ASTOUNDING

SCIENCE-FICTION

A STREET & SMITH PUBLICATION

The STARS LOOK DOWN

By LESTER DEL REY

AUGUST · 1940

20¢

"Calling All Cars!"

A MYSTERIOUS DISCOVERY SAVES UP TO 30% on GASOLINE!

OR COSTS NOTHING TO TRY

VACU-MATIC "Scores Again"

GETS NEW COAST-TO-CHICAGO RECORD

BOB McKENZIE

TRANSCONTINENTAL AUTOMOBILE CHAMPION

COAST TO COAST

Vacu-matic Carburetor Co.
7617 W. State Street
Wauwatosa, Wisconsin

Dear Sirs:

Having just completed a new speed record between Los Angeles and Chicago, driving a Chevrolet equipped with a Vacu-matic carburetor control, I thought you might be interested in knowing some of the facts and the important part Vacu-matic played in the success of the run.

The distance covered was 3328 miles in thirty-nine hours and forty-two minutes, officially timed by Western Union, which gave me an average speed of 59.7 M.P.H. based on elapsed time and with the Vacu-matic averaged 18-1/2 miles per gallon on gasoline.

Before leaving Los Angeles, we made several test runs both with and without the Vacu-matic, and the tests proved that Vacu-matic increased my gas mileage 3-1/2 miles per gallon at the driving speed of 60 M.P.H. and also very noticeable increase in both acceleration and power.

Yours very truly,

In addition to establishing new mileage records on cars in all sections of the country, the Vacu-matic has proven itself on thousands of road tests and on dynamometer tests which duplicate road conditions and record accurate mileage and horse power increases.

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Automatic Supercharge Principle

Vacu-matic is *entirely different!* It operates on the supercharge principle by automatically adding a charge of extra oxygen, drawn free from the outer air, into the heart of the gas mixture. It is entirely automatic and allows the motor to "breathe" at the correct time, opening and closing *automatically* as required to save dollars on gas costs.

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This certifies that I have carefully read 300 original letters received from Vacu-matic users testifying to gas savings up to 30%, many reporting added power, smoother running, and quicker pick-up. These letters are just a small part of the larger file of enthusiastic user letters that I saw at the company offices.

Signed Marcus J. Clautz
Notary Public

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Vacu-matic offers a splendid opportunity for unusual sales and profits. Every car, truck, tractor, and motorcycle owner a prospect. Valuable territories now being assigned. If you help us introduce it to a friend, you can obtain your own free. Check and mail coupon today.

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Easy To Install

Vacu-matic is constructed of six parts assembled and fused into one unit, adjusted and *sealed at the factory.* Nothing to regulate. Any motorist can install in ten minutes. The free offer coupon will bring all the facts. Mail it today!

The Vacu-matic Co. **Wauwatosa, Wis.**

AST—1

SEND THIS *Free Offer* COUPON

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7617-528 W. State St., Wauwatosa, Wis.

Please send full particulars about VACU-MATIC, also how I may obtain one for my own car FREE. This does not obligate me in any way.

Name .....

Address .....

City ..... State .....

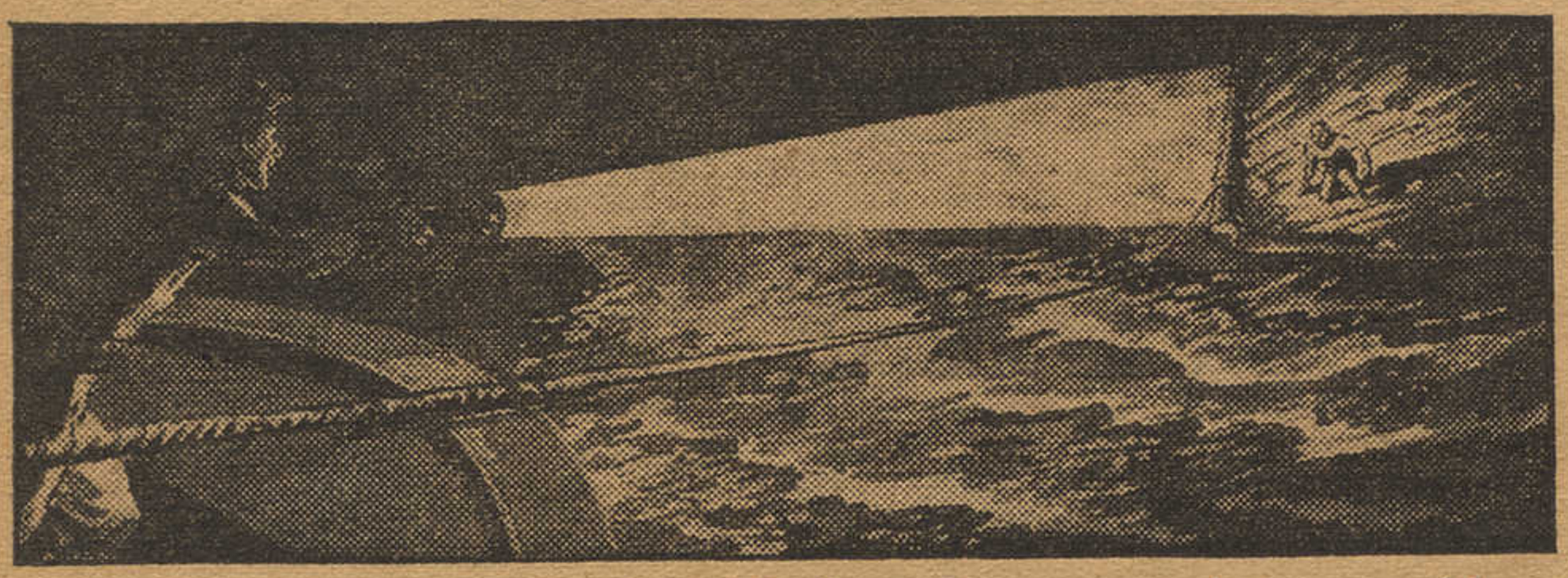
☐ Check here if interested in Agency Proposition.

TERROR STRICKEN, I LEAPT TOWARD THE SINISTER SHAPE!

A true experience of J. H. WILLIAMS, *Victoria, B. C.*

"ONE BLACK NIGHT I was returning to Vancouver, in my 15-foot inboard motorboat," writes Mr. Williams. "Suddenly, a dark and sinister shape loomed up directly ahead. There was no time to avoid it.

"I LEAPT as the boat crashed into the object —and found myself sitting on a crossbeam of a huge log boom that was being towed by a distant tug. My boat was gone. Shivering with cold, I shouted in vain—the tug was too far away for my voice to reach it.



"AFTER HOURS OF TORTURE, the night became stormy and the tug skipper shortened his line. Again I shouted—and this time a flashlight on the tug picked me out with its powerful beam. To the 'Eveready' *fresh* DATED batteries in *that* flashlight I probably owe my life—and you can take it from me, *I* am an 'Eveready' convert now.

(*Signed*) J. H. Williams"

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Unit of Union Carbide UCC *and Carbon Corporation*

ASTOUNDING
SCIENCE-FICTION

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WANTED: A CHRONOSCOPE

Such a time viewer would be darned handy in many ways, but at the moment—and this moment in which I am writing is so long gone as to be difficult to recall from its point of history by the time this is read—one would be useful in devising this page. Nevertheless, herewith a neck is stuck out in prophecy; the battle of robots is on.

The past months have seen machines do the fighting rather noisily on the parts of the Earth marked off as battle lines. They've seen, thereby, one of science-fiction's less happy themes made reality. Hitler & Co. must be science-fiction addicts. Perhaps it's one of science-fiction's principal faults that is going to puncture the bad-dream-turned-real.

Fiction has long loved the mighty fleets of machines—ground or space—in crashing battle. But it's been remarkably silent on where these metal mammoths originated. So long as most of the fighting is done by machines—most of the fighting is done by machines behind the lines.

In all history, the capital of war has been manpower. Income has been unimportant, because it takes twenty years or so to replace a soldier. This time machines are the capital, and there can be income. There will, in science-fiction's wars, be a period of initial shock wherein the savings—the already-produced machines—are squandered. If final decision cannot be reached in that brief initial period, it settles down to a war of income. Then the robots behind the lines do the fighting, with their hell-breathing children the pawns of little moment.

The steel mill, the turning lathe, the stamping press and tool-and-die industries, curiously inoffensive-seeming warriors, decide the battle.

Science-fiction's never considered them; there's so little drama in the steady *hum-click-buzz-hum* of an automatic lathe. And the big lathe turning out a gasoline cracking still, that Sunday drivers may jam the roads the tighter, looks so much like the same giant lathe occupied in blanking out a 16-inch rifle for a 45,000-ton battle wagon.

There's a bit more color in steel furnaces—but even they're ignored in favor of the splash and glory of a battle in space.

Science-fiction's rather skipped over lightly on that angle. But on Earth or in space, the lathe, the rolling mill, and the foundry flask or their descendants, will decide the question, unless the first shock can be complete.

Gasoline isn't as dramatic as nitroglycerin—but it does more work.

THE EDITOR.

KNOW RADIO *as*
Trained Technicians Know It

Many Make $30, $40, $50 a Week

Don't envy trained Radio Technicians because of their good pay, pleasant work; because everybody admires their technical knowledge and skill. Mail the Coupon. Learn how hundreds of men trained at home nights and became Radio Technicians without giving up their jobs or going to expensive schools. Get the facts about the "Radio Night School That Comes To You!"

HUNDREDS LEARNED RADIO AT HOME NIGHTS, GOT GOOD JOBS

Yes, hundreds of men from all walks of life are in pleasant, well-paying Radio jobs today because they trained at home nights to be Radio Technicians. These men hold jobs in practically every branch of Radio—installing, fixing, selling home and auto Radio sets; operating and maintaining Broadcast, Police, Aviation, Commercial, Experimental Radio Stations; selling, installing and servicing loudspeaker systems. Newer fields such as Television, Commercial Electronic Devices also offer opportunities now and for the future to Radio Technicians.

Chief Operator Broadcasting Station

When I completed 20 lessons, I obtained my Radio Broadcast Operator's license and immediately joined Station WMPC where I am now Chief Operator.
HOLLIS F. HAYES
327 Madison Street
Lapeer, Michigan

$200 To $300 a Month in Own Business

For the last two years I have been in business for myself making between $200 to $300 a month. Business has steadily increased. I have N. R. I. to thank for my start in this field.
ARLIE J. FROEHNER
300 W. Texas Ave.
Goose Creek, Texas

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Anyone can tune a Radio receiver, but very few can fix one when it doesn't work right; few can operate or maintain a Broadcast Station or handle the many other types of jobs which require a Technician's knowledge of Radio. That's why so many trained Radio Technicians get good pay, steady work, plenty of opportunities for advancement—why others hold jobs in other lines and operate a profitable spare time Radio business right from their own homes.

MANY MAKE FROM $5 TO $10 A WEEK IN SPARE TIME WHILE LEARNING

The N. R. I. "Night-School-at-Home" Course gives you a thorough training in Radio and Television principles; actual experience working with real Radio parts building circuits, test instruments and other Radio apparatus. In addition, a special section of the Course shows you how to do many Radio jobs which you can cash in on as you learn them. That's why many Radio Technicians earn good money—from $5 to $10 a week fixing Radio sets in spare time while learning. I ALSO GIVE YOU A MODERN, PROFESSIONAL ALL-WAVE, ALL-PURPOSE SET SERVICING INSTRUMENT to help you make money fixing Radios while learning and equip you for full time work after you graduate.

FIND OUT WHAT RADIO OFFERS YOU MAIL COUPON FOR FACTS NOW!

The thorough, easy-to-understand N. R. I. "Night School" Course in Practical Radio and Television has actually doubled, yes tripled, the earnings of some. It has put hundreds of men into good-pay technical Radio jobs—into pleasant work with good pay—the type of work other persons admire. Get "Rich Rewards in Radio" FREE today. See for yourself how easy it is to prepare at home nights for Radio's spare time and full time opportunities and those coming in Television. Read more than 100 letters from men who started in Radio this way. Get the facts about this great, growing field with a future. Mail the coupon now—in an envelope, or paste it on a penny postcard.

J. E. SMITH, President
National Radio Institute, Dept. OGD
Washington, D. C.

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Dept. OGD, National Radio Institute,
Washington, D. C.

Mail me FREE, without obligation, your 64-page book "Rich Rewards in Radio." (No salesman will call. Write plainly.)

Age.....

Name .....

Address .....

City..... State.....

Mary won..

So can you!

NANTICOKE, PA.—MARY HOWELLS, NINE-TEEN-YEAR-OLD BLUES SINGER, WINS TWO WEEKS' ENGAGEMENT AT MICHAEL TODD'S DANCING CAMPUS AT WORLD'S FAIR.

TODAY, Mary Howells is earning $50. a week in one of the world's greatest night clubs at the World's Fair. Yesterday she had never sung before an audience except in a high-school musical at Nanticoke.

Mary won this chance for fame over many other amateurs in the audition at Michael Todd's Hall of Music. She enjoyed an exciting free day at the World's Fair and today is a guest of that tower of hospitality—Hotel Times Square. "PIC" has paid her return fare from Nanticoke to New York.

Over Station WNEW, which featured Mary Howells on their program for "PIC" amateurs, Mary told reporters, "I have never been so thrilled as when I stepped up to the microphone—and I'm delighted at this chance for fame and big money."

If Mary wins the finals of the "PIC" amateurs she will receive a free trip to Hollywood and a casting interview with a great producer at Paramount Studios.

BUY YOUR COPY OF "PIC" AND ENTER THE

"PIC" AMATEUR CONTEST

Now!


the Stars look down
BY ESTER DEL REY
On only one thing did they agree—Man must and would reach those stars—

THE STARS LOOK DOWN

By Lester del Rey

A tale of two men agreeing on one thing—space travel—and disagreeing on practically anything else!

Illustrated by W. A. Koll

ERIN MORSE came down the steps slowly without looking back, and his long fingers brushed through the gray hair that had been brown when he first entered the building. Four year is a long time to wait when a man has work to do and the stars look down every night reminding him of his dreams. There were new lines in his face and little wrinkles had etched themselves around his dark eyes. But even four years had been too few to change his erect carriage or press down his wide shoulders. At sixty, he could still move with the lithe grace of a boy.

The heavy gate opened as he neared it and he stepped out with a slow, even pace. He passed the big three-wheeled car parked there, then stopped and breathed deeply, letting his eyes roam over the green woods and plowed fields and take in the blue sweep of the horizon. Only the old can draw the full sweetness from freedom, though the young may cry loudest for it. The first heady taste of it over, he turned his back on the prison and headed down the road.

There was a bugling from the car behind him, but he was barely conscious of it; it was only when it drove up beside him and stopped that he noticed. A heavily-built man stuck out a face shaped like a bulldog's and yelled.

"Hey, Erin! Don't tell me you're blind as well as crazy"

Morse swung his head and a momentary flash of surprise and annoyance crossed his face before he stepped over to the car. "You would be here, of course, Stewart."

"Sure. I knew your men wouldn't. Hop in and I'll ride you over to Hampton." At Erin's hesitation, he gestured impatiently. "I'm not going to kidnap you, if that's what you think. Federal laws still mean something to me, you know."

"I wouldn't know." Erin climbed in and the motor behind purred softly, its sound indicating a full atomic generator instead of the usual steam plant. "I suppose the warden kept you well informed of my actions."

The other chuckled. "He did; money has its uses when you know where to put it. I found out you weren't letting your men visit or write to you, and that's about all. Afraid I'd find out what was in the letter?"

"Precisely. And the boys could use the time better for work than useless visits to me. Thanks, I have tobacco." But at Stewart's impatient gesture he put the "makings" back and accepted a cigarette. "It isn't poisoned, I suppose?"

"Nor loaded."

Erin let a half smile run over his lips and relaxed on the seat, watching the road flash by and letting his mind run over other times with

Stewart. Probably the other was doing the same, since the silence was mutual. They had all too many common memories. Forty years of them, from the time they had first met at the Institute as roommates, both filled with a hunger for knowledge that would let them cross space to other worlds.

Erin, from a family that traced itself back almost to Adam, and with a fortune equally old, had placed his faith in the newly commercialized atomic power. Gregory Stewart, who came from the wrong side of the tracks, where a full meal was a luxury, was more conservative; new and better explosives were his specialty. The fact that they were both aiming at the same goal made little difference in their arguments. Though they stuck together from stubbornness, black eyes flourished.

Then, to complicate matters further, Mara Devlin entered their lives to choose Erin after two years of indecision and to die while giving birth to his son. Erin took the boy and a few workers out to a small island off the coast and began soaking his fortune into workshops where he could train men in rocketry and gain some protection from Stewart's thugs.

Gregory Stewart had prospered with his explosives during the war of 1958, and was piling up fortune on fortune. Little by little, the key industries of the country were coming under his control, along with the toughest gangs of gunmen. When he could, he bought an island lying off the coast, a few miles from Erin's, stocked it with the best brains he could buy, and began his own research. The old feud settled down to a dull but constant series of defeats and partial victories that gained nothing for either.

Erin came to the crowning stroke of Stewart's offensive, grimaced and tossed the cigarette away. "I forgot to thank you for railroading me up on that five-year sentence, Greg," he said quietly. "I suppose you were responsible for the failure of the blast that killed my son, as well."

Stewart looked at him in surprise which seemed genuine. "The failure was none of my doing, Erin. Anyway, you had no business sending the boy up on the crazy experimental model; any fool should have known he couldn't handle it. Maybe my legal staff framed things a little, but it *was* manslaughter. I could have wrung your neck when I heard Mara's son was dead, instead of letting you off lightly with five years —less one for good behavior."

"I didn't send him up." Erin's soft voice contrasted oddly with Stewart's bellow. "He slipped out one night on his own, against my orders. If the whole case hadn't been fixed with your money, I could have proved that at the trial. As it was, I couldn't get a decent hearing."

"All right, then, I framed you. But you've hit back at me without trying to, though you probably don't know it yet." He brushed Erin's protest aside quickly. "Never mind, you'll see what I mean soon enough. I didn't meet you to hash over past grievances."

"I wondered why you came to see me out."

They swung off the main highway into a smaller road where the speed limit was only sixty, and went flashing past the other cars headed for Hampton. Stewart gunned the car savagely, unmindful of the curves. "We're almost to the wharf," he pointed out needlessly, "so I'll make it short and sweet. I'm about finished with plans for a rocket that

will work—a few more months should do the trick—and I don't want competition now. In plain words, drop it, Erin, or all rules are off between us."

"Haven't they been?" Erin asked.

"Only partly. Forget your crazy ion-blast idea, and I'll reserve a berth for you on my ship; keep on bucking me, and I'll ruin you. Well?"

"No, Greg."

Stewart grunted and shrugged. "I was afraid you'd be a fool. We've always wanted the same things, and you've either had them to begin with or gotten them from under my nose. But this time it's not going to be that way. I'm declaring war. And for your information, *my* patents go through in a few days, so you'll have to figure on getting along without that steering assembly you worked out."

Erin gave no sign he had heard as the car came to a stop at the small wharf. "Thanks for picking me up," he said with grave courtesy, Stewart answered with a curt nod and swung the car around on its front wheels. Erin turned to a boy whose boat was tied up nearby. "How much to ferry me out to Kroll Island?"

"Two bucks." The boy looked up, and changed his smile quickly. "You one of them crazy guys who's been playing with skyrockets? Five bucks I meant."

Erin grimaced sligthly but held out the money.

II.

THERE WAS nobody waiting to greet him on the island, nor had he expected anyone. He fed the right combination into the alarm system to keep it quiet and set off up the rough wooden walk toward the buildings that huddled together a few hundred yards from the dock. The warehouses, he noticed, needed a new coat of paint, and the dock would require repairs if the tramp freighter was to use it much longer.

There was a smell of smoke in the air, tangy and resinous at first, but growing stronger as he moved away from the ocean's crisp counteracting odor. As he passed the big machine shop a stronger whiff of it reached him, unpleasant now. There was a thin wisp of smoke going up behind it, the faint gray of an almost exhausted fire. The men must be getting careless, burning their rubbish so close to the buildings. He cut around the corner and stopped.

The south wall of the laboratory was a black charred scar, dripping dankly from a hose that was playing on it. Where the office building had stood, gaunt steel girders rose from a pile of smoking ashes and half burned boards, with two blistered filing cabinets poking up like ghosts at a wake.

The three men standing by added nothing to the cheerfulness of the scene. Erin shivered slightly before advancing toward them. It was a foreboding omen for his homecoming, and for a moment the primitive fears mastered him. The little pain that had been scratching at his heart came back again, stronger this time.

Doug Wratten turned off the hose and shook a small arm at the sandy-haired young husky beside him. "All right," he yelled in a piping falsetto, "matter's particular and energy's discreet. But you chemists try and convince an atomic generator that it's dealing with building-block atoms instead of wave-motion."

Jimmy Shaw's homely pleasant face still studied the smoldering ashes. "Roll wave-motion into a ball and give it valence, redhead," he suggested. "Do that and I'll send Stewart a sample—it might make a

better bomb than the egg he laid on us. How about it, dad?"

"Maybe. Anyhow, you kids drop the argument until you're through being mad at Stewart," the foreman ordered. "You'll carry your tempers over against each other." Tom Shaw was even more grizzled and stooped than Erin remembered, and his lanky frame seemed to have grown thinner.

"All right," he decided in his twangy down East voice. "I guess it's over, so we . . . Hey, it's Erin!"

He caught at Jimmy's arm and pulled him around, heading toward Erin with a loose-jointed trot. Doug forgot his arguments and moved his underdone figure on the double after them, shouting at the top of his thin voice. Erin found his arm aching and his ears ringing from their voices.

He broke free for a second and smiled. "All right, I got a year off, I sneaked in, I'm glad to be back, and you've done a good job, I gather. Where are Hank and Dutch?"

"Over in the machine shop, I guess. Haven't seen 'em since the fire was under control." Shaw jerked a long arm at the remains. "Had a little trouble, you see."

"I saw. Stewart's men?"

"Uh-hmm. Came over in a plane and dropped an incendiary. Sort of ruined the office, but no real damage to the laboratory. If those filing cabinets are as good as they claimed, it didn't hurt our records."

