is a Y-shaped trail in the lower left, and a second Y branching at upper center, with no visible connection whatever. This blank between the two proves that a chi-zero, a neutral particle that doesn't cause ionization, passed from one to the other.

That rather reminds me of the story of the criminal who had, by persistent sandpapering, acid-etching, burning, and scraping, finally eliminated all traces of his fingerprints. The police arrested him and jailed him as the perpetrator of all those crimes at which no fingerprints could be found.

Again, when Lincoln Laboratories, some years back, sent a radar signal pulse toward Venus, and got back a sizzling-frying boiling mixture of electronic noises, computer correlation-analysis showed the probability 10,000,000 to 1 that they *had* successfully bounced a radar signal off of Venus. This was accepted as adequate proof-of-success.

When some of the parapsychology experiments yield odds of 10,000,000,000 to 1—that's a coincidence of no significance.

The odd thing about that is that the use of statistical analysis to demonstrate scientific facts was, really, introduced by Gregor Mendel—which was the major reason his theory of genetics was flatly rejected by the biologists of his time. Now all the sciences use statistics as a routine technique of establishing truths.

Incidentally, only recently have legal cases been decided on the basis of probability-of-truth of evidence, so Science and the Law can contribute to each other in this matter of Rules of Evidence.

The problem of observational evidence is always an acute one in 'tis-true-'tis-not-true debates. When does not-observing something constitute evidence of its nonexistence? For instance, I've lived over fifty years on this planet, and I've never seen an aardvark, a moray eel, or a centaur, although I have read reports of their existence. Again, I have a six-inch telescope, and have, on many evenings, looked at Jupiter and observed that it has four moons. But although I have looked carefully, I have *not* seen thirteen moons. Isn't that evidence that Jupiter actually has only four?

I've investigated dowsing, and found that dowsing is used routinely in many American towns, by utility field crews for finding underground pipes, conduits, et cetera.

Professional scientists, however, assure me they have never observed this phenomenon, and that, therefore, they know it doesn't really exist.

Reminds me somewhat of the famous lawsuit between two midwestern railroads, in the Nineteenth Century. The A. B. & C. crossed the tracks of the D. E. & F. at a particular point, and an A. B. & C. train one night got stalled on the crossing. A D. E. & F. train came along, didn't see it in time to stop, and great was the resultant confusion, smashing, and damage.

The whole resulting suit rested on the testimony of the old crossing-guard attendant, who stated that he had taken his red lantern, as required, as soon as the A. B. & C. train stalled, and run up the D. E. & F. track waving it, but the D. E. & F. engineer claimed he definitely had been looking, and definitely had not seen any red lantern.

When the case was closed, and the validity of the old man's testimony had been accepted to the great cost of the D. E. & F., the lawyer for the A. B. & C. finally took the old fellow aside.

"Look, George, the case is all settled. You gave your testimony, and they couldn't shake you. You won the case for us. But, dammit George, I'm curious. *Did* you take that lantern up there?"

The old fellow chuckled. "Yas, sir! I did! But you know, I was sure afraid somebody was gonna ask me, 'Was that lantern *lit?*' "

If a man's got a theory he dedicatedly believes in, he simply neglects to question it properly. If he believes that red lanterns always give off a bright red light—he'll forget to ask if it was lit.

And if he *knows* dowsing is impossible nonsense and superstition . . . he'll forget to ask "Does it work in practice?"

Another peculiarity in the use of data as evidence, is the tendency to use data—to consider it important and relevant to the problem—when the data accords with the investigator's current theory, yet to completely ignore that same data in

another area where it doesn't accord with his theory. I.e., to hold that the data is significant where it fits with his beliefs—but that it has no meaning where it challenges.

For example, it is widely held that any child, raised in a home and social environment of type A, will grow up to be a typical type A citizen, whatever his genetic background. This statement has been repeated so often, so loudly, and so widely, that something of Hitler's "Big Lie" proposition applies. Everybody knows it's true, because they've heard it so often from so many directions.

But data on test examples hasn't been presented.

On the other hand, psychologists and geneticists have had great interest in studying the behavior and personality patterns of identical, or one-egg, twins who were separated immediately after birth, and raised apart.

The data gathered in those studies indicate the genetic identity has more influence in personality and behavior pattern than the difference in environment. Since this data directly challenges the accepted "everybody knows" type "fact" that upbringing alone determines personality and behavior patterns, the twin data is not considered relevant to that problem.

The difficulty is not at all unlike that in a lawsuit in court; each side is quite honestly and sincerely convinced that they are aware of Truth, and are seeking only Justice and Right. Neither side is able to see the relevance or value of data on the opposing side, because of a selective blindness imposed by their own sincere beliefs. There is no intention or feeling of dishonesty, insincerity, or untruthfulness on either side—it's just that each side realizes the necessity of leaving out facts that aren't at all important, really, and just confuse people who don't understand what the situation really is . . .

This isn't an intention to lie, deceive, or mislead; it's an honest intention to clarify the situation so the Truth can be more readily apparent. And certainly that's an end that justifies minimizing confusing and irrelevant facts, isn't it?

Lawyers having fought through that particular morass for several millennia now, may have some useful suggestions as to Rules of Evidence for the members of the ASTT.

The nation badly needs a Society for Testing Theories.

The trouble is, it'll never happen —because every scientist *knows* he already knows exactly how a theory should be tested—he already knows what constitutes evidence, and how evidence should be evaluated and accepted or rejected.

Besides . . . if someone did draw up formalized and rigorous rules of evidence for Science, his own theories might get thrown out!

THE EDITOR.

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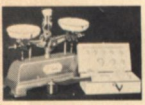

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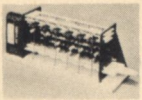

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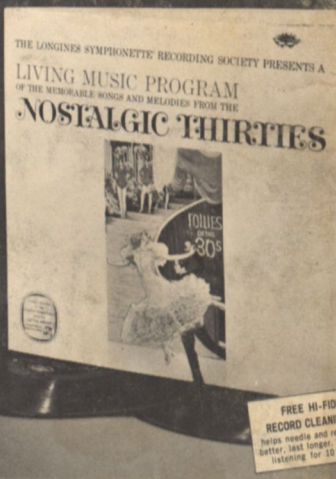

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