Doug grinned beatifically. "Hurt their plane more. Tom here had one of our test models sent up for it, and the rocket striking against the propeller spoiled their plans." He gestured out toward the ocean. "They're drinking Neptune's health in hell right now."

"Bloodthirsty little physicist, isn't he?" Jimmy asked the air. "Hey, Kung, the boss is back. Better go tell the others."

The Chinese cook came hobbling up, jerking his bad leg over the ground and swearing at it as it slowed him down. "Kung, him see boss fella allee same time more quick long time," he intoned. "Vely good, him come back. Mebbeso make big suppee chop-chop same time night."

He gravely shook hands with himself before Erin, his smile saying more than the garbled English he insisted on using, then went hobbling off toward the machine shop. Shaw turned to the two young men.

"All right, you kids, get along. I've got business with Erin." As they left, his face lengthened. "I'm glad you're back, boss. Things haven't been looking any too good. Stewart's getting more active. Oh, the fire didn't do us any permanent damage, but we've been having trouble getting our supplies freighted in—had to buy an old tramp freighter when Stewart took over the regular one—and it looks like war brewing all along the line."

"I know it. Stewart brought me back, and told me he was gunning for us." Erin dropped back on a rock, realizing suddenly that he was tired; and he'd have to see a doctor about his heart—sometime. "And he's stolen our steering unit, or claims he's getting it patented, at least."

"Hm-m-m. He can't have it; it's the only practical solution to the controls system there is. Erin, we'll—Skip it, here come Dutch and Hank."

But a sudden whistle from the rocket test tower cut in, indicating a test. The structural engineer and machinist swung sharply, and Doug and Jimmy popped out of the laboratory, at a run. Shaw grabbed

at Erin. "Come on," he urged. "This is the biggest test yet, I hope. Good thing you're here to see it." Even Kung was hobbling toward the tower.

ERIN FOLLOWED, puzzling over who could have set off the whistle; he knew of no one not accounted for, yet a man had to be in the tower; evidently there was an addition to the force of whom he knew nothing. They reached the guard rail around the tower, and the whistle tooted again, three times in warning.

"Where's the rocket?" Erin yelled over the whistle. There was nothing on the take-off cradle.

"Left two days ago; this is the return. Jack's been nursing it without sleep—wouldn't let anyone else have it," Shaw answered hurriedly. "Only took time off to send another up for the bomber."

Following their eyes, Erin finally located a tiny point of light that grew as he watched. From the point in the sky where it was, a thin shrilling reached their ears. A few seconds later, he made out the stubby shape of a ten-foot model, its tubes belching out blue flame in a long tight jet. With a speed that made it difficult to follow, it shot over their heads at a flat angle, heading over the ocean while its speed dropped. A rolling turn pointed it back over their heads, lower this time, and the ion-blast could be seen as a tight unwavering track behind it.

Then it reversed again and came over the tower, slowed almost to a stop, turned up to vertical with a long blast from its steering tubes, and settled slowly into the space between the guide rails. It slid down with a wheeze, sneezed faintly, and decided to stop peacefully. Erin felt a tingle run up his back at his first sight of a completely successful radio-controlled flight.

The others were yelling crazily. Dutch Bauer, the fat structural engineer, was dancing with Hank Vlecek, his bald pate shining red with excitement. "It worked, it worked," they were chanting.

Shaw grunted. "Luck," he said sourly, but his face belied the words. "Jack had no business sending our first model with the new helix on such a flight. Wonder the darn fool didn't lose it in space."

Erin's eyes were focused on the young man coming from the pit of the tower. There was something oddly familiar about those wide shoulders and the mane of black hair that hugged his head. As the boy came nearer, the impression was heightened by the serious brown eyes, now red for lack of sleep, that were slightly too deep in the round face.

The boy scanned the group and moved directly toward Morse, a little hesitantly. "Well," he asked, "how did you like the test . . . Mr. Morse, I think? Notice how the new helix holds the jet steady?"

Erin nodded slowly. So this was what Stewart had meant by his statement that he had been hit twice as hard. "A very good test," he acknowledged. "You resemble your father, Jack Stewart!"

Jack shifted on his feet, then decided there was no disapproval on Erin's face, and grinned. He held out a small package. "Then I'll give this to you, sir. It's a reel of exposed film, shot from the rocket, and it should show the other side—of the Moon!"

III.

THE SECRETARY glided into the richly-appointed room, sniffing at

the pungent odor given off by the dirty old pipe in Stewart's mouth. "Mr. Russell's here, sir," she announced, wondering whether his scowl was indicative of indigestion or directed at some particular person.

"Send him in, then." He bit at the stem of the pipe without looking at her, and she breathed a sigh of relief. It wasn't indigestion, which was the only thing that made him roar at the office force; at other times he was fair and just with them, if not given to kindliness. Looking at Russell as she sent him in, she guessed the object of his anger.

"Well?" Stewart asked curtly as his right-hand man entered.

"Now look," Russell began, "I admit I sent the plane over before you said, but was it my fault if they brought it down? How was I to know they had a torpedo they could control in the air?"

"Not torpedo, you fool; it was a rocket. And that's bad news, in itself, since it means they're making progress. But we'll skip that. I gave orders you were to wait until Morse refused my offer, and you didn't. Furthermore, I told you to send it over at night, when they'd be unprepared, and drop it on the tower and laboratory, not on the office. I'm not trying to burn people to death."

"But the pilot didn't want—"

"You mean you had your own little ideas." He tossed the pipe into a tray and began picking at his fingernails. "Next time I give you orders, Russell, I expect them to be followed. Understand? You'd better. Now get down to Washington and see what you can do about rushing our patent on the unified control; Erin Morse didn't look surprised or bothered enough to suit me. He's holding something, and I don't want it to show up as an ace. O. K., beat it."

Russell looked up in surprise, and made tracks toward the door. Either the old man was feeling unusually good, or he was worried. That had been easier than he expected.

Back on Kroll Island, Erin Morse settled back in his chair in the corner of the workshop that served as a temporary office. "Read this," he said, handing a dog-eared magazine with a harshly colored cover to Shaw. "It's a copy of *Interplanetary Tales*, one of the two issues they printed. It's not well known, but it's still classed as literature. Page 108, where it's marked in red."

Shaw looked at him curiously, and reached for the magazine. He began reading in his overly-precise manner, the exact opposite of his usual slow speech. " 'Jerry threw the stick over to the right, and the *Betsy* veered sharply, jarring his teeth. The controls were the newest type, arranged to be handled by one stick. Below the steering rod was a circular disk, and banked around it was a circle of pistons that varied the steering jet blasts according to the amount they were depressed. Moving the stick caused the disk to press against those pistons which would turn the ship in that direction, slowly with a little movement, sharply if it were depressed the limit.' "

He looked up at Erin. "But that's a fair description of the system we use."

"Exactly. Do you remember whether the submarine was patented?"

"Why, Jules Verne— Hm-m-m. Anything described reasonably accurately in literature can't be given a basic patent." Shaw thought it over slowly. "I take it we mail this to the attorneys and get Stewart's claim

voided. So that's why you didn't try for a patent on it?"

"Naturally."

MORSE PICKED UP the records that had been saved from the fire by insulated cabinets, and ran back over the last few year's work. They showed the usual huge expenditures and small progress. Rockets aren't built on a shoestring nor in the back yard during the idle hours of a boy scientist. "Total cost, five-foot experimental radio-controlled rocket, $13,843.51," read one item. From another book he found that it had crashed into the sea on its first flight and been destroyed.

But there were advances. The third model had succeeded, though the flickering, erratic blast had made control difficult. A new lightweight converter had been tested successfully, throwing out power from the atoms with only a 00.2% heat loss. An ion-release had been discovered by General Electratomic Co. that afforded a more than ample supply of ions, and Shaw had secured rights for its use. Toward the last there were outlays for some new helix to control the ion-blast on a tight line under constant force and a new alloy for the chamber. Those had always been the problems.

"Good work," Erin Morse nodded. "This last model, I gather, is the one Jack used to reach the Moon." Under it he penciled the word "success" in bright green. "The boys were quite excited over those pictures, even if they did show nothing spectacular. I'm glad he sent it."

"So am I. They needed encouragement." Shaw kicked aside a broken bearing, and moved his chair back against the wall. "I suppose you're wondering why Jack's working with us; I didn't know how you'd take it."

"I'm reserving my opinion for the facts." It had been a shock, seeing the boy there, but he had covered up as best he could and waited until information was vouchsafed.

Shaw began awkwardly, not sure yet whether Erin approved or not. "Jack came here about a year ago and—well, he simply told us he was looking for work. Had a blow-up with his father over your being sent up for the accident, it seems. Anyway, they'd been quarreling before because Jack wanted to specialize in atomics, and the old man wanted him to carry on with explosives.

"So Jack left home, took his degree with money his mother had left him, and came here. He's good, too, though I wouldn't tell him so. That new helix control is his work, and he's fixed up the ion-release so as to give optimum results, Since Doug and you studied atomics, they've made big progress, I reckon, and we needed someone with his training."

"Any experimental work needs new blood," Erin agreed. "So Greg succeeded in teaching his son that Mars was the last frontier, but not how to reach it."

"Seems that way. Anyway, his father's kicking up a worse fuss with us since he came. Somehow, there's a leak, and I can't locate the source —Jack has been watched, and he's not doing it. But Stewart's getting too much information on what we're doing—like that control. He managed to cut off freighter service and choke our source of supplies until I bought up a tramp and hired a no-good captain."

"He'll hit harder when we get his patent application killed. By the way, are the plans for that air-re-

newer of Jimmy's still around?"

Shaw nodded. "Yeah, I guess so. He never found out what was wrong with it, though, so we've been planning on carrying oxygen flasks with us." Based on the idea of photosynthesis, the air-renewer had been designed to break down the carbon dioxide waste product of breathing by turning it into sugar and free oxygen, as a plant does, and permit the same air being used over and over.

"All it needs is saturated air around the catalyst." Erin had fished around in the papers from the burned office until he had the plans. Now he spread them before Shaw and indicated the changes. "A spray of water here, and remove the humidity afterward. Took me three years up there, working when I could, to find that fault, but it's ready for the patent attorneys now. Dutch can draw up the plans in the morning."

They stuck the papers and books away and passed out of the building into the night. "Stars look righ good," Shaw observed. "Mars seems to be waiting until we can get there."

"That shouldn't be long now, with the rocket blast finally under control. What's that?" Erin pointed toward a sharp streak of light that rose suddenly over the horizon and arced up rapidly. As they watched, it straightened to vertical and went streaking up on greased wings until it faded into the heights beyond vision.

"Looks like Stewart's made a successful model." A faint high whine reached their ears now. "If he has, we *will* have a fight on our hands."

Erin nodded. "Start the boys on the big rocket in the morning; we can't stop for more experimental work now."

IV.

THE BIG electric hammer came down with a monotonous thud and clank, jarring against the eardrums in its endless hunger for new material to work on. Hank Vlecek's little bullet head looked like a hairy billiard ball stuck on an ape's body as he bobbed up and down in front of it, feeding in sheets of cuproberyl alloy. But the power in the machinist's arm seemed to match that of the motor.

Dutch Bauer looked up from a sheet of blueprints and nodded approvingly, then went back to the elaborate calculations required to complete the design he was working on. The two co-operated perfectly, Dutch creating structural pattern on paper, and Vlecek turning them into solid metal.

On paper, the *Santa Maria* was shaping up handsomely, though the only beauty of the ship itself was to be that given by severe utility. Short and squat, with flaring blast tubes, she showed little resemblance to the classic cigar-hulls of a thousand speculative artists. The one great purpose was strength with a minimum of weight, and the locating of the center of gravity below the thrust points of the rockets. When completed, there would be no danger of her tipping her nose back to Earth on the take-off.

Out on the ways that had been thrown up hastily, gaunt girders were shaping into position to form her skeleton, and some of the outer sheathing was in position. The stubby air fins that would support her in the air until speed was reached were lying beside her, ready to be attached, and a blower was already shooting in insulation where her double hull was completed. Space itself would be insulation against heat

loss, but the rays of the unfiltered sunlight needed something to check them, or the men inside the ship would have been boiled long before Mars was reached. Hsi Kung was running the blower, babbling at it in singsong Peking dialect. At a time like this, they were all common laborers when there was work to be done.

Erin pulled on coveralls and reached for the induction welder, while Jimmy Shaw consulted his blueprints. "Wonder why Doug hasn't shown up?" the boy asked. "He usually gets back from the mainland before morning, but it's nine already. Hm-m-m. Looks like Hank's machined enough hull plates to keep us busy until supper."

"It does, though where he finds time is a puzzle. He must work all night. We need other workers, if we're to compete with Stewart's force. Even counting Kung, eight men aren't enough for this job." Erin began climbing up the wooden framing that gave access to the hull, wondering whether his heart would bother him today. Sleep had been slow coming the night before, and he was tired. This work was too heavy for an old man, though he hadn't thought of himself as old before. Certainly he didn't look old.

"Wonder why Doug goes to town once a week?" he asked.

Jimmy chuckled. "Don't you know? He's found a girl friend there, believe it or not. Some woman has either taken pity on him, or he's found his nerve at last."

Doug wasn't exactly the sort that would appeal to women. His short, scrawny figure was all angles, and his face, topped by its thin mop of reddish hair, was vaguely like that of an eagle. Then, too, he usually stuttered around women.

Erin smiled faintly. "It's a shame, in a way, that Doug's so shy around girls. I hope he has better luck with this one than that other."

"So do I, though I wouldn't tell him so. He's been as cocky as a rooster since he found this Helen." Jimmy settled into position with a grunt and moved a sheet into place as it came up on the magnetic grapple Jack was working below them. "O. K., fire away."

THE WELDER was heavy, and the heat that poured up from the plates sapped at Morse's strength. He was conscious of sudden relief at noon when a shout came up to him. He released the welder slowly, rubbing tired muscles, and looked down at the weaving form of Doug Wratten. One of the physicist's thin arms was motioning him down erratically.

"Drunk!" Jimmy diagnosed in amazement. "Didn't know he touched the stuff."

There was no question of Doug's state. His words were thick and muffled as Erin reached him. "Go 'head 'n' fire me," he muttered thickly. "Fire me, Erin. Kick m' out 'thout a good word. I'm a low-down dir'y dog, tha's what."

"For being drunk, Doug? That hardly justifies such extreme measures."

"Uh-hu. Who's drunk? It's tha' girl . . . I foun' the leak we been worr'n 'bout."

Erin got an arm around him and began moving toward the bunkhouse, meaning to pay no attention to his mumbled words. But the last one struck home. The leak of information to Stewart's camp had been troubling them all for the last two months. "Yes?" he encouraged.

" 'S the girl. She's a spy for Stewart." His voice stuck in his throat and he rumbled unhappily. "Use'a be his sec'tary, planted her on me.

Jus' usin' me, tha's all. Saw a letter she was writin' him when I was waitin' f'r her to come down. Di'nt wait any more . . . Jus' usin' me; tol' me she was in'rested in my work. Tol' me she loved me. Foun' out all I knew . . . Better fire me, Erin."

"I think not, Doug. It might have happened to any of us. Why don't you go to sleep?"

Wratten rolled over in the bed as he was released, gagging sickly, and moaning to himself. "I love Helen . . . Helen . . . Damn Helen!" As Erin closed the door, his voice came out, pleading. "Don' tell Jimmy; he'd laugh."

Jimmy stood at the door as Erin came out. "Poor devil," he said. "I heard enough to know what happened. Anything I can do for him?"

"Let him sleep it off. I'll have a talk with him when he wakes up and see what I can do about bolstering up his faith in himself."

"O. K.," Jimmy agreed, "but it was a dirty, rotten trick of Stewart's, using him like that. . Say, dad's up at the shack swearing at something Stewart's done, and yelling for you. I just went up there."

Erin grunted, and turned hastily toward the temporary office building they had erected. It was always something, except when it was more than one thing. First the fire, the trouble with the patent, now safely squelched, difficulty in obtaining tools, and one thing after another, all meant to wear down their morale. This was probably one of the master strokes that seemed to happen almost at regular intervals.

Sometimes he wondered whether either of them would ever succeeded; forty years of rivalry had produced no results except enough to keep them trying. Now, when success for one of them seemed at hand, the feud was going on more bitterly than before, though it was mostly one-sided. And war was menacing the world again, as it would always threaten a world where there were no other escape valves for men's emotions. They needed a new frontier, free of national barriers, where the headstrong could fight nature instead of their brothers.

He had hoped to provide that escape valve in leading men to another planet, just as Stewart hoped. But would either of them succeed? Erin was sure of Stewart's ultimate failure—explosives couldn't do the trick; though he had enough of a sense of humor to realize that Stewart was saying the same thing about him and his method. If only there could be peace until he finished!

SHAW was waiting impatiently, swearing coldly in a voice Erin hadn't heard since the days when Tom was tricked out of a discovery by a company for which he worked as metallurgist, and he joined the men on the island. "The mail's in," he said, breaking off his flow of invectives. "Here's a present from Captain Hitchkins—says he can't get the cargo of berylium alloy we ordered made up. And here's the letter from the Beryl Co."

Erin picked up the letter, and read it slowly. It began with too profuse apologies, then cited legal outs. "—will realize that we are not breaking our contract by this action, since it contains a clause to the effect that our own needs shall come first. Mr. G. R. Stewart, who has controlling interest in our stock, has requisitioned our entire supply, and we are advised by our legal department that this contingency is covered by the clause mentioned. Therefore, we can no longer furnish the alloy you desire. We regret—"

He skimmed the passage of regret and polite lies, to center on a sentence at the end, which conveyed the real message, and revealed the source of the letter. "We doubt that you can secure berylium alloy at any price, as we are advised that Mr. Stewart is using all that the market can supply. If such is not the case, we shall, of course, be glad to extend our best wishes in your enterprise."

"How about that?" he asked Shaw, pointing to the last sentence. "Have you investigated?"

"Don't need to. Hitchkins showed more brains than I gave him credit for. He scoured the market for us, on his own initiative, and berylium just ain't." Shaw passed over the other letters that had come, reverting to his invectives. "Now what do we do?"

"Without berylium, nothing. We'll have to get it, some way." But Erin wondered. Whatever else Stewart was, he was thorough, and his last stroke had been more than the expected major move.

V.

THE supper table had turned into a conference room, since news of that importance was impossible to keep. Even Doug Wratten had partially forgotten his own troubles, and was watching Erin. Kung stood unnoticed in the doorway, his moonface picturing the general gloom.

Dutch Bauer finished his explanation and concluded. "So, that is it. No berylium, no *Santa Maria*. Even aluminum alloys are too heavy for good design. Aluminum—bah! Hopeless." He shrugged and spread his pudgy hands to show just how hopeless it was.

Jimmy grunted and considered. "How about magnesium alloys—something like magnalium?" he asked, but without much hope. "It's even lighter than berylium—1.74 density instead of 1.8."

"Won't work." Their eyes had turned to Shaw, who was the metallurgist, and his answer was flat. "Alloys aren't high enough in melting point, aren't hard enough, and don't have the strength of the one we've been using. When the ship uses the air for braking, or when the sun shines on it in space, we'll need something that won't soften up at ordinary temperatures, and that means berylium."

"Then how about the foreign markets?" Jack wanted to know. "My fa . . . Mr. Stewart can't control all of them."

Erin shook his head. "No luck. They're turning all they can get into bombing planes and air torpedoes. They're not interested in idealism."

"I liked that new helix, too." Jack tapped his fingers on the table, then snapped them out flat. "Well, there goes a nice piece of applied atomics. We should have brought our own berylium plant, I guess."

"And have to close down because Stewart gained control of the new process for getting berylium out of its ores." Shaw grunted. "We'd have had to fall back on the old process of extracting it by dissolving out in alkalies."

Erin looked up suddenly, staring at Shaw. "When I was first starting," he said thoughtfully, "I considered buying one of the old plants. It's still standing, all the machinery in place, but it's been closed down by the competition of the new process. The owner's hard up, but he can't sell the place for love or money."

Jimmy's face dropped its scowl and came forth with a fresh grin, even the mention of a faint hope was

enough to send up his enthusiasm. "So we buy it or get him to open up, start using it, and go ahead in spite of Stewart. How much does the old system cost, dad?"

"About fifteen hundred dollars a ton, using a couple of tricks I could show them. Going to try it, Erin?"

Erin nodded silently, but the frown was still on his face as he got up and went out to the new office where he could use the visiphone. The plant had a maximum capacity of four tons a week, which was hardly adequate, and there were other objections, but trying would do no harm. The frown was heavier when he came back.

"Sanders will open up," he reported, "but he'll need money to fix the plant up. He agrees to turn the plant over to us, and furnish the alloy at the price Tom mentioned, but we'll have to invest about sixty thousand in new equipment. Add that to cost of the metal, and it runs to a rather steep figure."

"But—"

"I know. I'm not kicking about the money, or wouldn't be if I had it to spend." Erin hadn't meant to tell them of his own troubles, but there was no way to avoid it now. "Stewart left nothing to chance. The stocks and investments I had began to slip a month ago, and they kept slipping. My brokers advised me that they have liquidated everything, and I have about ten cents on a dollar left; today's mail brought their letter, along with the other news."

Jack swore hotly. "Da . . . Stewart always could ruin a man on the market. Erin, I've got a decent legacy from my mother, and we're practically running a co-operative here anyhow. It's all yours."

Erin saw suddenly just what the loss of the boy had meant to Stewart, and the last of the numbness from his own son's death slipped away. His smile was at sweet as a woman's, but he shook his head. "Did you read your mail today?"

"No, why?"

"Because Stewart would know his own son well enough to take precautions. See if I'm not right."

They watched intently as the letters came out of Jack's pocket and were sorted. He selected one bulky one, and ripped it open hastily, drawing out the paper where all could see, skimming over it until it formed a complete picture. "'It almost seems that someone is deliberately trying to ruin you,'" he read. "'Our best efforts have failed completely—' Damn! There's about enough left to pay for the new machinery needed, and that's all."

Doug came out of his trance. "I won't be needing my savings for the future now," he said grimly. "It's not much, but I'd appreciate your using it, Erin. And I don't think any of us will want the salary you've been paying us."

The others nodded. All of them had been paid more than well, and had had no chance to spend much of their salary. Their contributions were made as a matter of course, and Erin totaled them.

"It may be enough," he said. "Of course, we form a close corporation, all profits—if there are any from this—being distributed. I'll have the legal papers drawn up. Perhaps it will be enough, perhaps not, but we can put it to the test. Our big trouble is that we need new workers, men to help Hank particularly. Most of the machining will have to be done here on the island now."

"Mebbeso you fella catches man fella plenty." Kung hobbled forward to the table, a dirty leather

"It's all right—they didn't get the ship!"

sack in his hands. "You fella catchee li'l planek fin' allee same time catchee big time, makee flee." His pidgin went on, growing too thick for them to understand.

Tom Shaw held up a protesting hand. "Talk chink," he ordered. "I spent five years there once, so I can get the lingo if you take your time."

Kung threw him a surprised and grateful glance, and broke into a rambling discourse, motioning toward the sky, the bag in his hand, and counting on his fingers.

Shaw turned back to the others. "He says he wants to join up, putting in the money he's been saving for his funeral when they ship his body back to China. Wants to know if his race will be allowed on the other planets when we reach them?"

"Tell him the planets are big enough for all races, provided ships are built to carry them."

"Vely good, boss fella, savee plenty." Kung lapsed again into Peking dialect.

Shaw kicked back his chair, going over to pound the cook on the back. For once, the sourness was absent from his voice.

"He says he can get us workers then, who'll obey with no questions asked, and won't cost us more than enough to buy them cheap food. His tong will be glad to furnish them on his say-so. Since Japan conquered them, and they digested the Japanese into their own nation again, it seems they need room to expand.

"Darn it, Erin, with even the Chinese cook behind you, we're bound to beat Stewart."

VI.

CAPTAIN HITCHKINS had left the unloading to the ruffian he called his mate and was examining the progress made on the island. His rough English face was a curious blend of awe and skepticism. "Naow was that 'ere a ship, mitey," he told Erin, "I'd s'y 'twas a maost seaworthy job, that I would, thaough she's lackin' a bit o' keel. 'N' I m'y allaow as she's not bad, not bad a'tawl."

Erin let him talk on, paying as little attention to his speech as the captain would have to a landlubber's comments on the tub of a freighter. Hitchkins was entirely satisfied with that arrangement. The *Santa Maria* could speak for herself.

The hull was completed, except for a section deliberately left open for the admission of the main atomic generator, and a gleaming coat of silver lacquer had been applied, to give the necessary luster for the deflection of the Sun's rays. In comparison to a seagoing ship, she was small, but here on the ways, seen by herself, she loomed up like some monster out of a fantasy book. Even with the motors installed, and food for six years stocked, she still held a comfortable living space for the eight men who would go with her.

"I heard as 'aow they've a new lawr passed, mikin' aout against the like o' such, thaough," Hitchkins went on. "Naow w'y would they do that?"

"People are always afraid of new things, captain. I'm not worried about it, though." Erin turned over the bills of lading. "Have any trouble this trip?"

"Some o' the men were minded the p'y was a bit laow. But they chinged their minds w'en they come to, that they did." He chuckled. I've a bit of a w'y wi' the men, sir."

They were back at the dock now, watching the donkey engines laboring under the load of alloy plates that was being transferred to the machine shop. The Chinese labor-

ers were sweating and struggling with the trucks on which these were hauled, but they grinned at him and nodded. He had no complaint with the labor Kung had obtained. If the money held out, things looked hopeful.

Jack Stewart located him, and yelled. "There's a Mr. Stewart at the office," he said flatly. "He came while you were showing Captain Hitchkins the ship, and is waiting for you. Shall I tell him to go on waiting?"

"No, I'll see him; might as well find out the worst." Stewart had visiphoned that he was coming under a temporary truce, so Erin was not surprised. "Carry on, captain." He turned after Jack toward the shack, wishing the boy would treat his father a little less coldly. It wasn't good for a man to feel that way about his father, and he wished Stewart no personal troubles.

Jack swung off toward the ship as they sighted Stewart, and the older man's eyes followed the retreating figure.

"He's a good boy, Greg," Erin said, not unkindly. "I didn't plan this, you know."

"Skip it. He's no concern of mine, the stubborn ass." Stewart held out a newspaper. "I thought you might be interested to know that the law has been passed against the use of atomic power in any spaceship. It just went through the State legislature and was signed by the governor."

"Don't you think it's a bit high-handed? I though that interstate and international commerce was out of the hands of the State legislatures."

Stewart tapped the paper. "But there's no provision against their ruling on interplanetary commerce, Erin. A few scare stories in the Sunday supplements, and a few dinners to the right men did the trick. They were sure the Martians might find the secret and turn atomic power back on us."

"So you had to come and bring me the news. I suppose you expect me to quit now, and twiddle my thumbs."

"That offer of a berth on my ship —which will work—still stands. Of course, if I have to get out an injunction to stop you, it will make matters a little more difficult, but the result will be the same."

Erin smiled grimly. "That was the poorest move you've made, Greg," he said. "Your lawmakers bungled. I read the law, and it forbids the use of atomic power in the 'vacuum of space.' And good scientists will tell you that a vacuum is absolute nothing space—and between the planets, at least, there are a few molecules of matter to the cubic inch. Your law and injuction won't work."

"You've seen a lawyer, I suppose?"

"I have, and he assures me there's nothing to stop me. Furthermore, until I reach space, the law doesn't apply, and when I'm in space, no Earth-made laws can govern me."

Stewart shrugged. "So you've put one over on me again. You always were persistent, Erin. The only man I haven't been able to beat—yet. Maybe I'll have to wait until your crazy ship fails, but I hope not."

"I'll walk down to the dock with you," Erin offered. "Drop in any time you want to, provided you come alone." He was feeling almost friendly now that success was in sight. Stewart fell in beside him, his eyes turned toward the group of laborers Jack was directing.

"I suppose—" he began, and stopped.

"He goes along, according to his own wishes."

Stewart grunted. "You realize, Erin, that one false attempt might set the possibility of the public's accepting rocket flight back fifty years. And the men in the ship would be —well, wouldn't be." He hesitated. "How much would you take to stop it?"

"You know better than that." But Erin realized that the question was more an automatic reaction than anything else. When Stewart asked that, he could see no other solution, and money had been his chief weapon since he made his first fortune.

As the man left in the little boat that had brought him, Erin wondered, though. Was Stewart licked, for once and for all? Or was it only that the combination of seeing his son turned against him, and finding his carefully laid scheme hadn't made a decent fizzle? He shrugged and dismissed it. There seemed little more chance for trouble, but if it came, it would be the unexpected, and worry would do no good.

IT WAS the unexpected, but they were not entirely unwarned. The first pale light of the false dawn showed when a commotion at the door awakened them. Doug got up grumply and went groping toward the key. "Some darned chink in a fight, I suppose," he began.

Then he let out a sound that scarcely fitted a human throat, and jerked back in. The others could see only two small, rounded arms that came up around his neck, and a head of hair that might have been brown in a clearer light. The voice was almost hysterical.

"Doug! Oh, I was afraid I wouldn't get here in time."

"Helen!" Doug's words were frigid, but he trembled under the robe. "What are— Don't start anything— I saw the letter."

They could see her more clearly now, and Jimmy whistled. No wonder Doug had taken it so hard. She was almost crying, and her arms refused to let him go. "I knew you'd seen the first page—part of it. But you didn't read all."

"Well?" Only the faint ghost of a doubt tinged his inflection.

"I wasn't just acting the Saturday before; I meant it. That's why I was writing the letter—to tell Mr. Stewart I was through with him." She groped into her purse and came out with a wrinkled sheet. "Here, you can see for yourself. And then you were gone and I found this in the wastebasket where you threw it, so I didn't quit. I thought you'd never speak to me. Believe me, Doug?"

His wizened little face wasn't funny now, though two red spots showed up ridiculously on his white skin. His long, tapering fingers groped toward her, touched, and drew back. She caught them quickly. "Well—" he said again; then, "what are you doing here, anyhow, Helen . . . Helenya?"

She jerked guiltily. "Stewart. His lieutenant—Russell—wanted the combination to your alarm system again—forgot it."

"You gave it?"

"I had to. Then I came here to warn you. There are a bunch of them, every rat on his force, and they're coming here. I was afraid you'd be—"

There was something almost wonderful about Doug then. All the silly cockiness and self-consciousness were gone. "All right," he said quietly. "Go back to the cook shack and stay there; you'll know where to find it. No, do as I say. We'll

talk it over later, Helen. I don't want you around when it happens. Go on. Erin, Tom, you'll know what to do. I'll wake the Chinese and get them in order." And he was gone at a run.

VII.

THEY didn't stop for clothes, but went out into the chill air as they were. Doug had the Chinese lined up and was handing out the few spare weapons grimly, explaining while he worked. A tall north-country yellow man asked a few questions in a careful Harvard accent, then turned back and began barking orders in staccato Mandarin. Whether they would be any good in a fight was a question, but the self-appointed leader seemed to know his business. They were no cowards, at least.

Tom Shaw passed Jimmy a dried plug of tobacco. "Better take it," he advised. "When you're fighting the first time, it takes something strong in your mouth to keep your stomach down, son. And shoot for their bellies—it's easier and just as sure."

There was no time to throw up embankments at the wharf, so they drew back to the higher ground, away from the buildings, which would have sheltered them, but covered any flanking movement by the gunmen. Jack stared incredulously at the gun in his hand, and wiped the sweat from his hands. "Better lend me some of that tobacco," he said wryly. "My stomach's already begun fighting. You using that heavy thing?"

"Sure." The gun was a sixty-pound machine rifle, equipped with homemade grips and shoulder and chest pads, set for single fire. It looked capable of crushing Shaw's lanky figure at the first recoil, but he carried it confidently. "It's been done before; grew up with a gun in my hand in the Green Mountains."

Erin rubbed a spot over his heart surreptitiously and waited. Stewart would be defeated only when he died, it seemed, and maybe not then.

Then they made out the figures in the tricky light of the dawn, long shadows that slunk silently over the dock and advanced up the hill toward the bunkhouse. Some movement must have betrayed the watchers, for one of the advancing figures let out a yell and pointed.

"Come on, mugs," a hoarse voice yelled. "Here's our meat, begging to be caught. A bonus to the first man that gets one."

Whing! Shaw twitched and swore. "Only a crease," he whispered, "and an accident. They can't shoot." He raised the heavy gun, coming upright, and aimed casually. It spoke sharply, once, twice, then in a slow tattoo. The light made the shooting almost impossible, but two of the men yelled, and one dropped.

"Make it before sunup," he warned, as the thugs drew back nervously. "The light'll hit our eyes then and give them the advantage." Then the men below evidently decided it was only one man they had to fear, and came boiling up, yelling to encourage themselves; experience had never taught them to expect resistance. Shaw dropped back on his stomach, beside the others, shooting with even precision, while Erin and Jimmy followed suit. The rest were equipped only with automatics, which did little good.

"Huh!" Jack rubbed a shoulder where blood trickled out, his eyes still on the advance.

Erin felt the gun in his hand buck backward and realizing suddenly

that he was firing on the rushing men.

Jimmy's voice was surprised: "I hit a man—I think he's dead." He shivered and stuck his face back to the sights, trying to repeat it.

Shaw spat out a brown stream. "Three," he said quietly. "Out of practice, I guess."

The few Chinese with hand arms attempted a cross fire as the men came abreast, but their marksmanship was hopeless. Then all were swept together, waves breaking against each other, and individual details were lost. Guns were no good at close range, and Erin dropped the rifle, grabbing quickly for the hatchet in his belt as a heavy-set man singled him out.

He saw the gun butt coming at him in the man's hand, ducked instinctively, and felt it hit somewhere. But the movement with the hatchet seemed to complete itself, and he saw the man drop. Something tingled up his spine, and the weapon came down again, viciously. Brains spattered. "Shouldn't hit a man who's down," a voice seemed to say, but the heat of fighting was on him, and he felt no regret at the broken rule.

A sharp stab stuck at his back, and he swung to see a knife flashing for a second stroke. Pivoting on his heel, he dived, striking low, and heard the knife swish by over his head. Then he grabbed, caught, and twisted, and the mobsman dropped the metal from a broken arm. Most of the fighters had turned away down the hill, and he moved toward the others.

Jimmy spat out a stream of tobacco in the face of an opponent, just as another swung a knife from his side. Erin jumped forward, but Tom Shaw was before him, and the knife fell limply as Shaw fired an automatic from his hip. "Five," Erin heard his dispassionate voice. Beside Shaw, Hank Vlecek was reducing heads with a short iron bar.

ERIN MOVED into the fight again, swinging the hatchet toward a blood-covered face, not waiting to see its effect. Two of the Chinese lay quietly, and one was dragging himself away, but none of his men seemed fatally injured. He scooped up a fallen knife, jumped for one man, and twisted suddenly to sink it in the side of Jack's opponent, then jerked toward the two who were driving Doug backward.

Doug stumbled momentarily, and something slashed down. Morse saw the little body sag limply, and threw the hatchet. Metal streaked through the air to bury itself in the throat of one of the men, and his eyes flashed sideways. Kung stood there, another kitchen knife poised for the throwing. The remaining one of Doug's assailants saw it, too, and the knife and gun seemed to work as one. Kung gasped and twisted over on his bad leg, the knife missing; but the hatchet found its mark. Only a split second had elapsed, but time had telescoped out until a hundred things could be seen in one brief flash.

And then, without warning, it seemed, the battle was over, and the gunmen drew back, running for the dock. Shaw grabbed for his gun, and yelled, "Stop!" A whining bullet carried his message more strongly, and they halted. He spat the last of his tobacco out. "Pick up your dead and wounded, and get out! Tell Stewart he can have the bodies with our compliments!"

Russell lay a few yards off, and their leader had been the first to fall under Erin's hatchet. Lacking direction, they milled back, less than

a third of the original number, and began dragging the bodies toward the dock. Shaw followed them grimly, the ugly barrel of the machine gun lending authority to his words, and Erin turned toward Doug.

The physicist was sitting up. "Shoulder," he said thickly. "Only stunned when I hit the ground. Better see about Kung over there." Then a rushing figure of a girl swooped down, taking possession of him, and biting out choking cries at his wound. Erin left him in Helen's hands and turned to the cook.

It was too late. Kung had joined his ancestors, and the big hill-country Chinese stood over him. "A regrettable circumstance, Mr. Morse," he ennunciated. "Hsi Kung tendered you his compliments and requested that I carry on for him. I can assure you that our work will continue as before. In view of the fact that you are somewhat depleted as to funds, Hsi Kung has requested that his funeral be a simple one."

Erin looked at Kung's body in dull wonder; since he could remember, the man had apparently lived only that he might have a funeral whose display would impress the whole of his native village in China. "I guess we can ship him back," he said slowly. "How many others?"

"Two, sir. Three with injuries, but not fatal, I am sure. I must congratulate your men on the efficiency with which the battle was conducted. Most extraordinary."

"Thanks." Erin's throat felt dry, and his knees threatened to buckle under him, while his heart did irregular flipflops. To him it seemed that it was more than extraordinary none of his men were dead; all were battered up, but they had gotten off with miraculous ease. "Can some of your men cook?"

"I should feel honored, sir, if you would appoint your servant, Robert Wah, to Hsi Kung's former position."

"Good. Serve coffee to all, and the best you can find for any that want to eat—your men as well." Then, to Shaw who had come up, "Finished?"

Shaw nodded. "All gone, injured and wounded with them. Wonder if Stewart's fool enough to drag us into court over it? I didn't expect this of him."

"Neither did I, but it will be strictly private, I'm—sure." Erin's knees weakened finally, and Shaw eased him to a seat. He managed a smile at the foreman's worried face. "It's nothing—just getting old." He'd have to see a doctor about his heart soon. But there was still work to be done. With surprise, he noticed blood trickling down one arm. Stewart had done that; it was always Stewart.

VIII.

THE CLERKS in Gregory Stewart's outer office sat stiffly at their work, and the machine beat out a regular tattoo, without any of the usual interruptions for talk. Stewart's private secretary alone sat idle, biting her nails. In her thirteen years of work, she thought she had learned all of the man's moods, but this was a new one.

He hadn't said anything, and there had been no blustering, but the tension in the office all came from the room in which he sat, sucking at his pipe and staring at a picture. That picture, signed "Mara," had always puzzled her. It had been there while his wife was still living, but it was not hers.

The buzzer on the P.B.X. board broke in, and the girl operator forgot her other calls to plug in instantly. "Yes, sir," she said hastily. "Erin Morse, on Kroll Island. I have the number. Right away, sir."

She could have saved her unusual efforts; at the moment, Stewart was not even conscious of her existence. He stared at the blank visiscreen, his lips moving, but no sound came out. There was a set speech by his side, written carefully in the last hour, but now that he had made his decision, he crumpled it and tossed it in the wastebasket.

The screen snapped into life, and the face of his son was on it, a face that froze instantly. At least they were open for calls today, which was unusual; ordinarily, no one answered the buzzer. Stewart's eyes centered on the swelling under the shirt, where the boy's wound was bandaged. "Jack," he said quickly. "You all right?"

The boy's voice was not the one he knew. "Your business, *sir!*"

Humbleness came hard to Stewart, who had fought his way up from the raw beginnings only because he lacked it. Now it was the only means to his end. "I'd like to speak to Erin, please."

"Mr. Morse is busy." The boy reached for the switch, but the other's quick motion stayed his hand.

"This is important. I'm not fighting this morning."

Jack shrugged, wincing at the dart of pain, and turned away. Stewart watched him fade from the screen's focus, and waited patiently until Erin's face came into view. It was a tired face, and the erect shoulders were less erect this time.

Morse stared into the viewer without a change of expression. "Well, Stewart?"

"The fight's over, Erin." It was the hardest sentence Stewart had ever spoken, but he was glad to get it over. "I hadn't meant things to work out the way they did, last night. That was Russell's idea, the dirty rat, and I'm not sorry he found his proper reward. When I do any killing, I'll attend to it myself."

Erin still stared at him with a set face, and he went on, digging out every word by sheer will power. "I'd meant them to blow up your ship, I admit. Maybe that would have been worse, I don't know. But Russell must have had a killing streak in him somewhere, and took things into his own hands. Who was killed?"

"A Chinese cook and two others, of the same race. Your men might have done more."

"Maybe. *Men* might have. Yellow river rats never could put up a decent fight against opposition of the caliber you've got." Stewart checked off a point on a small list and asked, "Any relatives of the dead?"

"The cook had an uncle in China —he must have slipped over the border, since he's not American-born. I'm shipping him back with the best funeral I can afford. The others came from Chinatown."

"I'll have the cook picked up today and see that he gets a funeral with a thousand paid mourners. The same to the others, and ten thousand cash to the relatives of each. No, I'd rather; I'm asking it as a favor, Erin."

Erin smiled thinly. "If you wish. Your rules may be queer, from my standards, but it seems you do have a code of your own. I'm glad of that, even if it is a bit rough."

STEWART TWITCHED his mouth jerkily; that hurt, somehow. Erin

had a habit of making him seem inferior. Perhaps his code was not the sporting one, but it did include two general principles: mistakes aren't rectified by alibis, and a man who has proved himself your equal deserves respect.

"I don't fight a better man, anyway, Erin," he admitted slowly. "You took all I handed out and came up fighting. So you'll have no trouble getting supplies from now on, and we'll complete this race on equal footing. How did Jack take it?"

"Like a man, Greg." In all the years of their enmity, neither had quite dropped the use of first names, and Erin's resentment was melting. "He's a fine boy. You sired well."

"Thank God for that at least. Erin, you hold a patent on an air-reconditioning machine, and I need it. The government's building submarines, and I can get a nice bunch of contracts if I can supply that and assure them of good air for as long as they want to stay under." Stewart's voice had gone businesslike. "Would ten percent royalties and a hundred thousand down buy all but space rights? It's not charity, if that worries you."

"I didn't think it was." For himself, the price mattered little, but here was a chance to pay back some of the money the others had invested with him. He made his decision instantly. "Send over your contracts, and I'll sign them."

"Good. Now, with all threats gone, how about that berth on my ship I offered you? She'll be finished in a week, with a dependable fuel, and there's room for one more."

Erin smiled broadly now at Stewart's old skepticism of his methods. "Thanks, but the *Santa Maria* is practically done, too, using a dependable *power source*. Why not come with me?"

It was Stewart's turn to smile. And as he cut connections, it seemed to him that even the face in the picture was smiling a little for the first time in almost forty years.

Erin rubbed his wounded arm tenderly and wondered what it would feel like to go ahead without a constant, lurking fear. At the moment, the change was too radical for his comprehension. Things looked too easy.

IX.

THE *Santa Maria* was off the skids and the ground swell on the ocean bobbed her up and down lightly, like a horse champing at its bit. Not clipper built, Erin thought, but something they could be proud of. Now that she was finished, all the past trouble seemed unreal, like some disordered nightmare.

"Jack and I are making a test run at once," he announced. "It'll be dark in a few minutes, so you can follow our jets and keep account of our success or failure. No, just the two of us, this first time. We're going up four thousand miles and coming back down."

"How many of us go on the regular trip?" Jimmy wanted to know. "Dutch says he'll stay on the ground and design them. Since Doug's turned into a married man, he'll stay with his wife, I suppose, but how about the rest?"

They nodded in unison; though there had been no decision, it had always been understood that all were to go. Doug wrapped his arm possessively around Helen and faced Erin. "I'm staying with my wife, all right," he stated, "but she's coming along. Why should men hog all the glory?"

Erin glanced at the girl hastily. This had not been in the plans. "I'm going," she said simply, and he nodded. This thing was too great for distinction of sex—or race. He motioned to Robert Wah who stood in the background, looking on wistfully, and the tall Chinese bowed deeply.

"I should be honored, sir, by the privilege." Pleasure lighted his face quickly, and he moved forward unobtrusively, adding himself to their company. That made eight, the number the ship was designed for.

Jack was already climbing into the port, and Erin turned to follow him, motioning the others back. There was no need risking additional lives on this first test, though he felt confident of this gleaming monster he had dreamed and fought for.

"Ready?" he asked, strapping himself in. Jack nodded silently, and Erin's fingers reached for the firing keys. They were trembling a little. Here under them, lay the work of a lifetime. Suppose Stewart was right, after all? He shook the sudden doubt from himself, and the keys came down under his fingers.

The great ship spun around in the water, pointing straight out toward Europe. The ground swell made the first few seconds rough riding, but she gathered speed under her heels and began skimming the crests until her motion was perfectly even. All the years Erin had spent in training, in planning, and in imagining, a hundred times, every emergency and its answers rose in his mind, and the metal around him became almost an extension of his body.

Now she was barely touching the water, though there was a great wake behind her that seethed and boiled. Then the wake came to an end, and she rose in the air around her, the stubby fins supporting her at the speed she was making. Erin opened up the motors, tilting the stick delicately in his hand, and she leaped through the air like a soul torn free. He watched the hull pyrometers, but the tough alloy could stand an amazing amount of atmospheric friction.

"Climb!" he announced at last, and the nose began tilting up smoothly. The rear-viewer on the instrument board showed the waves running together and the ocean seemed to drop away from them and shrink. At half power she was rising rapidly in a vertical climb.

"Look!" Jack's voice cut through the heady intoxication Erin felt, and he took his eyes from the panel. Off to the side, and at some distance, a long streak of light climbed into the sky, reached their height, and went on. Even through the insulated hull, a faint booming sound reached them. "Stewart's ship! He's beat us to the start!"

"The fool!" The cry was impulsive, and he saw the boy wince under its slightly. "There might be some small chance, though. I hope he makes it. He'll follow an orbit that takes the least amount of fuel, and we'll be cutting through at least a quarter gravity all the way for comfort. He can't beat us."

The course of the other ship, he could see, held true and steady. Stewart knew how to pilot; holding that top-heavy mass of metal on its tail was no small job.

Jack gripped the straps that held him to his seat, but said nothing, his eyes glued on the blast that mushroomed down from the other ship, until it passed out of sight. Behind the *Santa Maria*, the pale-blue jet looked insignificant after seeing the other. Something prickled

oddly at Erin's skin, and he wondered whether that was the Heaviside layer, but it passed, and there was only the press of acceleration.

He opened up again, as the air dropped behind, and the smooth hum of the atomics answered sweetly. Jack released himself and hitched his way toward the rear observation room, then fought the acceleration back to Erin's side. "Jets are perfect," he reported. "Not a waver, and they're holding in line perfectly. No danger to the tubes. How high?"

"Two hundred miles, and we're making about twenty-five miles a minute now. Get back to your seat, son, I'm holding her up." He tapped the keys for more power, and grunted as the pull struck him. By the time they were a few thousand miles out, most of Earth's gravity would be behind them, and they wouldn't have that added pressure to contend with. Acceleration alone was bad enough.

AT THE two-thousand-mile limit, Morse twisted the wheel of the control stick and began spinning her over on her tail. Steering without the leverage of atmosphere was tricky, though part of his training had taken that into account, to the best of his ability. He completed the reversal finally, and set the keys for a deceleration that would stop them at the four-thousand-mile limit.

Jack was staring out at the brilliant points made by the stars against the black of space, but he gasped as Erin cut the motors. "How far?" he asked again. "There seems to be almost no gravity."

"Earth is still pulling us, but only a quarter strength. We've reached the four-thousand mark we planned —and proved again that gravity obeys the law of inverse squares." The novelty of the sensation appealed to him, but the relief from the crushing weight was his real reason for cutting power. Now his heart labored from weight and excitement, and he caught his breath, waiting for it to steady before turning back.

"Ready?" he asked, finally, and power came on. They were already moving slowly back, drawn by the planet's pull. "Hold tight; I'm going to test my steering." Under his hands the stick moved this way and that, and the ship struggled to answer, sliding into great slow curves that would have been sudden twists and turns in the air. All his ingenuity in schooling himself hadn't fully compensated for the difficulties, but practice soon straightened out the few kinks left.

His breath was coming in short gasps as he finished; the varying stress of gravity and acceleration had hit hard at him, and there was a dull thumping in his chest. "Take over, Jack," he ordered, holding his words steady. "Do you good to learn. Half acceleration."

But the thumping went on, seeming to grow worse. Each breath came out with an effort. Jack was intent on his controls, though there was little to do for the moment, and did not notice; for that, Erin was grateful. He really had to see a doctor; only fear of the diagnosis had made him put it off this long.

"Reversal," Jack called. He began twisting the control, relying on pure mathematics and quick reactions to do the trick. They began to come around, but Erin could feel it was wrong. The turn went too far, was inaccurately balanced, and the ship picked up a lateral spin that would give rise to other diffi-

culties. Here was one place where youth and youth's quick reflexes were useless. It took the steady hand of calculating judgment, and to the head that had imagined this so often it all seemed old.

He fought his way forward, pressing back the heart that seemed to burst through his chest. Jack was doing his best, but he was not the ship's master. He welcomed Erin's hand that reached down for the stick. Experience had corrected the few mistakes of the previous reversal, and the ship began to come around in one long accurate blast. When it stopped, her tail was steadily blasting against the Earth.

"I'll carry on." Erin knew he had to, since descent, even in an atmosphere, was far trickier than it might seem. To balance the speed so that the air-fins supported her, without tearing them off under too much pressure required no small skill. He buckled himself back in, and let her fall rapidly. Time was more important, something told him, than the ease of a slower descent. He waited till the last moment before tapping on more power, heard the motors thrumb solidly, and waited for the first signs of air. The pyrometer needles rose quickly, but not to the danger point. The tingling feeling lashed through him again, and was gone, and he began maneuvering her into a spiral that would set her down in the water where she could coast to the island.

He glanced back at the boy, whose face expressed complete trust, and bit at his lips, but his main concern was for the ship. Once destroyed, that might never be duplicated. Time, he prayed, only time enough. The ocean was coming into view through thin clouds below, but it still seemed too far.

"God!" Jack's cry cut into his worries. "To the left—it's the other ship."

Erin stole a quick glance at the window, and saw a ragged streak of fire in the distance. Stewart's ship must have failed. But there was no time for that. The ocean was near, now.

He cut into a long flat glide, striving for the delicate balance of speed and angle that would set her down without a rebound, and held her there. A drag from the friction of the water told him finally that she was down. More by luck than design, his landing was near the take-off point, and the island began poking up dimly through the darkness. He threw on the weak forward jets, guessing at the distance, and juggling the controls.

There was a red mist in front of his eyes that made seeing difficult, but he let her creep in until the wood timbers of the dock stood out clearly. Then the mist turned black, and he had only time to cut all controls. He couldn't feel the light crunch as she touched the shore.

ERIN WAS in bed in the bunkhouse when consciousness returned, and his only desire was to rest and relax. The strange man bending over him seemed about to interfere, and he shoved him away weakly. Tom Shaw bent over him, putting his hands back, and holding them until he desisted.

"The ship is perfect," Tom's voice assured him, oddly soft for the foreman. "We're all proud of you, Erin, and the doctor says there's no danger now."

"Stewart?" he asked weakly.

"His ship went out a few thousand miles, and the tubes couldn't stand the concentrated heat of his jets. Worked all right on small models, but the volume of explosives was

cubed with the square of the tube diameter, and it was too much. We heard his radio after he cut through the Heavyside, and he was trying to bring her down at low power without burning them out completely. We haven't heard from the rescue squad, but they hope the men are safe."

The strange man clucked disapprovingly. "Not too much talk," he warned. "Let him rest."

Erin stirred again, plucking at the covers. So he finally was seeing a doctor, whether he wanted to or not. "Is there—" he asked. "Am I—grounded?"

Shaw's hand fell over his and the grizzled head nodded. "Sorry, Erin."

X.

ERIN STOOD in the doorway of the bunkhouse, looking out over the buildings toward the first star to come out. Venus, of course, but Mars would soon show up. He had not yet told the men that the flight was off, and they were talking contentedly behind him, discussing what they would find on Mars.

A motorboat's drone across the water caught his attention and he turned his eyes to the ocean. "There's someone coming," he announced. "At least they seem to be headed this way."

Jimmy jumped up, scattering the cards he had been playing with his father. "Darn! Must be the reporters. I notified the press that tonight was supposed to be the take-off and forgot to tell them it was postponed when you came back from the test. Shall I send them back?"

"Bring them up. There should be room enough here for them. Have Wah serve coffee." Erin moved back toward his bunk, being careful to take it easy, and sank down. "There's something I have to tell them, and you at the same time."

Helen brought him his medicine and he took it, wondering what reception his words would have with the newspapermen. Previous experience had made him expect the worst. But these men were quiet and orderly as they filed in, taking seats around the recreation tables. Even though it had failed, Stewart's flight had taught them that rocketry was a serious business. Also, they were picked men from the syndicates, not the young cubs he had dealt with before. Wah brought in coffee and brandy.

"Your man tells us the flight has been delayed," one of them began. He showed no resentment at the long ride by rail and boat for nothing. "Can you tell us, then, when you're planning to make it, and give us some idea of the principle of flight you use?"

"Jimmy can give you mimeographed sheets of the ship's design and power system," Erin answered. "But the flight is put off indefinitely. Probably it will be months before it occurs, and possibly years. It depends on how quickly I can transfer my knowledge to a younger man."

"But we understood a successful trial had already been made, with no trouble."

"No mechanical trouble, that is. But, gentlemen, no matter how perfectly built a machine may be, the human element must always be considered. In this case, it failed. I've been ordered not to leave the ground."

There were gasps from his own men, and the tray in Wah's hands spilled to the floor, unnoticed. Shaw and Jack moved about among the others, speaking in low voices.

Among the newspapermen, bewilderment substituted for consterna-

tion. "I fail to see—" the spokesman said.

Erin found it difficult to explain to laymen, but he tried an example. "When the Wright brothers made their first power flights, they had already gotten practice from gliders. But suppose one of them had been given a plane without previous experience, and told to fly it across the Atlantic? This, to a much greater extent, is like that.

"Perhaps later, if rocketry becomes established, men can be given flight training in a few weeks. Until then, only those who have spent years of ground work can hope to master the more difficult problems of astronautics. This may sound like boasting to you, but an immediate flight without myself as pilot is out of the question."

Jack struck in, silencing their questioning doubts. "I tried it, up there," he told them, "and I had some experience with radio-controlled models. But mathematics and intelligence, or even a good understanding of the principles involved, aren't enough. It's like skating on frictionless ice, trying to cut a figure eight against a strong head wind. Without Erin, I wouldn't be here."

THEY ACCEPTED the fact, and Erin went on. "Two men, to my knowledge, spent the time and effort to acquire the basic groundwork—Gregory Stewart and myself. Even though he crashed, killing two of his men, he demonstrated his ability to hold a top-heavy ship on its course under the most trying conditions. To some extent, I have proved my own ability. But Stewart has no ship, and I have no pilot. Mars will have to wait until one of my own men can be given adequate preparation."

The spokesman tapped his pencil against a pad of paper and considered. "But, since each of you lacks what the other has, why not let Stewart pilot your ship? Apparently he's willing to give up his interests here and try for some other planet."

"Because he doesn't consider my ship safe." Erin knew that it might prove detrimental to their acceptance of his design, but that couldn't be helped. "Stewart and I have always been rivals, less even in fact than in ideas. Now that his own ship proved faulty, he'd hardly be willing to risk one in which he has no faith."

A broad man in the background stirred uneasily, drawing his hat farther down over his face, which was buried in his collar. "Have you asked him?" he demanded in a muffled voice.

"No." It had never occurred to Erin to do so. "If you insist, I'll call him, but there can be only one answer."

The heavy man stood up, throwing back his hat and collar. "You might consult me before quoting my opinions, Erin," Gregory Stewart stated. "Even a fool sometimes has doubts of his own wisdom." The eyes of those in the room riveted on him, but he swung to his son, who was staring harder than the others.

"Will the *Santa Maria* get to Mars?" he asked.

Jack nodded positively. "It will get there, and back. I'm more than willing to stake my life on that. But you—"

"Good. I'll take your word for it, Jack, with the test flight to back it up. How about it, Erin?" He swung to his rival, some of the old arrogance in his voice. "Maybe I'd be glory-hogging, but I understand you're in the market for a pilot. Like to see my letters of reference?"

Strength flowed back into Erin's legs, and he came to his feet with a smile, his hand outstretched. "I think you'll prove entirely satisfactory, Greg." It had been too sudden for any of them to realize fully, but one of the photographers sensed the dramatic, and his flash bulb flared whitely. The others were not slow in following suit.

"When?" a reporter asked. "Expect to be ready in the near future?"

"Why not now? The time's about right, and my affairs are in order. Is everything ready here?" Judging from their looks that it was, Stewart took over authority with the ease of old habit. "All right, who's coming? A woman? How about you, Jack?"

Jack's voice was brisk, but the cold had thawed from it. "Count me in, dad. I'm amateur copilot."

"Me, I think I go, too," Dutch Bauer decided. "Maybe then I can build better when I come back."

Erin counted them, and rechecked. "But that's nine," he demurred. "The ship is designed for eight."

Tom Shaw corrected him. "It's only eight, Erin. I've decided to let Jimmy carry on the family tradition. Shall we stay here and watch them take off?"

There was a mad rush for the few personal belongings that were to go, and a chorus of hasty good-bys. Then they were gone, the reporters with them, and the two men stood quietly studying each other. Erin smiled at his foreman, an unexpected mist in his eyes. "Thanks, Tom. You needn't have done that."

"One in the family's enough. Besides, Dutch wanted to go." His voice was gruff as he steadied Erin to the door and stood looking out at the mob around the spaceship. The reporters were busy, getting last words, taking pictures, and the Chinese laborers were clustered around Wah, saying their own adieus. Then Greg's heavy roar came up, and they tumbled back away from the ship, while the men were to go filed in. The great port closed slowly and the first faint trial jets blasted out.

Confidence seemed to flow into the tubes, and they whistled and bellowed happily, twisting the ship and sending her out over the water in a moon-silvered path. Erin saw for the first time the fierce power that lay in her as she dropped all normal bounds and dove forward in a headlong rush. Stewart was lifting her rather soon, but she took it, and was off.

They followed the faint streak she made in the air until it was invisible, and a hum from the speaker sent Shaw to the radio. Greg's voice came through. "Sweet ship, Erin, if you hear me. I'll send you a copy of 'Gunga Dhin' from Mars. Be seeing you."

Erin stayed in the door, watching the stars that looked down from the point where the *Santa Maria* had vanished. "Tom," he said at last, "I wish you'd take my Bible and turn to the last chapter of Deuteronomy. You'll know what I mean."

A minute later Shaw's precise reading voice reached him. "'And the Lord said unto Moses, This is the land which I sware unto Abraham, unto Isaac, and unto Jacob, saying, I will give it unto thy seed: I have caused thee to see it with thine eyes, but thou shalt not go over thither.'"

"At least I have seen it, Tom; the stars look different up there." Erin took one final look and turned back into the room. "Until the reporters come back here, how about a game of rummy?"

RENDEZVOUS

By John Berryman

A properly run search-curve will find anything—even in space—with one exception: a man who's hunting for you!

Illustrated by F. Kramer

Bo Riggs came to a halt as he reached the major's door. He squared his broad shoulders and took another reef in his firm chin.

"Come!" he heard Major Hawley call in answer to the sharp rap of his knuckles. Bo stepped into the office and saluted with an audible snap.

"Captain Riggs, sir, reporting for instruction," he clipped out.

"Oh, hello, Bo," Hawley said informally, shifting his pipe with a genial smile. "How're things going?"

"Fine, prof," Bo grinned at his erstwhile professor. "We've been having a bang-up time on the *Bear*."

Hawley nodded. "Yes," he said, his black eyes twinkling, "I wanted to speak to you about the *Little Bear*. Beckett's wife is ill and I'm sending him back in. You'll be in command until further notice. Think you can handle it?"

Bo's grin spread half across his face. "Yes, sir!" he exclaimed. "I'll do my best, sir!"

"No doubt," Hawley said dryly. "There's a slight shift in your ship's schedule. Instead of returning here to Ursine after your survey of F634, the *Bear* is to meet me and continue on to F635 after replenishing its oxygen from the *Vodalo*."

"Meet you, sir?" Bo asked.

"Yes. I'm taking the *Vodalo* out with a party of astronomers to hunt for the radio-active comet Pitzdorf, reported in the system of F118. By a rendezvous with the *Vodalo* you'll save yourself a trip back in for oxygen. The survey dispatcher is working out the rendezvous co-ordinates now."

Bo nodded his understanding. "Will the dispatcher have the probable position of the comet, sir?" he inquired.

Hawley's friendly smile vanished, to be replaced by a scowl. "The comet?" he demanded. "Why do you want to know where that is?"

Bo's stomach turned a flipflop as Hawley glared at him from beneath his heavy brows. What had he said now?

He swallowed before he spoke. "Why, just in case you didn't show up, sir. I'd like to know which way to go after you."

Every trace of pleasantness disappeared from the major's face. "Riggs," he snapped at the hapless captain, "sometimes you talk like a jackass. Now get out!"

The miserable captain saluted mechanically, at a loss for words. A sharp repetition of the order made him spin on his heel and leave the major's office. Too many times a friendly interview had ended thus for Bo to be taken completely by surprise. But, as always, the root of the major's ire escaped him.

IT HADN'T BEEN a very satisfactory way to get his first command, Bo reflected in the following days, while the *Little Bear* and her crew of ten fled through space. Still, hardly any conversation with the major ended very satisfactorily.

The first vague concern he had felt over the scene faded from memory as the thrill of dropping down through halogen-laden atmospheres to each virgin planet flooded over him. With Bo's skilled hands at the controls the *Little Bear* visited the eight planets of F634, now renamed Wilma, in sentimental regard for Beckett's wife. Mere figures now, in the *Bear's* files were their orbits, diameters, gravities, masses. Each body had been visited, surveyed, recorded.

The day had come when Bo gave the order to blast free of Wilma I, the innermost, stewing, chlorinated planet of that green Sun. Farther still toward the fathomless edge of the Galaxy he drove the *Bear*, toward the rendezvous with Hawley and the *Vodalo*.

Now they were there. They had arrived at that trackless crossroads in space, a million parsecs from any place a man could dare call home, a million parsecs from so much as a liter of free oxygen. Until her own

stores of the precious element were replenished, the *Bear* could not continue on the task of cataloguing which the Patrol had outlined for it.

The *Bear* had made the rendezvous all right, but where was Hawley? Where was Hawley and the oxygen he could spare from the fat bulk of the *Vodalo?* It was 0:03 of the *Bear's* forty-third day out from Ursine when Pete Piatt had announced that she lay motionless with reference to the drift of the Galactic rim in those regions of space. Three minutes out, Bo had thought; not bad for a beginner!

But Willoughby, fussing with the radio, couldn't get a peep out of it. Bo looked at him with raised eyebrows.

"What's the matter, Sam?" he wanted to know. "The major's boat kicks up enough fuss to jiggle your needle at a hundred thousand kilos."

"That's right, cap," Willoughby said, swinging around in his chair. "It isn't just possible, now, is it, that Philo Hawley might not be quite on time?"

Bo's face lengthened. "If you're counting on that, Sam, forget it. Philo was never late in his life. They tell me he even has a metronome on his heart to keep him on time."

Willoughby laughed and turned back to his dials. "Maybe he wasn't generating just then, cap," he suggested. "After all, he has to cut his power to listen for us, doesn't he?"

"Yeah, that's right. O. K., Sam, try him again. We'll hear him a hell of a long time before he knows we're around. The generators in this rowboat aren't detectable a centimeter over twenty-five thousand kilos. Holler when you get him."

But Bo hadn't felt as unconcerned as he had tried to sound to the boys in the control room. They were a good gang, all right, the best crew a guy could want on his first solo; but, hell, there wasn't any use giving them a start. The major late? It was incredible. Bo retired to his cabin after 6:00 mess and waited.

The rest of the crew of the *Little Bear* waited, too. Until Sam or Jerry saw the telltale flicker of a telltale needle, they would have to sit and wait. Only then, when they knew the direction of the big spaceship, could they blast toward it.

Bo had slung his iron-hard frame into his bunk at 12:00 of the forty-third day out. He woke up after an indeterminate period. 15:30, his wrist chronometer said. The deadly quiet of the *Bear* made him restless. Without the barely audible, but never-absent hum of the generators, he was ill at ease.

Pulling his denim cruise jumper over pajamas, he made his way to the elevator and rode up to the control room. Thank the Lord, the gravitic compensator fields kept terrestrial gravity even when the *Bear* wasn't accelerating.

Jerry North was fiddling aimlessly with the radio detector when Bo stepped out of the lift. "Hi ya, cap," he grunted, spreading his finger in a blasé gesture of greeting. "Cancha sleep?"

"Stuff your jets," Bo told him grumpily, slumping into the swivel chair at the control board. "Where's Fletcher?"

"Fletch got hungry, cap," Jerry grinned at him. "I think he's raiding Cooky's pantry."

"Cooky'll bash him with a cleaver some dogwatch," Bo predicted for the hundredth time. "I wonder how Wilma Beckett is."

"Yeah, I wonder. I wonder how Hawley's making out, too."

"Not a peep, eh?"

"Not a wiggle. Listen, Bo, that guy's lost. Somebody oughta find him."

"Sure we aren't the guys who're lost, Jerry?"

Jerry regarded the captain for several seconds of silence. "What do you think, cap?"

Bo shook his head. "I would have sworn that we weren't a thousand kilometers from that damned rendezvous, Jerry. Hell, I've computed and navigated problems *ten* times as tough as this in maneuvers, and split the center—"

"This ain't maneuvers, cap," Jerry inserted softly.

Bo blinked. "Yeah."

THEY HEARD the lift whine away, then come back and deposit Fletcher, Bo's mate. "Hi, cap," he said in surprise. "Snooping around after hours, eh? Spying on the dogwatch, eh? A fine way for a captain to treat his first crew!"

Riggs laughed a little. "I thought I'd catch you A. W. O. L., Fletch," he chuckled. "You snuck out for a little walk, didn't you?"

"Yep!" he said emphatically. "All around Cooky's pantry."

"He'll bash your head in with a cleaver some day," Bo and Jerry said in weary unison, looking at each other from where they lazed in the depths of their padded chairs.

"Yeah, that's what he said when he swallowed all the chicken he had in his puss," Fletcher laughed. "No wonder the guy's so fat. He has to go on a diet every six months to make the weight, the dope!" The other two laughed a little, and then the control room stilled as Fletcher found a seat behind the silent calculator.

"Nothing yet?" he said at last. Jerry shook his head. "That's not so good, cap," he offered.

It was Bo's turn to shake his head. "Nothing to worry about, Fletch. He'll turn up. You've been generating from time to time, haven't you?"

"Yep. Every little while I blast her around, thirty seconds this way, thirty seconds that. But what the hell, we'll hear him before he hears us."

"Yeah, maybe," Bo replied. "I wish I could be sure this wasn't one of his little tricks. He's the damnedest guy in the Universe to try to make you look silly. If he didn't have that gang of astronomers in tow, I'd bet that's the score."

"Maybe they found that comet right off," Jerry suggested. "He may have dumped the wise men and back-tracked it here as fast as he could leg it. Maybe he's sitting a hundred kilos away and watching what you're up to."

Bo shook his head savagely. "Damn that guy!" he swore. "If I didn't think there was a chance that he was up to some monkey business like that, I'd be looking for him this minute. We can't sit here forever. We'll smother."

Jerry shifted uneasily in his chair. "Yeah, cap," he said slowly. "What about that? How long can we wait?"

Bo raised his eyes and looked at him in silence. "Oh, maybe ten days," he opinioned at length. "We had oxygen for fifty days, and this is pretty near the end of the forty-third. We could stretch it a little, I suppose. Maybe two, three days. I don't know."

Fletcher was holding an unlighted cigarette in his fingers. He laid it down very deliberately on the calculator. "Maybe I don't light up, cap," he hinted softly.

"Oh, don't be silly," Bo snapped a little heatedly. "We'll pick him up in a few hours. Go on, smoke all you want to."

Fletcher let the cigarette lay. His act, although Bo gave no such order, communicated itself to the rest of the crew. By the forty-fifth day out from Ursine, the weed had lost every votary aboard the *Little Bear*. Bo could no longer conceal his anxiety from the others. It was an open secret, in any event. He called the whole crew together at the end of the dogwatch of the forty-sixth day.

The little control room was crowded. Piatt and old Howie Bean, the computor and navigator, lolled over the calculator. Deuel and Fehr, from the engine room, stood restlessly at the left with Cooky, while Edwards, feeling as useless as only a chemist can in space, hung on to the telescope. Sam Willoughby and Jerry North were scrapping for the chair at the radio, and Fletcher perched contentedly on the control panel behind Riggs' swivel. Bo was talking.

"As it is, we've overstayed that amount of time. It's too late now to run for it. We'd all smother before we got to Ursine. If I had had any idea that the *Vodalo* was in trouble, we would have scrammed for home. But, damn it, now we've *got* to find Hawley. *He's got our oxygen!*"

Only the tiny sounds of restless moving greeted his announcement. Fletcher, behind the captain, bit his nails unconsciously.

Bo looked around the little circle of tense faces. "Until we've found Hawley," he spoke tersely, "no idle talking. Save our air." He swung his eyes again. "Any suggestions?"

Deuel leaned forward. "Cap?" he asked.

"Yeah?"

"What about electrolizing our water? We could breathe the oxygen, and we've got plenty of power." The faces of several of the younger men lighted up for a moment. The older hands stood still.

Bo shook his head shortly. "I've figured on that. We get two days there. There's only enough for fifty days in the tanks. The rest we make."

Deuel was not discouraged. "What about splitting up our carbon dioxide?" he queried. "We could—"

"We couldn't do it, in the first place," Fehr answered for Riggs, "and there isn't enough to matter.

Bo nodded curt agreement. "Anything else?" he snapped, feeling his voice get tense in spite of himself. This was a hell of a fix. No one had anything to offer. Bo straightened his back.

"In that case, since we can't find the *Vodalo* where it ought to be, we're going to look where it might have been. Pete, you and Bean have a pretty good idea of where Hawley had to go to pick up that comet. I want to scour space back along his route for a way, then back-track and look ahead in case he drifted on. Get to work on it. We'll have to work back in an expanding cone toward his most probable location.

"The rest of you guys take it easy. No orders from now on. Get all the sleep you can stomach."

Most of the crew left via the lift. Jerry North stayed behind at the radio, while Pete Piatt and old Bean bent over the calculator. Its whirring and clicking were the only sounds in the control room for many minutes.

At last Piatt brought a return slip from the machine to Bo. "Here's as good as we can give you, cap," he said softly. "We'll have to do one hell of a lot of scouring."

Bo looked at the co-ordinates that the machine had printed. "How long would it take to get within a hundred thousand kilos of every point in that cone, five hundred parsecs in each direction from here?" he almost whispered.

Piatt shook his head. "Too long, Bo," he said gently. "You've got to do better than that."

Bo looked up in surprise. "You've got to do better than that," he had said. Hell, Pete was five years older than he was. He was asking Pete for advice, not the other way around —or was he? They were all looking at him, looking *to* him to get them out of it. This was what it meant to have a command. He looked from Pete to old Howie Bean to Jerry North. Their eyes were fixed on him, standing out sharply against their white faces.

Bo swallowed. "That's the best I can do right now, Pete," he replied, struggling to keep his voice calm. "We can cover one cone pretty thoroughly, can't we?"

"Yes, one cone. Either back toward where we think Hawley was, or out past there, if you figure he drifted by us."

"You've got the cone as narrow as possible, Pete?"

"Uh-huh. If we don't broaden the locus of his possible courses out enough, we increase the chances of missing him that way. If we broaden it too much, we don't get far enough away from here, and increase the chances of missing him for that reason. We worked out the optimum angle."

Tingling silence echoed off the doming walls of the control room. Bo slowly swung his swivel away from them and faced the bank of controls. Back or forward? "We'll go back," he heard himself say in a voice that sounded faint and far away. "If the major got here and couldn't stop, he'd be no help to us, anyway." He could hear the three expel their breaths.

Swinging back with sudden determination to face them, he cracked off a stream of orders. "Pete, get to work on our course. We're blasting this crock in a double inverse spiral back toward the comet until we meet Hawley. Jerry, tell Fehr to get busy yanking the oxy out of our water. Give us a boost on CO_2—two percent's enough for now. On the ball."

JERRY JUMPED up from the radio, the whine of the departing lift playing a thin overtone to the hum of the calculator under Pete's fingers. Bo turned to the rocket switches. A flick of his fingers sounded the "Stations" gong throughout the ship, and it was only an instant until every man on duty had his earphone and larynx mike on.

"Get that drive generator hot!" Bo snapped out, knowing Fehr had already done it.

The engineer's "White hot, Bo!" sounded quickly in his ear.

"Let me have it, Pete!" Bo's voice cracked crisply. His flying fingers entered the first course co-ordinates on the board. Without the slightest sensation of movement the *Little Bear* leaped away from her barren rendezvous at an acceleration which would have pulverized even the plates and girders of her tightly woven hull had not the inertia screens produced by her drive generators subtly warped the surrounding space to let her pass through at speeds which made the velocity of light seem a virtual standstill.

Thus the *Little Bear's* forty-seventh day out from Ursine saw her jerking like a thing possessed away

from that point in space where she had lain motionless for four days. Bit by bit her changes in course occurred less frequently as the cone of most probable locations of the missing *Vodalo* broadened.

In four-hour shifts Jerry and Sam Willoughby spelled each other at the radio, cutting out the *Bear's* drive generator in frequent attempts to detect radiation produced by the *Vodalo's* power plant. Not the tiniest flicker of their instruments rewarded them.

For four days the *Bear* drove back along Hawley's supposed course, moving more and more slowly from the rendezvous position. Bo, sitting wearily at the board, would trust no one to set the courses but himself. If he had used every fiber in his mind in bringing the *Bear* exactly to the rendezvous point, he checked and directed their probing course with his very soul. Important it had been that the *Bear* should have arrived at that rendezvous, but vital was it that she be able to return exactly to that point after a thousand changes of course.

Fletcher was giving Jerry a rest at the radio, poring over the delicate detector dials, as though trying to force the needles to quiver by the very fire of his gaze. Bean automatically ran off the next course change.

Fletcher exhaled a long-contained breath and sagged back from the detector panel. "Nuts," he half growled, "this is futile." No one disagreed. "Listen," he said to nobody in particular, "just suppose Hawley got the *Vodalo* fixed up and has been blasting toward the rendezvous while we were ransacking this hypothetical cone. Hell, he might have sailed right by us. Look here, Bo," he demanded, addressing the captain directly, "this damned cone is almost a parsec in diameter now. For the love of Pete, we might look the rest of our lives and never find him."

Bo swung around to face his mate, his crisp blond hair a snarl about his brows. He said nothing.

BEAN, his computation completed, looked up from the calculator as he switched it off. "Ah, Fletch," he said in his grave, old voice, "just suppose he did do that. He may have pulled in just a few hours after we pulled out. Think of that. What would he do then?" His wrinkled face crackled into a devilish grin. "Why, he'd start to look for us. The major's no dumbbell, Fletch; he'd figure we were looking for him, so he'd look for us where he thought we were, right?"

Fletcher sucked air between his teeth. "Jeepers!" he said foolishly. "Suppose he decided we took the *other* cone!"

Bean laughed at him.

"What's so funny, Bean?" Fletcher snapped irritably.

"The other cone!" the navigator laughed dryly. "Why, hell, Fletcher, what if he was in this cone, just a thousandth of a parsec away? We'd never know it. We might pass through the place he'd just been, or the place he was going to be, a hundred times, and never catch enough of his radiation to detect. Oh, I think we can forget about that other cone."

Fletcher's mouth was slowly sagging open. "Hey!" His eyes were widening as he looked at the silent, motionless captain. "Hey, Bo! Think about that! If he's out looking for us, why, hell, we'll never get together except by the most improbable accident that ever happened!"

Bo looked at him, looked through

him. "I remember one of old Sprague's lectures at the Academy," he said deliberately. Sprague had introduced them into calculus. "He was talking about indeterminate solutions, and he had a neat little story. He said if two guys were in a department store, and they wanted to get together, there was absolutely no way of guaranteeing they would ever meet unless one of them stood still. If they both looked, they might circulate till the end of time and never see each other." He turned his head over to Bean. "That's what you mean, isn't it, Howie?"

"Yes, sir," the old man said respectfully. "But, please, sir, I wasn't criticizing you, sir!"

"You should be, Bean," Bo said bitterly. "But what the hell could we do? How do we know that Hawley can fix up the *Vodalo*, or whether there is any *Vodalo* any more?" He looked at the worn spot in the composition deck beneath his feet. "The best we can do is to keep on looking out here. We've staked everything on this cone, and we've got to keep betting."

Fletcher was suddenly on his feet. "Listen, Bo," he was chattering, "do something, for the love of Pete, do something! You aren't going to just sit here and keep on looking when Hawley may be looking for us, are you?" His syllables became tense, choked. "What d'ya expect us to do? Find Hawley when all we know is that he's anywhere inside a billion billion billion cubic kilos?" He had advanced toward the still-seated Riggs, his fists clenched tightly at his sides, weaving a little on his feet, like a fighter about to spring upon an opponent.

Bean stepped softly down from the stool at the calculator and around behind Fletcher. "Take it easy, Fletch," he softly advised. "Here, have a drink."

Fletcher spun to face him at the water cooler. "Take it easy, eh?" he shrilled. "Damn it, you old crow, take it easy when we're going to smother! Do you hear me? Smother!" He grasped Bean's jumper in his white fist, pulling the navigator's lined face up to his. "What're you gonna do when there ain't any more air?" he ground out between his teeth. "When you start to gag and get dizzy, you dried up old fool!"

Riggs cut him short. "Shut up, Fletcher!" he snapped from his seat. "Shut up, I tell you! You've had enough. Go below."

For a moment Fletcher appeared to waver between springing upon his commander and walking toward the lift. Bean supplied him with his decision by gently pulling his elbow. Once the mate was faced away from the captain, he stepped docilely enough to the lift and dropped down to the bunk room below.

Bean faced Bo solemnly. "They're getting pretty anxious, cap," he said. "They're looking to you."

Bo got up. "You don't need to tell me, Bean," he replied to the older man. "Thanks for cooling Fletcher off."

"Yes, sir. Sorry I got him going like that."

"That's all right. Watch things while I go below," Bo told him wearily, his face drawn and old. As he waited for the lift to rise in answer to his signal, his shoulders slumped and his head dropped toward his chest. Bean's sharp old eyes regarded him anxiously.

In the engine room Fehr and Deuel were standing impotently over the *Bear's* little compressor, watch-

ing it chug quietly. They looked up as Bo left the lift and walked over toward them. Both nodded silently and returned their gaze to the compressor.

"How much will there be?" Bo asked in a low voice.

"Fifty hours," Fehr said shortly, not raising his eyes. Deuel was clenching and unclenching his fists. His voice, pitched high with suppressed excitement, broke the throbbing of the compressor.

"Fifty hours! That's only two days!" He swallowed the rest of what he had meant to say in a gulp. But he could not retain it. "When do we start using that?" he cried.

Bo looked at Fehr. "Another day," Fehr estimated. "We got an extra day added to the fifty by low consumption this last week."

Deuel's heavy breathing sounded above the compressor. Bo exchanged glances with Fehr over the engineer's bowed head. Fehr still had his nerve. Or was it trust Bo saw there? He rode back to the control room.

Jerry North was flicking the selector switch around the compass as he tried all six directions for field strength. All the same—zero. Bo saw him cut the *Bear's* drive generators back in. This endless waiting, he thought, what an ordeal! It would almost have been better if they could have felt the acceleration die when Jerry made a try, but, no, the gravitic compensators kept their weight at that constant one terrestrial gravity, never letting them know by the slightest change in sensation that they were moving or changing course. It was as though they were making no effort, as though they were sitting motionless in the horrible nothingness of space, waiting, waiting. Even the stars scarcely seemed to move. There was no way to realize their frenzied motion.

The radio operator straightened up as Bo slumped wearily into his swivel. "Bo," he began, "we've got to widen our reception area—"

"How?" Bo interrupted him, trying not to sound hopeless.

"Well, this is only a suggestion, but, uh, couldn't we send out the lifeboats? They could do a little to—"

"What!" Bo was staring at him incredulously. "Lifeboats! That's it! Hell, what does anybody do when his ship sinks? Takes to the boats!" Bo was standing on his feet, rocking excitedly on his toes. "Hey, Jerry, what a brainstorm!"

Jerry looked at him through narrowed, suspicious eyes. "Take it easy, cap," he said warily. "If we can't get to any air in the *Bear*, a fat chance we'll have in a lifeboat!"

Bo acted as though he had not heard him. Once again the "Stations" gong was sounding in every compartment of the *Little Bear*. Pressing his mike against his throat, Bo was speaking quickly, furiously. "Get up here, everybody! On the double!"

Jerry could hear the excited babble of voices in his earphone as everybody below wanted to know whether the radio had picked up Hawley. "No, no," Bo shouted, "we haven't found him, but I'll bet plenty I know where he is!"

WITHIN a minute the lift had brought the other eight to join Jerry in the control room. Bo was pacing back and forth in his excitement. When the crew had quieted down, he faced them.

"This is no time to remember rank, so forget I'm the captain for a

while," he began. Most of the men grinned a little. It was pretty hard to think of Bo as a captain, in a sense. Discipline wasn't necessary on a rowboat like the *Little Bear*. No, he was a different kind of captain, one with a rank they couldn't forget.

"We're all in this," Bo went on seriously. "We should all have a part in the decision." He looked down at the deck for a moment.

"It isn't so very long ago," Bo began again, "that somebody said to me, 'The trouble with you, Riggs, is that you're too damned naïve.' I think the major was right, even if he was referring to a put-up job." He grinned a little at the recollection in spite of himself. "Maybe I've been too damned naïve again. What are we looking for, anyway?"

His unexpected, appearently irrelevant question made the crew look from face to face.

"All right!" he snapped at them. "What are we looking for? Speak up, somebody, speak up!"

"For Hawley," somebody said.

"For Hawley!" Bo rasped with rich sarcasm. "The hell we are. We're looking for the *Vodalo!*" He glared at them.

"For Pete's sake," Fehr ventured, "that's the same thing. Go where Hawley is, there's the *Vodalo*. Same thing."

"Of course it's the same, Fehr," Bo replied saccharinly, "but, damn it all, we haven't been looking for the *Vodalo!*"

The crew stood quite silent, eying their raging captain uncertainly. Bean was moving slowly forward.

"Hold it, Bean," Bo told him, raising a restraining palm. "I said we haven't been looking for the *Vodalo*, and I meant it! We've been scouring this whole damned corner of the Galaxy, looking for radiation from the ship's generators. We don't want the radiation; we want the ship!"

Jerry's eyes flew open. His pointed finger jabbed toward Bo as he vainly tried to make his excited vocal cords respond.

"Sure, Jerry!" Bo was shouting. "Sure! If Hawley can't generate, we'll never find him!" He faced them with a wild fire in his eyes. "Like hell we won't!

"What happened, you dopes, what happened?" he demanded. "Something blew on the *Vodalo*, it must have, or Hawley would have met us. It must have been the generator, or, anyway, if it wasn't we'll never see him again. So maybe he drifts right past the rendezvous. Can't stop. No power."

Bean stepped toward him. His voice was deep and terrible. "You mean we picked the wrong cone!" He stood rigidly for a moment in front of the captain, his distended nostrils dragging the air. In a second of suspended time Bo could see every man, see those drawn faces, that look of final despair, of recognized defeat.

"No!" his voice rang out. "No! We didn't take the wrong cone and leave the right one! Why? Both cones were wrong! If Hawley drifted past the rendezvous, *he must have left a lifeboat!* By all the gods, he *must* have!"

The instant of silence that preceded the thunderclap of shouts was like a ringing crack of the detonator that sets off an explosion.

Bo held them in check. "Maybe there isn't any *Vodalo*," he reminded them soberly; "maybe there isn't any lifeboat to tell us where it is. But if Hawley ever got within a hundred parsecs, he could have sent a boat."

Fehr's heavy voice cut in above even Bo's exultant tones. "If we

expect to get back to the rendezvous before we smother, we'd better quit kidding around."

THE GANG in the control room melted away. Moments later only Fletcher and Jerry North were there with Bo.

"You'll want Pete or Bean, won't you?" Fletcher asked tensely.

Bo smiled at him, the glint of victory in his eyes. "No, I won't. I know where I am to a thousand kilos, and if I can't get back that close to the rendezvous, I'm ready to shoot myself."

"If you don't, you won't have to," Jerry suggested.

Bo ignored him gleefully. It was only seconds before his fingers had elected the proper course from the calculator and entered it on the control board. He sat back.

"Fifty-one hours and some minutes," he chuckled. "We won't quite smother."

"Not if he's there," Jerry admitted.

But was he there? Deep in the hull Fehr slowly doled out their remaining oxygen, liberally dosing it with carbon dioxide. A fast pulse and respiration for a few hours wouldn't hurt that crew. And it'd let them live on a damned sight less oxy.

The sensationless reversal was almost a day gone. The markless spot in markless space where Bo thought Hawley's lifeboat should be was creeping nearer, more and more slowly. Jerry was at the dials now, crouched over as never before, looking for that tiny flicker of power that would betray the lifeboat's generator. The lifeboat they hoped existed.

At 12:43 of their fifty-third day out from Ursine, Bo cut the switches. "Back home," he announced tersely. Jerry turned to face him, a wan smile flickering over his mouth.

"And there's nobody there," he supplied.

"Nobody?"

"Uh-huh."

"Then we start looking. Can we pick up a lifeboat at five thousand kilos?"

"I'm almost positive we can't. Maybe three thousand."

"Pete, some figures to fit that, quick!"

But before the computor could so much as enter their co-ordinates on the board, Jerry gasped, a great, belching gasp.

"Got him!"

Bo drilled him with his eyes. "Sure?"

"Positive! Baby, we must have

missed him by about ten meters. He's right in our lap!"

Bo slowly sagged down in his seat. His eyes fell gradually shut. They had made it.

THERE WAS no trick to picking up the lifeboat. True to their expectations, two members of the *Vodalo's* crew were there, incoherently jubilant.

Their simple story told where the *Vodalo* could be found. Scant hours later, as the last of the *Little Bear's* oxygen was splurged in an oxy-drunk spree, they pulled alongside the drifting spaceship. Once inside, they heard the full tale from Hawley.

"The whole thing was my fault, Riggs," he said, smiling happily. "A couple of hundred parsecs short of the rendezvous the generator went mildly on the fritz. Instead of dropping a boat right then, like a fool I decided we could fix it. We did, all right, fixed it perfectly. The whole works blew out and left us with no power but the accumulators. We couldn't even launch the boats for several hours. By the time we kicked one out, we were well past and going at a pretty good clip yet. Our lifeboat reached the rendezvous just as you blasted out, wide open. They even picked up your radiation."

Bo's wide, joyful grin told everything about his feelings. "Don't blame yourself, sir. If I had stayed where I belonged, we would have gotten together right then. But, by all the tailless comets, if it hadn't been for a story that old Sprague told us at the Academy, we'd never have made it!"

Hawley looked at him with a devilish twinkle in his snapping black eyes. "Yes, I know," he mused. "That's the one about the department store, isn't it?"

"Why, yes, sir, how did you know?" Bo exclaimed in surprise.

"I told it to him. That's why I told those two in the lifeboat to stay there until they died. I knew you'd come back. There's nothing really wrong with you, Riggs. You're just a little slow, that's all!"

PROPHECY?

From "The Legion of Time," by Jack Williamson, Part I, May, 1938, Astounding Science-Fiction, Page 18:

> "Time don't make no difference here. The last man on your bed was the Austrian, Erich van Arneth. He came from the Isonzo front, in 1915. The one in the chink's bed was the Frenchman, Jean Querard. He was blown up in the defense of Paris, in 1940."

The only other mention of war of the 1940s made in the story was a similar passing reference to a Russian rocket flier who fell in the arctic in 1942.

Our authority does not disclose the course of the '40 war beyond these two points.

IN TIMES TO COME

THE fact that a story is printed in a magazine indicates that the editor believed a majority of his readers would find it at least average entertainment, and that many would find it good stuff. Occasionally the editor is blessed by the receipt of something that makes him go around with a grin of joy for days. A manuscript comes in sometimes that is not merely good entertainment—it's something that the editor can *know* is going to take hold of readers and make 'em follow every pages of the yarn—and to blazes with bedtime, supper or going out for *that* evening!

I felt sure "Final Blackout" was a yarn of that sort, and said so. The readers—see "Brass Tacks"—are now saying so.

Next month starts another serial of that sort. A. E. van Vogt, because of circumstances that tied him up, sent in only the first three of four parts—and *I* was mad! The fourth part was delayed a week, and when it arrived—the pile of manuscripts around got left while I finished *"Slan!"*

It's a superman story—which tells you nothing, because there hasn't been any like it before. This superman is a boy—a nine-year-old boy that a world of humans is grimly determined to exterminate, as they shot down his father, and as they butchered his mother before his eyes in a city street.

That's the first page of the yarn. From that page on it doesn't slow its pace for a paragraph—including the last!

Gentlemen, it's a lulu!

THE EDITOR.

ANALYTICAL LABORATORY

As "Brass Tacks" would indicate, "Final Blackout" took first place. One thing the Laboratory cannot properly evaluate is the strength of a vote. That is, a man who says he thinks a certain story is the "best story of the year" still can vote it first place for the month only. At any rate, the record looks like this:

1.	Final Blackout	L. Ron Hubbard
2.	The Roads Must Roll!	Robert Heinlein
3.	Testament of Akubii	Norman L. Knight
4.	Deputy Correspondent	Harl Vincent
5.	Carbon Eater	Douglass Drew

THE EDITOR.

VAULT OF THE BEAST

By A. E. van Vogt

They of the other Universe couldn't reach this one —so they made a robot, a highly, horribly adaptable robot, to release their prisoned comrade!

Illustrated by Edd Cartier

THE creature crept. It whimpered from fear and pain, a thing, slobbering sound horrible to hear. Shapeless, formless thing yet changing shape and form with every jerky movement.

It crept along the corridor of the space freighter, fighting the terrible urge of its elements to take the shape of its surroundings. A gray blob of disintegrating stuff, it crept, it cascaded, it rolled, flowed, dissolved, every movement an agony of struggle against the abnormal need to become a stable shape.

Any shape! The hard, chilled-blue metal wall of the Earth-bound freighter, the thick, rubbery floor. The floor was easy to fight. It wasn't like the metal that pulled and pulled. It would be easy to become metal for all eternity.

But something prevented. An implanted purpose. A purpose that drummed from electron to electron, vibrated from atom to atom with an unvarying intensity that was like a special pain: *Find the greatest mathematical mind in the Solar System, and bring it to the vault of the Martian ultimate metal. The Great One must be freed! The prime number time lock must be opened!*

That was the purpose that hummed with unrelenting agony through its elements. That was the thought that had been seared into its fundamental consciousness by the great and evil minds that had created it.

There was movement at the far end of the corridor. A door opened. Footsteps sounded. A man whistling to himself. With a metallic hiss, almost a sigh, the creature dissolved, looking momentarily like diluted mercury. Then it turned brown like the floor. It became the floor, a slightly thicker stretch of dark-brown rubber spread out for yards.

It was ecstasy just to lie there, to be flat and to have shape, and to be so nearly dead that there was no pain. Death was so sweet, so utterly desirable. And life such an unbearable torment of agony, such a throbbing, piercing nightmare of anguished convulsion. If only the life that was approaching would pass swiftly. If the life stopped, it would pull it into shape. Life could do that. Life was stronger than metal, stronger than anything. The approaching life meant torture, struggle, pain.

The creature tensed its now flat, grotesque body—the body that could develop muscles of steel—and waited in terror for the death struggle.

Spacecraftsman Parelli whistled happily as he strode along the gleaming corridor that led from the engine room. He had just received a wireless from the hospital. His wife was

With a horrible effort it wrenched itself from the metal form and took the semblance of something trying to be human—

doing well, and it was a boy. Eight pounds, the radiogram had said. He suppressed a desire to whoop and dance. A boy. Life sure was good.

Pain came to the thing on the floor. Primeval pain that sucked through its elements like acid burning, burning. The brown floor shuddered in every atom as Parelli strode over it. The aching urge to pull toward him, to take his shape. The thing fought its horrible desire, fought with anguish and shivering dread, more consciously now that it could think with Parelli's brain. A ripple of floor rolled after the man.

Fighting didn't help. The ripple grew into a blob that momentarily

seemed to become a human head. Gray, hellish nightmare of demoniac shape. The creature hissed metallically in terror, then collapsed palpitating, slobbering with fear and pain and hate as Parelli strode on rapidly—too rapidly for its creeping pace.

The thin, horrible sound died; the thing dissolved into brown floor, and lay quiescent yet quivering in every atom from its unquenchable, uncontrollable urge to live—live in spite of pain, in spite of abysmal terror and primordial longing for stable shape. To live and fulfill the purpose of its lusting and malignant creators.

THIRTY FEET up the corridor, Parelli stopped. He jerked his mind from its thoughts of child and wife. He spun on his heels, and stared uncertainly along the passageway from the engine room.

"Now, what the devil was that?" he pondered aloud.

A sound—a queer, faint yet unmistakably horrid sound was echoing and re-echoing through his consciousness. A shiver ran the length of his spine. That sound—that devilish sound.

He stood there, a tall, magnificently muscled man, stripped to the waist, sweating from the heat generated by the rockets that were decelerating the craft after its meteoric flight from Mars. Shuddering, he clenched his fists, and walked slowly back the way he had come.

The creature throbbed with the pull of him, a gnawing, writhing, tormenting struggle that pierced into the deeps of every restless, agitated cell, stabbing agonizingly along the alien nervous system; and then became terrifyingly aware of the inevitable, the irresistible need to take the shape of the life.

Parelli stopped uncertainly. The floor moved under him, a visible wave that reared brown and horrible before his incredulous eyes and grew into a bulbous, slobbering, hissing mass. A venomous demon head reared on twisted, half-human shoulders. Gnarled hands on apelike, malformed arms clawed at his face with insensate rage—and changed even as they tore at him.

"Good God!" Parelli bellowed.

The hands, the arms that clutched him grew more normal, more human, brown, muscular. The face assumed familiar lines, sprouted a nose, eyes, a red gash of mouth. The body was suddenly his own, trousers and all, sweat and all.

"—God!" his image echoed; and pawed at him with letching fingers and an impossible strength.

Gasping, Parelli fought free, then launched one crushing blow straight into the distorted face. A drooling scream of agony came from the thing. It turned and ran, dissolving as it ran, fighting dissolution, uttering strange half-human cries.

And, struggling against horror, Parelli chased it, his knees weak and trembling from sheer funk and incredulity. His arm reached out, and plucked at the disintegrating trousers. A piece came away in his hand, a cold, slimy, writhing lump like wet clay.

The feel of it was too much. His gorge rising in disgust, he faltered in his stride. He heard the pilot shouting ahead:

"What's the matter?"

Parelli saw the open door of the storeroom. With a gasp, he dived in, came out a moment later, wild-eyed, an ato-gun in his fingers. He saw the pilot, standing with staring, horrified brown eyes, white face and rigid body, facing one of the great windows.

"There it is!" the man cried.

A gray blob was dissolving into the edge of the glass, becoming glass. Parelli rushed forward, ato-gun poised. A ripple went through the glass, darkening it; and then, briefly, he caught a glimpse of a blob emerging on the other side of the glass into the cold of space.

The officer stood gaping beside him; the two of them watched the gray, shapeless mass creep out of sight along the side of the rushing freight liner.

Parelli sprang to life. "I got a piece of it!" he gasped. "Flung it down on the floor of the storeroom."

It was Lieutenant Morton who found it. A tiny section of floor reared up, and then grew amazingly large as it tried to expand into human shape. Parelli with distorted, crazy eyes scooped it up in a shovel. It hissed; it nearly became a part of the metal shovel, but couldn't because Parelli was so close. Changing, fighting for shape, it slobbered and hissed as Parelli staggered with it behind his superior officer. He was laughing hysterically. "I touched it," he kept saying, "I touched it."

A LARGE blister of metal on the outside of the space freighter stirred into sluggish life, as the ship tore into the Earth's atmosphere. The metal walls of the freighter grew red, then white-hot, but the creature, unaffected, continued its slow transformation into gray mass. Vague thought came to the thing, realization that it was time to act.

Suddenly, it was floating free of the ship, falling slowly, heavily, as if somehow the gravitation of Earth had no serious effect upon it. A minute distortion in its electrons started it falling faster, as in some alien way it suddenly became more allergic to gravity.

The Earth was green below; and in the dim distance a gorgeous and tremendous city of spires and massive buildings glittered in the sinking Sun. The thing slowed, and drifted like a falling leaf in a breeze toward the still-distant Earth. It landed in an arroyo beside a bridge at the outskirts of the city.

A man walked over the bridge with quick, nervous steps. He would have been amazed, if he had looked back, to see a replica of himself climb from the ditch to the road, and start walking briskly after him.

Find the—greatest mathematician!

It was an hour later; and the pain of that throbbing thought was a dull, continuous ache in the creature's brain, as it walked along the crowded street. There were other pains, too. The pain of fighting the pull of the pushing, hurrying mass of humanity that swarmed by with unseeing eyes. But it was easier to think, easier to hold form now that it had the brain and body of a man.

Find—mathematician!

"Why?" asked the man's brain of the thing; and the whole body shook with startled shock at such heretical questioning. The brown eyes darted in fright from side to side, as if expecting instant and terrible doom. The face dissolved a little in that brief moment of mental chaos, became successively the man with the hooked nose who swung by, the tanned face of the tall woman who was looking into the shop window, the—

With a second gasp, the creature pulled its mind back from fear, and fought to readjust its face to that of the smooth-shaven young man who sauntered idly in from a side street. The young man glanced at him,

looked away, then glanced back again startled. The creature echoed the thought in the man's brain: "Who the devil is that? Where have I seen that fellow before?"

Half a dozen women in a group approached. The creature shrank aside as they passed, its face twisted with the agony of the urge to become woman. Its brown suit turned just the faintest shade of blue, the color of the nearest dress, as it momentarily lost control of its outer atoms. Its mind hummed with the chatter of clothes and "My dear, didn't she look dreadful in that awful hat?"

There was a solid cluster of giant buildings ahead. The thing shook its human head consciously. So many buildings meant metal; and the forces that held metal together would pull and pull at its human shape. The creature comprehended the reason for this with the understanding of the slight man in a dark suit who wandered by dully. The slight man was a clerk; the thing caught his thought. He was thinking enviously of his boss who was Jim Brender, of the financial firm of J. P. Brender & Co.

The overtones of that thought struck along the vibrating elements of the creature. It turned abruptly and followed Lawrence Pearson, bookkeeper. If people ever paid attention to other people on the street, they would have been amazed after a moment to see two Lawrence Pearsons proceeding down the street, one some fifty feet behind the other. The second Lawrence Pearson had learned from the mind of the first that Jim Brender was a Harvard graduate in mathematics, finance and political economy, the latest of a long line of financial geniuses, thirty years old, and the head of the tremendously wealthy J. P. Brender & Co. Jim Brender had just married the most beautiful girl in the world; and this was the reason for Lawrence Pearson's discontent with life.

"Here I'm thirty, too," his thoughts echoed in the creature's mind, "and I've got nothing. He's got everything—everything while all I've got to look forward to is the same old boardinghouse till the end of time."

It was getting dark as the two crossed the river. The creature quickened its pace, striding forward with aggressive alertness that Lawrence Pearson in the flesh could never have managed. Some glimmering of its terrible purpose communicated itself in that last instant to the victim. The slight man turned; and let out a faint squawk as those steel-muscled fingers jerked at his throat, a single, fearful snap.

The creature's brain went black with dizziness as the brain of Lawrence Pearson crashed into the night of death. Gasping, whimpering, fighting dissolution, it finally gained control of itself. With one sweeping movement, it caught the dead body and flung it over the cement railing. There was a splash below, then a sound of gurgling water.

The thing that was now Lawrence Pearson walked on hurriedly, then more slowly till it came to a large, rambling brick house. It looked anxiously at the number, suddenly uncertain if it had remembered rightly. Hesitantly, it opened the door.

A streamer of yellow light splashed out, and laughter vibrated in the thing's sensitive ears. There was the same hum of many thoughts and many brains, as there had been in the street. The creature fought against the inflow of thought that threatened to crowd out the mind of Lawrence Pearson. A little dazed by the struggle, it found itself in a large,

bright hall, which looked through a door into a room where a dozen people were sitting around a dining table.

"Oh, it's you, Mr. Pearson," said the landlady from the head of the table. She was a sharp-nosed, thin-mouthed woman at whom the creature stared with brief intentness. From her mind, a thought had come. She had a son who was a mathematics teacher in a high school. The creature shrugged. In one penetrating glance, the truth throbbed along the intricate atomic structure of its body. This woman's son was as much of an intellectual lightweight as his mother.

"You're just in time," she said incuriously. "Sarah, bring Mr. Pearson's plate."

"Thank you, but I'm not feeling hungry," the creature replied; and its human brain vibrated to the first silent, ironic laughter that it had ever known. "I think I'll just lie down."

All night long it lay on the bed of Lawrence Pearson, bright-eyed, alert, becoming more and more aware of itself. It thought:

"I'm a machine, without a brain of my own. I use the brains of other people, but somehow my creators made it possible for me to be more than just an echo. I use people's brains to carry out my purpose."

It pondered about those creators, and felt a surge of panic sweeping along its alien system, darkening its human mind. There was a vague physiological memory of pain unutterable, and of tearing chemical action that was frightening.

The creature rose at dawn, and walked the streets till half past nine. At that hour, it approached the imposing marble entrance of J. P. Brender & Co. Inside, it sank down in the comfortable chair initialed L. P.; and began painstakingly to work at the books Lawrence Pearson had put away the night before.

At ten o'clock, a tall young man in a dark suit entered the arched hallway and walked briskly through the row after row of offices. He smiled with easy confidence to every side. The thing did not need the chorus of "Good morning, Mr. Brender" to know that its prey had arrived.

Terrible in its slow-won self-confidence, it rose with a lithe, graceful movement that would have been impossible to the real Lawrence Pearson, and walked briskly to the washroom. A moment later, the very image of Jim Brender emerged from the door and walked with easy confidence to the door of the private office which Jim Brender had entered a few minutes before.

THE THING knocked and walked in —and simultaneously became aware of three things: The first was that it had found the mind after which it had been sent. The second was that its image mind was incapable of imitating the finer subtleties of the razor-sharp brain of the young man who was staring up from dark-gray eyes that were a little startled. And the third was the large metal bas-relief that hung on the wall.

With a shock that almost brought chaos, it felt the overpowering tug of that metal. And in one flash it knew that this was ultimate metal, product of the fine craft of the ancient Martians, whose metal cities, loaded with treasures of furniture, art and machinery were slowly being dug up by enterprising human beings from the sands under which they had been buried for thirty or fifty million years.

The ultimate metal! The metal that no heat would even warm, that no diamond or other cutting device,

could scratch, never duplicated by human beings, as mysterious as the *ieis* force which the Martians made from apparent nothingness.

All these thoughts crowded the creature's brain, as it explored the memory cells of Jim Brender. With an effort that was a special pain, the thing wrenched its mind from the metal, and fastened its eyes on Jim Brender. It caught the full flood of the wonder in his mind, as he stood up.

"Good lord," said Jim Brender, "who are you?"

"My name's Jim Brender," said the thing, conscious of grim amusement, conscious, too, that it was progress for it to be able to feel such an emotion.

The real Jim Brender had recovered himself. "Sit down, sit down," he said heartily. "This is the most amazing coincidence I've ever seen."

He went over to the mirror that made one panel of the left wall. He stared, first at himself, then at the creature. "Amazing," he said. "Absolutely amazing."

"Mr. Brender," said the creature, "I saw your picture in the paper, and I thought our astounding resemblance would make you listen, where otherwise you might pay no attention. I have recently returned from Mars, and I am here to persuade you to come back to Mars with me."

"That," said Jim Brender, "is impossible."

"Wait," the creature said, "until I have told you why. Have you ever heard of the Tower of the Beast?"

"The Tower of the Beast!" Jim Brender repeated slowly. He went around his desk and pushed a button.

A voice from an ornamental box said: "Yes, Mr. Brender?"

"Dave, get me all the data on the Tower of the Beast and the legendary city of Li in which it is supposed to exist."

"Don't need to look it up," came the crisp reply. "Most Martian histories refer to it as the beast that fell from the sky when Mars was young —some terrible warning connected with it—the beast was unconscious when found—said to be the result of its falling out of sub-space. Martians read its mind; and were so horrified by its subconscious intentions they tried to kill it, but couldn't. So they built a huge vault, about fifteen hundred feet in diameter and a mile high—and the beast, apparently of these dimensions, was locked in. Several attempts have been made to find the city of Li, but without success. Generally believed to be a myth. That's all, Jim."

"Thank you!" Jim Brender clicked off the connection, and turned to his visitor. "Well?"

"It is not a myth. I know where the Tower of the Beast is; and I also know that the beast is still alive."

"Now, see here," said Brender good-humoredly, "I'm intrigued by your resemblance to me; and as a matter of fact I'd like Pamela—my wife—to see you. How about coming over to dinner? But don't, for Heaven's sake, expect me to believe such a story. The beast, if there is such a thing, fell from the sky when Mars was young. There are some authorities who maintain that the Martian race died out a hundred million years ago, though twenty-five million is the conservative estimate. The only things remaining of their civilization are their constructions of ultimate metal. Fortunately, toward the end they built almost everything from that indestructible metal."

"Let me tell you about the Tower of the Beast," said the thing quietly. "It is a tower of gigantic size, but

only a hundred feet or so projected above the sand when I saw it. The whole top is a door, and that door is geared to a time lock, which in turn has been integrated along a line of ieis to the ultimate prime number."

JIM BRENDER stared; and the thing caught his startled thought, the first uncertainty, and the beginning of belief.

"Ultimate prime number!" Brender ejaculated. "What do you mean?" he caught himself. "I know of course that a prime number is a number divisible only by itself and by one."

He snatched at a book from the little wall library beside his desk, and rippled through it. "The largest known prime is—ah, here it is —is 2305843009213939 51. Some others, according to this authority, are 77843839397, 182521213001, and 78875943472201."

He frowned. "That makes the whole thing ridiculous. The ultimate prime would be an indefinite number." He smiled at the thing. "If there is a beast, and it is locked up in a vault of ultimate metal, the door of which is geared to a time lock, integrated along a line of ieis to the ultimate prime number—then the beast is caught. Nothing in the world can free it."

"To the contrary," said the creature. "I have been assured by the beast that it is within the scope of human mathematics to solve the problem, but that what is required is a born mathematical mind, equipped with all the mathematical training that Earth science can afford. You are that man."

"You expect me to release this evil creature—even if I could perform this miracle of mathematics."

"Evil nothing!" snapped the thing. "That ridiculous fear of the unknown which made the Martians imprison it has resulted in a very grave wrong. The beast is a scientist from another space, accidentally caught in one of his experiments. I say 'his' when of course I do not know whether this race has a sexual differentiation."

"You actually talked with the beast?"

"It communicated with me by mental telepathy."

"It has been proven that thoughts cannot penetrate ultimate metal."

"What do humans know about telepathy? They cannot even communicate with each other except under special conditions." The creature spoke contemptuously.

"That's right. And if your story is true, then this is a matter for the Council."

"This is a matter for two men, you and I. Have you forgotten that the vault of the beast is the central tower of the great city of Li—billions of dollars' worth of treasure in furniture, art and machinery? The beast demands release from its prison before it will permit anyone to mine that treasure. You can release it. We can share the treasure."

"Let me ask you a question," said Jim Brender. "What is your real name?"

"P-Pierce Lawrence!" the creature stammered. For the moment, it could think of no greater variation of the name of its first victim than reversing the two words, with a slight change on "Pearson." Its thoughts darkened with confusion as the voice of Brender pounded:

"On what ship did you come from Mars?"

"O-on *F4961*," the thing stammered chaotically, fury adding to the confused state of its mind. It fought for control, felt itself slipping, suddenly felt the pull of the ultimate metal that made up the bas-relief on

the wall, and knew by that tug that it was dangerously near dissolution.

"That would be a freighter," said Jim Brender. He pressed a button. "Carltons, find out if the *F4961* had a passenger or person aboard, named Pierce Lawrence. How long will it take?"

"About a minute, sir."

"You see," said Jim Brender, leaning back, "this is mere formality. If you were on that ship, then I shall be compelled to give serious attention to your statements. You can understand, of course, that I could not possibly go into a thing like this blindly. I—"

The buzzer rang. "Yes?" said Jim Brender.

"Only the crew of two was on the *F4961* when it landed yesterday. No such person as Pierce Lawrence was aboard."

"Thank you." Jim Brender stood up. He said coldly. "Good-by, Mr. Lawrence. I cannot imagine what you hoped to gain by this ridiculous story. However, it has been most intriguing, and the problem you presented was very ingenious indeed—"

The buzzer was ringing. "What is it?"

"Mr. Gorson to see you, sir."

"Very well, send him right in."

The thing had greater control of its brain now, and it saw in Brender's mind that Gorson was a financial magnate, whose business ranked with the Brender firm. It saw other things, too; things that made it walk out of the private office, out of the building, and wait patiently until Mr. Gorson emerged from the imposing entrance. A few minutes later, there were two Mr. Gorsons walking down the street.

Mr. Gorson was a vigorous man in his early fifties. He had lived a clean, active life; and the hard memories of many climates and several planets were stored away in his brain. The thing caught the alertness of this man on its sensitive elements, and followed him warily, respectfully, not quite decided whether it would act.

It thought: "I've come a long way from the primitive life that couldn't hold its shape. My creators, in designing me, gave to me powers of learning, developing. It is easier to fight dissolution, easier to be human. In handling this man, I must remember that my strength is invincible when properly used."

With minute care, it explored in the mind of its intended victim the exact route of his walk to his office. There was the entrance to a large building clearly etched on his mind. Then a long, marble corridor, into an automatic elevator up to the eighth floor, along a short corridor with two doors. One door led to the private entrance of the man's private office. The other to a storeroom used by the janitor. Gorson had looked into the place on various occasions; and there was in his mind, among other things, the memory of a large chest—

The thing waited in the storeroom till the unsuspecting Gorson was passed the door. The door creaked. Gorson turned, his eyes widening. He didn't have a chance. A fist of solid steel smashed his face to a pulp, knocking the bones back into his brain.

This time, the creature did not make the mistake of keeping its mind tuned to that of its victim. It caught him viciously as he fell, forcing its steel fist back to a semblance of human flesh. With furious speed, it stuffed the bulky and athletic form into the large chest, and clamped the lid down tight.

Alertly, it emerged from the storeroom, entered the private office of

Mr. Gorson, and sat down before the gleaming desk of oak. The man who responded to the pressing of a button saw John Gorson sitting there, and heard John Gorson say:

"Crispins, I want you to start selling these stocks through the secret channels right away. Sell until I tell you to stop, even if you think it's crazy. I have information of something big on."

Crispins glanced down the row after row of stock names; and his eyes grew wider and wider. "Good lord, man!" he gasped finally, with that familiarity which is the right of a trusted adviser, "these are all the gild-edged stocks. Your whole fortune can't swing a deal like this."

"I told you I'm not in this alone."

"But it's against the law to break the market," the man protested.

"Crispins, you heard what I said. I'm leaving the office. Don't try to get in touch with me. I'll call you."

The thing that was John Gorson stood up, paying no attention to the bewildered thoughts that flowed from Crispins. It went out of the door by which it had entered. As it emerged from the building, it was thinking: "All I've got to do is kill half a dozen financial giants, start their stocks selling, and then—"

By one o'clock it was over. The exchange didn't close till three, but at one o'clock, the news was flashed on the New York tickers. In London, where it was getting dark, the papers brought out an extra. In Hankow and Shanghai, a dazzling new day was breaking as the newsboys ran along the streets in the shadows of skyscrapers, and shouted that J. P. Brender & Co. had assigned; and that there was to be an investigation—

"We are facing," said the chairman of the investigation committee, in his opening address the following morning, "one of the most astounding coincidents in all history. An ancient and respected firm, with world-wide affiliations and branches, with investments in more than a thousand companies of every description, is struck bankrupt by an unexpected crash in every stock in which the firm was interested. It will require months to take evidence on the responsibility for the short-selling which brought about this disaster. In the meantime, I see no reason, regrettable as the action must be to all the old friends of the late J. P. Brender, and of his son, why the demands of the creditors should not be met, and the properties liquidated through auction sales and such other methods as may be deemed proper and legal—"

"Really, I don't blame her," said the first woman, as they wandered through the spacious rooms of the Brenders' Chinese palace. "I have no doubt she does love Jim Brender, but no one could seriously expect her to remain married to him *now*. She's a woman of the world, and it's utterly impossible to expect her to live with a man who's going to be a mere pilot or space hand or something on a Martian spaceship—"

COMMANDER HUGHES of Interplanetary Spaceways entered the office of his employer truculently. He was a small man, but extremely wiry; and the thing that was Louis Dyer gazed at him tensely, conscious of the force and power of this man.

Hughes began: "You have my report on this Brender case?"

The thing twirled the mustache of Louis Dyer nervously; then picked up a small folder, and read out loud:

"Dangerous for psychological reasons . . . to employ Brender. . . . So many blows in succession. Loss of wealth, position and wife. . . .

No normal man could remain normal under . . . circumstances. Take him into office . . . befriend him . . . give him a sinecure, or position where his undoubted great ability . . . but not on a spaceship, where the utmost hardiness, both mental, moral, spiritual and physical is required—"

Hughes interrupted: "Those are exactly the points which I am stressing. I knew you would see what I meant, Louis."

"Of course, I see," said the creature, smiling in grim amusement, for it was feeling very superior these days. "Your thoughts, your ideas, your code and your methods are stamped irrevocably on your brain and"—it added hastily—"you have never left me in doubt as to where you stand. However, in this case, I must insist. Jim Brender will not take an ordinary position offered by his friends. And it is ridiculous to ask him to subordinate himself to men to whom he is in every way superior. He has commanded his own space yacht; he knows more about the mathematical end of the work than our whole staff put together; and that is no reflection on our staff. He knows the hardships connected with space flying, and believes that it is exactly what he needs. I, therefore, command you, for the first time in our long association, Peter, to put him on space freighter *F4961* in the place of Spacecraftsman Parelli who collapsed into a nervous breakdown after that curious affair with the creature from space, as Lieutenant Morton described it— By the way, did you find the . . . er . . . sample of that creature yet?"

"No, sir, it vanished the day you came in to look at it. We've searched the place high and low—queerest stuff you ever saw. Goes through glass as easy as light; you'd think it was some form of light-stuff—scares me, too. A pure sympodial development—actually more adaptable to environment than anything hitherto discovered; and that's putting it mildly. I tell you, sir— But see here, you can't steer me off the Brender case like that."

"Peter, I don't understand your attitude. This is the first time I've interfered with your end of the work and—"

"I'll resign," groaned that sorely beset man.

The thing stifled a smile. "Peter, you've built up the staff of Spaceways. It's your child, your creation; you can't give it up, you know you can't—"

The words hissed softly into alarm; for into Hughes' brain had flashed the first real intention of resigning. Just hearing of his accomplishments and the story of his beloved job brought such a rush of memories, such a realization of how tremendous an outrage was this threatened interference. In one mental leap, the creature saw what this man's resignation would mean: The discontent of the men; the swift perception of the situation by Jim Brender; and his refusal to accept the job. There was only one way out—that Brender would get to the ship without finding out what had happened. Once on it, he must carry through with one trip to Mars; and that was all that was needed.

The thing pondered the possibility of imitating Hughes' body; then agonizingly realized that it was hopeless. Both Louis Dyer and Hughes must be around until the last minute.

"But, Peter, listen!" the creature began chaotically. Then it said, "Damn!" for it was very human in its mentality; and the realization that Hughes took its words as a sign of weakness was maddening. Un-

certainty descended like a black cloud over its brain.

"I'll tell Brender when he arrives in five minutes how I feel about all this!" Hughes snapped; and the creature knew that the worst had happened. "If you forbid me to tell him, then I resign. I— Good God, man, your face!"

Confusion and horror came to the creature simultaneously. It knew abruptly that its face had dissolved before the threatened ruin of its plans. It fought for control, leaped to its feet, seeing the incredible danger. The large office just beyond the frosted glass door—Hughes' first outcry would bring help—

With a half sob, it sought to force its arm into an imitation of a metal fist, but there was no metal in the room to pull it into shape. There was only the solid maple desk. With a harsh cry, the creature leaped completely over the desk, and sought to bury a pointed shaft of stick into Hughes' throat.

Hughes cursed in amazement, and caught at the stick with furious strength. There was sudden commotion in the outer office, raised voices, running feet—

IT WAS quite accidental the way it happened. The surface cars swayed to a stop, drawing up side by side as the red light blinked on ahead. Jim Brender glanced at the next car.

A girl and a man sat in the rear of the long, shiny, streamlined affair, and the girl was desperately striving to crouch down out of his sight, striving with equal desperation not to be too obvious in her intention. Realizing that she was seen, she smiled brilliantly, and leaned out of the window.

"Hello, Jim, how's everything?"

"Hello, Pamela!" Jim Brender's fingers tightened on the steering wheel till the knuckles showed white, as he tried to keep his voice steady. He couldn't help adding: "When does the divorce become final?"

"I get my papers tomorrow," she said, "but I suppose you won't get yours till you return from your first trip. Leaving today, aren't you?"

"In about fifteen minutes." He hesitated. "When is the wedding?"

The rather plump, white-faced man who had not participated in the conversation so far, leaned forward.

"Next week," he said. He put his fingers possessively over Pamela's hand. "I wanted it tomorrow but Pamela wouldn't—er, good-by."

His last words were hastily spoken, as the traffic lights switched, and the cars rolled on, separating at the first corner.

The rest of the drive to the spaceport was a blur. He hadn't expected the wedding to take place so soon. Hadn't, when he came right down to it, expected it to take place at all. Like a fool, he had hoped blindly—

Not that it was Pamela's fault. Her training, her very life made this the only possible course of action for her. But—*one week!* The spaceship would be one fourth of the long trip to Mars—

He parked his car. As he paused beside the runway that led to the open door of *F4961*—a huge globe of shining metal, three hundred feet in diameter—he saw a man running toward him. Then he recognized Hughes.

The thing that was Hughes approached, fighting for calmness. The whole world was a flame of cross-pulling forces. It shrank from the thoughts of the people milling about in the office it had just left. Everything had gone wrong. It had never intended to do what it now had to do. It had intended to spend most of the trip to Mars as a blister of metal on

the outer shield of the ship. With an effort, it controlled its funk, its terror, its brain.

"We're leaving right away," it said.

Brender looked amazed. "But that means I'll have to figure out a new orbit under the most difficult—"

"Exactly," the creature interrupted. "I've been hearing a lot about your marvelous mathematical ability. It's time the words were proved by deeds."

Jim Brender shrugged. "I have

"When you are quite through shooting me," said Brender's perfect duplicate, "perhaps we can talk."

no objection. But how is it that you're coming along?"

"I always go with a new man."

It sounded reasonable. Brender climbed the runway, closely followed by Hughes. The powerful pull of the metal was the first real pain the creature had known for days. For a long month, it would now have to fight the metal, fight to retain the shape of Hughes—and carry on a thousand duties at the same time.

That first stabbing pain tore along its elements, and smashed the confidence that days of being human had built up. And then, as it followed Brender through the door, it heard a shout behind it. It looked back hastily. People were streaming out of several doors, running toward the ship.

Brender was several yards along the corridor. With a hiss that was almost a sob, the creature leaped inside, and pulled the lever that clicked the great door shut.

There was an emergency lever that controlled the antigravity plates. With one jerk, the creature pulled the heavy lever hard over. There was a sensation of lightness and a sense of falling.

Through the great plate window, the creature caught a flashing glimpse of the field below, swarming with people. White faces turning upward, arms waving. Then the scene grew remote, as a thunder of rockets vibrated through the ship.

"I hope," said Brender, as Hughes entered the control room, "you wanted me to start the rockets."

"Yes," the thing replied, and felt brief panic at the chaos in its brain, the tendency of its tongue to blur. "I'm leaving the mathematical end entirely in your hands."

It didn't dare stay so near the heavy metal engines, even with Brender's body there to help it keep its human shape. Hurriedly, it started up the corridor. The best place would be the insulated bedroom—

Abruptly, it stopped in its headlong walk, teetered for an instant on tiptoes. From the control room it had just left, a thought was trickling—a thought from Brender's brain. The creature almost dissolved in terror as it realized that Brender was sitting at the radio, answering an insistent call from Earth—

It burst into the control room, and braked to a halt, its eyes widening with humanlike dismay. Brender whirled from before the radio with a single twisting step. In his fingers, he held a revolver. In his mind, the creature read a dawning comprehension of the whole truth. Brender cried:

"You're the . . . thing that came to my office, and talked about prime numbers and the vault of the beast."

He took a step to one side to cover an open doorway that led down another corridor. The movement brought the telescreen into the vision of the creature. In the screen was the image of the real Hughes. Simultaneously, Hughes saw the thing.

"Brender," he bellowed, "it's the monster that Morton and Parelli saw on their trip from Mars. It doesn't react to heat or any chemicals, but we never tried bullets. Shoot, you fool!"

It was too much, there was too much metal, too much confusion. With a whimpering cry, the creature dissolved. The pull of the metal twisted it horribly into thick half metal; the struggle to be human left it a malignant structure of bulbous head, with one eye half gone, and two snakelike arms attached to the half metal of the body.

Instinctively, it fought closer to

Brender, letting the pull of his body make it more human. The half metal became fleshlike stuff that sought to return to its human shape.

"Listen, Brender!" Hughes' voice came urgently. "The fuel vats in the engine room are made of ultimate metal. One of them is empty. We caught a part of this thing once before, and it couldn't get out of the small jar of ultimate metal. If you could drive it into the vat while it's lost control of itself, as it seems to do very easily—"

"I'll see what lead can do!" Brender rapped in a brittle voice.

Bang! The half-human creature screamed from its half-formed slit of mouth, and retreated, its legs dissolving into gray dough.

"It hurts, doesn't it?" Brender ground out. "Get over into the engine room, you damned thing, into the vat!"

"Go on, go on!" Hughes was screaming from the telescreen.

Brender fired again. The creature made a horrible slobbering sound, and retreated once more. But it was bigger again, more human; and in one caricature hand a caricature of Brender's revolver was growing.

It raised the unfinished, unformed gun. There was an explosion, and a shriek from the thing. The revolver fell, a shapeless, tattered blob, to the floor. The little gray mass of it scrambled frantically toward the parent body, and attached itself like some monstrous canker to the right foot.

And then, for the first time, the mighty and evil brains that had created the thing, sought to dominate their robot. Furious, yet conscious that the game must be carefully played, the Controller forced the terrified and utterly beaten thing to its will. Scream after agonized scream rent the air, as the change was forced upon the unstable elements. In an instant, the thing stood in the shape of Brender, but instead of a revolver, there grew from one browned, powerful hand a pencil of shining metal. Mirror bright, it glittered in every facet like some incredible gem.

The metal glowed ever so faintly, an unearthly radiance. And where the radio had been, and the screen with Hughes' face on it, there was a gaping hole. Desperately, Brender pumped bullets into the body before him, but though the shape trembled, it stared at him now, unaffected. The shining weapon swung toward him.

"When you are quite finished," it said, "perhaps we can talk."

It spoke so mildly that Brender, tensing to meet death, lowered his gun in amazement. The thing went on:

"Do not be alarmed. This which you hear and see is a robot, designed by us to cope with your space and number world. Several of us are working here under the most difficult conditions to maintain this connection, so I must be brief.

"We exist in a time world immeasurably more slow than your own. By a system of synchronization, we have geared a number of these spaces in such fashion that, though one of our days is millions of your years, we can communicate. Our purpose is to free our colleague, Kalorn, from the Martian vault. Kalorn was caught accidentally in a time warp of his own making and precipitated onto the planet you know as Mars. The Martians, needlessly fearing his great size, constructed a most diabolical prison, and we need your knowledge of the mathematics peculiar to your space and number world—and to it alone—in order to free him."

The calm voice continued, earnest but not offensively so, insistent but

friendly. He regretted that their robot had killed human beings. In greater detail, he explained that every space was constructed on a different numbers system, some all negative, some all positive, some a mixture of the two, the whole an infinite variety, and every mathematic interwoven into the very fabric of the space it ruled.

Ieis force was not really mysterious. It was simply a flow from one space to another, the result of a difference in potential. This flow, however, was one of the universal forces, which only one other force could affect, the one he had used a few minutes before. Ultimate metal was *actually* ultimate.

In their space they had a similar metal, built up from negative atoms. He could see from Brender's mind that the Martians had known nothing about minus numbers, so that they must have built it up from ordinary atoms. It could be done that way, too, though not so easily. He finished:

"The problem narrows down to this: Your mathematic must tell us how, with our universal force, we can short-circuit the ultimate prime number—that is, factor it—so that the door will open any time. You may ask how a prime can be factored when it is divisible only by itself and by one. That problem is, for your system, solvable only by your mathematics. Will you do it?"

BRENDER REALIZED with a start that he was still holding his revolver. He tossed it aside. His nerves were calm as he said:

"Everything you have said sounds reasonable and honest. If you were desirous of making trouble, it would be the simplest thing in the world to send as many of your kind as you wished. Of course, the whole affair must be placed before the Council—"

"Then it is hopeless—the Council could not possibly accede—"

"And you expect me to do what you do not believe the highest governmental authority in the System would do?" Brender exclaimed.

"It is inherent in the nature of a democracy that it cannot gamble with the lives of its citizens. We have such a government here; and its members have already informed us that, in a similar condition, they would not consider releasing an unknown beast upon their people. Individuals, however, can gamble where governments must not. You have agreed that our argument is logical. What system do men follow if not that of logic?"

The Controller, through its robot, watched Brender's thoughts alertly. It saw doubt and uncertainty, opposed by a very human desire to help, based upon the logical conviction that it was safe. Probing his mind, it saw swiftly that it was unwise, in dealing with men, to trust too much to logic. It pressed on:

"To an individual we can offer—everything. In a minute, with your permission, we shall transfer this ship to Mars; not in thirty days, but in thirty seconds. The knowledge of how this is done will remain with you. Arrived at Mars, you will find yourself the only living person who knows the whereabouts of the ancient city of Li, of which the vault of the beast is the central tower. In this city will be found literally billions of dollars' worth of treasure made of ultimate metal; and according to the laws of Earth, fifty percent will be yours. Your fortune re-established, you will be able to return to Earth this very day, and reclaim your former wife, and your position. Poor silly child, she loves you still, but the iron conventions and training of

her youth leave her no alternative. If she were older, she would have the character to defy those conventions. You must save her from herself. Will you do it?"

Brender was as white as a sheet, his hands clenching and unclenching. Malevolently, the thing watched the flaming thought sweeping through his brain—the memory of a pudgy white hand closing over Pamela's fingers, watched the reaction of Brender to its words, those words that expressed exactly what he had always thought. Brender looked up with tortured eyes.

"Yes," he said, "I'll do what I can."

A BLEAK RANGE of mountains fell away into a valley of reddish gray sand. The thin winds of Mars blew a mist of sand against the building.

Such a building! At a distance, it had looked merely big. A bare hundred feet projected above the desert, a hundred feet of length and *fifteen hundred feet of diameter*. Literally thousands of feet must extend beneath the restless ocean of sand to make the perfect balance of form, the graceful flow, the fairylike beauty, which the long-dead Martians demanded of all their constructions, however massive. Brender felt suddenly small and insignificant as the rockets of his spacesuit pounded him along a few feet above the sand toward that incredible building.

At close range the ugliness of sheer size was miraculously lost in the wealth of the decorative. Columns and pilasters assembled in groups and clusters, broke up the façades, gathered and dispersed again restlessly. The flat surfaces of wall and roof melted into a wealth of ornaments and imitation stucco work, vanished and broke into a play of light and shade.

The creature floated beside Brender; and its Controller said: "I see that you have been giving considerable thought to the problem, but this robot seems incapable of following abstract thoughts, so I have no means of knowing the course of your speculations. I see however that you seem to be satisfied."

"I think I've got the answer," said Brender, "but first I wish to see the time lock. Let's climb."

They rose into the sky, dipping over the lip of the building. Brender saw a vast flat expanse; and in the center— He caught his breath!

The meager light from the distant sun of Mars shone down on a structure located at what seemed the exact center of the great door. The structure was about fifty feet high, and seemed nothing less than a series of quadrants coming together at the center, which was a metal arrow pointing straight up.

The arrow head was not solid metal. Rather it was as if the metal had divided in two parts, then curved together again. But not quite together. About a foot separated the two sections of metal. But that foot was bridged by a vague, thin, green flame of ieis force.

"The time lock!" Brender nodded. "I thought it would be something like that, though I expected it would be bigger, more substantial."

"Do not be deceived by its fragile appearance," answered the thing. "Theoretically, the strength of ultimate metal is infinite; and the ieis force can only be affected by the universal I have mentioned. Exactly what the effect will be, it is impossible to say as it involves the temporary derangement of the whole number system upon which that particular area of space is built. But now tell us what to do."

"Very well." Brender eased him-

self onto a bank of sand, and cut off his antigravity plates. He lay on his back, and stared thoughtfully into the blue-black sky. For the time being all doubts, worries and fears were gone from him, forced out by sheer will power. He began to explain:

"The Martian mathematic, like that of Euclid and Pythagoras, was based on endless magnitude. Minus numbers were beyond their philosophy. On Earth, however, beginning with Descartes, an analytical mathematic was evolved. Magnitude and perceivable dimensions were replaced by that of variable relation-values between positions in space.

"For the Martians, there was only one number between 1 and 3. Actually, the totality of such numbers is an infinite aggregate. And with the introduction of the idea of the square root of minus one—or *i*—and the complex numbers, mathematics definitely ceased to be a simple thing of magnitude, perceivable in pictures. Only the intellectual step from the infinitely small quantity to the lower limit of every possible finite magnitude brought out the conception of a variable number which oscillated beneath any assignable number that was not zero.

"The prime number, being a conception of pure magnitude, had no reality in *real* mathematics, but in this case was rigidly bound up with the reality of the ieis force. The Martians knew ieis as a pale-green flow about a foot in length and developing say a thousand horsepower. (It was actually 12.171 inches and 1021.23 horsepower, but that was unimportant.) The power produced never varied, the length never varied, from year end to year end, for tens of thousands of years. The Martians took the length as their basis of measurement, and called it one 'el'; they took the power as their basis of power and called it one 'rb.' And because of the absolute invariability of the flow they knew it was eternal.

"They knew furthermore that nothing could be eternal without being prime; their whole mathematic was based on numbers which could be factored, that is, disintegrated, destroyed, rendered less than they had been; and numbers which could not be factored, disintegrated or divided into smaller groups.

"Any number which could be factored was incapable of being infinite. Contrariwise, the infinite number must be prime.

"Therefore, they built a lock and integrated it along a line of ieis, to operate when the ieis ceased to flow —which would be at the end of Time,

provided it was not interfered with. To prevent interference, they buried the motivating mechanism of the flow in ultimate metal, which could not be destroyed or corroded in any way. According to their mathematic, that settled it."

"But you have the answer," said the voice of the thing eagerly.

"SIMPLY this: The Martians set a value on the flow of one 'rb.' If you interfere with that flow to no matter what small degree, you no longer have an 'rb.' You have something less. The flow, which is a universal, becomes automatically less than a universal, less than infinite. The prime number ceases to be prime. Let us suppose that you interfere with it to the extent of *infinity minus one*. You will then have a number divisible by two. As a matter of fact, the number, like most large numbers, will immediately break into thousands of pieces, i. e., it will be divisible by tens of thousands of smaller numbers. If the present time falls anywhere near one of those breaks, the door would open then. In other words, the door will open immediately if you can so interfere with the flow that one of the factors occurs in immediate time."

"That is very clear," said the Controller with satisfaction and the image of Brender was smiling triumphantly. "We shall now use this robot to manufacture a universal; and Kalorn shall be free very shortly." He laughed aloud. "The poor robot is protesting violently at the thought of being destroyed, but after all it is only a machine, and not a very good one at that. Besides, it is interfering with my proper reception of your thoughts. Listen to it scream, as I twist it into shape."

The cold-blooded words chilled Brender, pulled him from the heights of his abstract thought. Because of the prolonged intensity of his thinking, he saw with sharp clarity something that had escaped him before.

"Just a minute," he said. "How is it that the robot, introduced from your world, is living at the same time rate as I am, whereas Kalorn continues to live at your time rate?"

"A very good question." The face of the robot was twisted into a triumphant sneer, as the Controller continued. "Because, my dear Brender, you have been duped. It is true that Kalorn is living in our time rate, but that was due to a shortcoming in our machine. The machine which Kalorn built, while large enough to transport him, was not large enough in its adaptive mechanism to adapt him to each new space as he entered it. With the result that he was transported but not adapted. It was possible of course for us, his helpers, to transport such a small thing as the robot, though we have no more idea of the machine's construction than you have.

"In short, we can use what there is of the machine, but the secret of its construction is locked in the insides of our own particular ultimate metal, and in the brain of Kalorn. Its invention by Kalorn was one of those accidents which, by the law of averages, will not be repeated in millions of our years. Now, that you have provided us with the method of bringing Kalorn back, we shall be able to build innumerable interspace machines. Our purpose is to control all spaces, all worlds—particularly those which are inhabited. We intend to be absolute rulers of the entire Universe."

The ironic voice ended; and Brender lay in his prone position the prey of horror. The horror was twofold, partly due to the Controller's monstrous plan, and partly due to the

thought that was pulsing in his brain. He groaned, as he realized that warning thought must be ticking away on the automatic receiving brain of the robot. "Wait," his thought was saying, "that adds a new factor. Time—"

THERE was a scream from the creature as it was forcibly dissolved. The scream choked to a sob, then silence. An intricate machine of shining metal lay there on that great gray-brown expanse of sand and ultimate metal.

The metal glowed; and then the machine was floating in the air. It rose to the top of the arrow, and settled over the green flame of ieis.

Brender jerked on his antigravity screen, and leaped to his feet. The violent action carried him some hundred feet into the air. His rockets sputtered into staccato fire, and he clamped his teeth against the pain of acceleration.

Below him, the great door began to turn, to unscrew, faster and faster, till it was like a flywheel. Sand flew in all directions in a miniature storm.

At top acceleration, Brender darted to one side.

Just in time. First, the robot machine was flung off that tremendous wheel by sheer centrifugal power. Then the door came off, and, spinning now at an incredible rate, hurtled straight into the air, and vanished into space.

A puff of black dust came floating up out of the blackness of the vault. Suppressing his horror, yet perspiring from awful relief, he rocketed to where the robot had fallen into the sand.

Instead of glistening metal, a time-dulled piece of junk lay there. The dull metal flowed sluggishly and assumed a quasi-human shape. The flesh remained gray and in little rolls as if it were ready to fall apart from old age. The thing tried to stand up on wrinkled, horrible legs, but finally lay still. Its lips moved, mumbled:

"I caught your warning thought, but I didn't let them know. Now, Kalorn is dead. They realized the truth as it was happening. End of Time came—"

It faltered into silence; and Brender went on: "Yes, end of Time came when the flow became momentarily less than eternal—came at the factor point which occurred a few minutes ago."

"I was . . . only partly . . . within its . . . influence, Kalorn all the way. . . . Even if they're lucky . . . will be years before . . . they invent another machine . . . and one of their years is billions . . . of yours. . . . I didn't tell them. . . . I caught your thought . . . and kept it . . . from them—"

"But why did you do it? Why?"

"Because they were hurting me. They were going to destroy me. Because . . . I liked . . . being human. I was . . . somebody!"

The flesh dissolved. It flowed slowly into a pool of lavalike gray. The lava crinkled, split into dry, brittle pieces. Brender touched one of the pieces. It crumbled into a fine powder of gray dust. He gazed out across that grim, deserted valley of sand, and said aloud, pityingly:

"Poor Frankenstein."

He turned toward the distant spaceship, toward the swift trip to Earth. As he climbed out of the ship a few minutes later, one of the first persons he saw was Pamela.

She flew into his arms. "Oh, Jim, Jim," she sobbed. "What a fool I've been. When I heard what had happened, and realized you were in danger, I— Oh, Jim!"

Later, he would tell her about their new fortune.

DONE WITHOUT EAGLES

By Philip St. John

Court Perry'd lost his space-ticket—the greatest of the pilots no longer allowed to pilot! But without that ticket—with certain other handicaps!—he was still the best of 'em all!

Illustrated by Schneeman

The triangulator registered eight thousand miles up from Earth, though, naturally, we couldn't see the old ball behind us. When they built the *Kickapoo* they left out all windows, and covered her with a new laboratory product to bounce back hard radiations, which is why I have a couple of normal kids instead of half-monsters; cosmic rays just love to play around with a man's genes and cause mutations if they get a chance. Anyway, the spy instruments we used were worth a whole factory of portholes.

Captain Lee Rogers ran his eyes over the raised indicators when I signaled that we'd made one diameter, and found them all grooved where they should be. He pushed back his shoulders and tapped down for normal space acceleration before swinging around to face me. "They all come back, Sammy," he said, for no good reason I could see. "Once a man's been outside the atmosphere, you can't keep him grounded. Remember Court Perry?"

How could I help it, with some of the records he'd made still unbeaten? He'd won his eagles back in the old quartz-window days. Then, when they built the *Kickapoo* as the first blind ship and made him captain, he'd made history and legends for six years, until even the die-hards admitted spy instruments worked, and every student in navigation school with marrying ideas darned near worshiped him. After that his landings and take-offs began to go sour, and got worse for months. They seemed to be improving again at the last, but it was too late then; the officials called him in and yanked his eagles, offering him an office job instead, which he turned down. That had been five years before and nobody had heard a word of the captain since.

"Sure," I told Lee. "It was before I got my copilot ticket on the *Kickapoo*, but they gave us his life for inspirational reading in navigation school. Why?"

He handed me over a hen-scratched paper giving the passenger listings. "Take a look at the angel roll. The steward sent it up for my O. K. on the use of the superdeck cabin."

"Inspector eying our flare?" The superdeck cabin is reserved for officials, usually, and lies right down the hall from the dugout—navigation room—next to the captain and pilot's quarters.

Lee shook his head. "Free-wing angels. We're carrying a full load this trip, and they came aboard with 'any consideration will be appreciated' passes, so I had to O. K. it. You might read it, you know."

It was an idea, though I was be-

I had a vision of the black gang going after that mutation—and his four gorilla arms swinging!

ginning to catch on. All the same, my eyes popped when I saw the names after Cabin O-A. "Captain Courtney R. Perry, Ret., and Stanley N. Perry, M. A., M. M., Ph. D., F. R. P. S., F. R. S.," I read. "Hm-m-m. So he's come out of the hole. Who's the alphabet?"

"Court Perry's son, and that's only part of his degrees and such. One of the hard-radiation mutes—mutation, he meant, not speechless—born while the captain was on the old ships, so don't be surprised when you see him. Claims he's a superman, and maybe he is— Get ready for trouble, Sammy."

"I don't get it." I'd been wanting to meet Court Perry for years, and this looked like a first-class opportunity to me.

Lee grimaced. "Naturally, not knowing him. I was his pilot before they sacked him, though, and I know what he'll think of another man pushing his ship. Inside of an hour, you'll hear a knock on the door there, and won't have to guess who it is."

LEE WAS wrong, partly. It wasn't more than half an hour before the knock came, and the door opened to show the hugest body I'd seen on a man six feet tall and not fat. It was topped by a head that was simply magnificent; beautiful describes it better than handsome. And below that—well, the man had four arms, all fully developed, and muscled like a gorilla's, with long hands that ended in six tapering fingers apiece. Apparently the double shoulder system left no room for a waist, but ran in a straight line from hips up. I must have gasped, but the mute took no notice of it.

"Hi, Lee! How's tricks?"

Lee gave him a rather troubled grin and came to his feet to grab one of the arms. "Not bad, Stan, though the two of you might have written once in a while. You're looking good. How's Court?"

"All right, I guess." He swung a couple of hands in an uncertain gesture that gave me the heebies. "He wants to join you here for a while, if you don't mind."

"Afraid I can't. The rules forbid passengers—"

"What's that?" The voice rapped out from the hall and swung me around to face a little, thin man with a ramrod down his back and a neat Vandyke on his face. He looked like the sort who'd hit heaven and been routed through hell on the return ticket, but come through it. Pride, authority, and indignation were all mixed, and another expression I couldn't quite place. Something about him made me pull my stomach in and come to attention, even though he wasn't wearing twin eagles on his old space cap.

"What's that, Lee?" he rapped out again, pushing forward to the dugout. "When have I ever been an angel, eh? Don't be an ass!"

Lee's arm barred his way. "Sorry, sir, but technically you're an angel now. The rule clearly states that no passengers are to be admitted to navigation or engine rooms under any circumstances. You taught me those rules were to be obeyed!"

"I taught you not to be a blamed fool! Out of my way, Lee. I'm coming in. I want to find out what's happened to my ship while you've been running it. Stan, make way for me!"

Stan started forward, and I didn't like the look of those bulking shoulders, but Lee waved him back with a sharp gesture. There were little creases torturing his forehead, and the muscles along his jaw stood out sharply. "Sorry, Captain Perry.

I'm wearing the eagles on this ship. Return to your quarters!"

For only a fraction of a second, Court Perry winced, and then his face froze into a blank. "Very good, Captain Rogers!" he said precisely, coming to salute. He executed a rightabout-face with a snap and marched down the hall, fingering the place where the eagles should have been, Stan following.

I swung on Lee. "Good Lord, man, did you have to—"

"I had to." The cigarette in his hands was mashed to a pulp, and he tossed it away savagely, fiddling with the controls, while the air machine clicked out the only noises in the room and I made myself busy with charts. Finally he shrugged and reached for another cigarette.

"Court Perry dug me out of an orphanage, Sammy, put me through navigation school, and taught me all he knew about running the *Kickapoo*. He's—" Lee stopped and looked to see how I was taking it. "All right, I suppose it does make me seem an ungrateful pup. But if I'd broken that rule or let him override my authority, he'd have hated me for a weakling and himself for having failed with me. Now let's forget it and wait for his next move. He won't give up on the first try."

He didn't. Almost as Lee finished speaking, the etherphone *ikked* from behind the controls, and I jumped to answer it. "'Lee Rogers,'" I read as it came over, "'captain, *Kickapoo:* Captain Courtney Perry and son are to have full freedom of ship. Signed, Redman, president—' How'd they get word through without sending on our transmitter?"

"Probably Stan built a sender from the pile of gadgets he always carries along."

"In fifteen minutes?"

"Um-hm-m-m. He does those things when he wants to. I've seen him take a computator apart and reassemble it in ten." Lee glanced at the clock and slid off the throne. "Take over. So Court still has pull in the office, it seems. Redman had no business interfering; we're in space and my word is supposed to be final. Nothing I can do about it, though. Come in!"

The door snapped open to show Court Perry standing with his feet exactly on the imaginary line of the dugout, Stan behind him. He came to rigid attention and saluted stiffly. Lee returned it. "The freedom of the ship is yours, Captain Perry," he acknowledged. "Sammy, see that Captain Perry is provided with a set of master keys to the lower decks."

"Thank you, Captain Rogers." Court's square shoulders were perhaps a trifle farther back as he stepped over the line and approached the control seat. He reached out as I slid up to let him take it, then hesitated. "With your permission, sir."

"Permission granted." It was the first time I'd seen formality in space, and I felt awkward as a two-tailed comet between them. Lee disappeared around the panel to the etherphone cubbyhole with a handful of miscellaneous and unrelated charts in his hands.

As Court took the seat I had vacated the huge bulk of Stan moved in front of me, cutting off my view. He was almost too big for the little room. But I could hear the faint sounds of the old man's fingers on the panel, as he tested it bit by bit. He grunted once or twice, and Stan seemed to mutter something, then twitched his arms slightly and looked around. Court got up.

"Copilot— Sammy's the name, isn't it? Good." He nodded faintly

at that. "Sammy, where are the testing instruments? I used to keep them under the panel, but apparently they're no longer there."

"We don't carry testers, sir; at least, I've never seen any."

"No testers, eh?" He swallowed it carefully, then tossed his voice over the instrument panel. "Captain Rogers, your copilot informs me there are no instrument testers. Is that correct?"

Lee's voice bounced back at him. "It is, Captain Perry. Under the new regulations, we're checked over at both ends, and no tests are made in space. That system has proved entirely satisfactory."

"Hm-m-m. I distinctly remember explaining to you the reasons for space tests. Take-off accelerations sometimes jar loose a delicate control, and furthermore, ground men are sometimes careless; they're not trained in actual flight conditions, and their lives aren't involved. I advise an immediate test of your instruments. Hull Indicator C responds slowly, and the meteor repeller itself may be at fault instead of the indicator."

"Sorry, sir, that's impossible. We have no testers."

Court grimaced at that. "Your engine-room testers can be adapted. I believe I also taught you how that was done."

"Sorry, Captain Perry," Lee decided positively. "I don't consider such measures necessary under the present regulations."

Seeing the uselessness of argument, Court shrugged. "Take over, Sammy," he said, relinquishing the controls. "And if he'll listen, you might remind Captain Rogers that Mars lies in the region of the Little Swarm now. Meteors—even peanut-sized ones—aren't pleasant company when the hull repellers are out of order. Now, if I could have those keys—"

When the door closed again, Lee came out of the hole. "Easier than I thought— Hm-m-m. Nothing wrong with C indicator that I can see. It answers to a change in the hull charge perfectly. Wonder what happens next."

NOTHING really happened for a while, except that Stan and Court were poking over the ship in a methodless hunt for inefficiency. It was just that something was in the air, an unpleasantness that traveled from the control room down to the crew deck, and finally hit the passengers. But any little thing in space does that, and the old customers of the line shrugged and forgot it, as much as they could. Court wandered about the ship with Stan at his heels, but I could see no particular point to his activities.

I was off duty on a prowl when the first trouble came. Down from the cook's galley came a caterwauling and sounds of some sort of scrap, with the shrill yelps of the little cook predominating. As I bounced around a corner, I saw Tony leave the deck in a flying leap and plunge toward the entrance of his domain.

Then one of Stan's big arms came out carelessly and caught him in midair. "Naughty boy," the mute said softly. "You'll hurt yourself trying that. Lucky I was here to catch you." He held the cook easily, while the little man squirmed and fumed helplessly.

"What's going on here?" I wanted to know. Tony swung away at the sound of my voice and bounced up and down before me.

"Mr. Noyes, you gotta help me, you gotta! They steal my galley;

they snoop all over; they won't let me work. How can I cook without I get in? Get 'em out, Mr. Noyes, kill 'em, lock 'em in irons. Oh, Santa Maria, I'll kill 'em so dead! Alla my help's in there, and I ain't telling 'em what to do! They'll spoil the dinner. Get away from my galley, you bums, or I make soup outa you both! Spoil my dinner, I feed you to pigs! Mr. Noyes, you gotta get 'em out."

Stan grinned at me and winked, which was my first indication that he had a sense of humor of some sort. "Tony's a little overenthusiastic, Sammy. Don't mind him." He caught one of the little man's flailing fists and drew him close, patting his head. "Sh, Tony. Dad decided to investigate the galley, so we dropped down. Tony came in just as we were looking over his pans, and set up a squawk. When he grabbed a butcher knife and came at us, I had to put him out. Finished in there, dad?"

"All finished." Court appeared in the door. "Tony!"

The tone of voice cut through Tony's indignation and left the cook at a limp attention.

"Yes—sir?"

"Tony, you use too much grease, and you don't clean your pans often enough! Look at that!" He held out a frying pan with a thin coat of oil on the bottom. "That carries one meal's flavor over to the next food. I've found grease on your griddles, too, thick enough to come off on my finger and half stale. Anything to say about it?"

"That new helper," Tony suggested weakly. "Musta been the new helper!"

"So? Then teach that new helper to keep clean pans. I don't like indigestion. All right, back to your work! Hello, Sammy. Any objections from headquarters?"

"Not this time, sir." I suppose Lee would have objected, but Lee didn't need to know. After all, there had been a slightly off taste to the food this voyage, and I didn't have much use for Tony's treatment of his assistants, anyway.

Court smiled, apparently in the best of spirits after his conquest of the galley. "Fine. I don't suppose Captain Lee has followed my advice, eh? . . . No, I thought not. Thinks I'm a meddling old fool who had no business going over his head Pigheaded—made him that way, I guess. Needs an accident to teach him good sense—and he'll get it, or I'm mistaken. Damn!"

He caught his foot against a swabber's kit and lurched forward, grabbing at a handrail to regain his balance. "Who left that . . . that bucket in the middle of a man's way? Rollins still bossing the middle decks? A fine way to run a ship! You go on with Sammy, Stan. I'm seeing Rollins."

"Don't want me to go with you, dad?"

"No, I won't need you. Rollins knows me well enough to behave himself. Swab pails in the middle of the deck!" He went stumbling off toward the stairs that led to the crew quarters, carrying himself on parade dress. Stan and I turned up to the superdeck. He began filling his pipe with three hands, while I watched in fascinated silence until it was finished, and he turned back to me.

"Dad's quite a remarkable man, Sammy," he said. "You're not getting a very good slant on him, I suppose, but if you knew him better you'd find it isn't prejudice on my part—I have no prejudices."

"I've seen one thing," I agreed. "He's the only man I ever knew who could be thoroughly provoked with the captain and not take it out on the copilot as well. It's a pity he and Lee can't get together."

THE MUTE threw open the door of his cabin and motioned me in. "Make yourself comfortable. I wouldn't worry about Lee and dad, fellow. They both put a ship's command above Heaven and Earth, but that'll be finished the minute we dock. Anyway, it's sort of a farewell fling for dad, so he's making the most of it."

"How do you mean, farewell trip? Thanks, yes." The wine he brought out of some little gadget was icy cold and delicious. He sampled his own before replying.

"Heart trouble, they told him. When he found out, he decided to make one more trip in the *Kickapoo* and settle down on Mars. No dying on Earth for him. Keep this under your hat—Lee's not to know—but the chances are all against his living another year. So I left the wife and kids behind and came along."

"The wife and kids?" It had caught me off guard, and I blurted out the question like a darned fool.

There was a grin on his face then. "Sure, I'm married, and there are four children back in dad's old house—all like me. I'm a true mutation, you know; pass on my differences to any children. It's my duty to continue my strain; otherwise the human race may have to wait a few thousand more years for another superman."

There was certainly no false modesty about him; neither was his tone boasting. About all I could say to that was a grunt.

He grinned again. "It's the truth, Sammy, so why should I deny it? I look strange to you, but you must admit I have advantages physically; among others, I'm practically immune to all diseases. I finished high school and college in the absolute minimum time. I got the 'F. R. P. S.' after my name for working out a process for grinding lenses in a true parabola to an accuracy of one molecule's thickness—using a colloidal abrasive suspended in air, and controlled by the irregularities themselves; that was something they said couldn't be done. Want more proof?"

Something suddenly brought me up out of the seat and toward him, and I could feel a flood of anger running through me at his egotism. I hated the man with a red blood lust that made me crouch in grim determination to clutch and mangle and bite. Then, as quickly as it had come, it was gone, and I found him laughing at me.

"Telepathic control, Sammy, so don't feel foolish. Convinced of my right to call myself super now?"

It was as good an explanation of his ability as anything else, but there were still angles to it. "O. K., you're a superman. But why aren't you out turning the world over? I've never read a superman story in which the fellow minded his own business like the average man."

"You won't—it isn't interesting that way. But one superman in a world of normal men isn't enough to do much. His best bet is to raise children and pass it on until only the supermen are left—that's the way nature did it. I learned early to speak and act like a normal man, whatever differences there are in our way of thinking. Anyway, I was brought up by normal men, and I'm somewhat limited by that—my children won't be. More wine?"

I nodded, my head spinning. I'd

felt about the same way in training school when I got my first whiff of butyl mercaptan in the chemistry class and was told a living animal could make and use a similar odor. It was a good thing Court came in then.

"Rollins knows better now," he said, satisfaction heavy in his voice. "Sammy, your name's up on the caller; captain wants you." And as I slipped out of the cabin toward the dugout, I caught a less-welcome sentence from him: "Think I'll look over the engine room tomorrow, Stan."

All I could do was pray!

APPARENTLY my prayers weren't much good, though. Near the end of Captain Lee's shift the next day, while I was waiting around to take over, the engine phone buzzed and McAllister's voice rattled through it. Lee winced and held it out so we could both hear.

McAllister was in fine fettle. "Captain, there's an old fool down here making trouble, with a freak to help him! Three of my best men have their arms broken and a couple are out. 'Twas a lovely fight, while it lasted, but I've work to be done and no more time for play. What'll I do with 'em?"

"What happened? Where are they now?"

"They're backed in a corner a-waiting for more competition right now, and the old man's using highly uncomplimentary language, so they'll get it. He came down to fiddle around, you might say, over the shininess of my turbines and the dripping of my oil, and I let him have his way with only a word or two dropped about his nose being a bit long. But when the freak found where one of the black gang had hidden some liquor and the old man broke the bottles, the nigger jumped him, and the freak joined the play. Naturally, the others didn't stand by helpless, and I had a bit of a time quieting things down. . . . Shall I shoot them or use a club?"

Lee swore into the phone and then quieted down to make sense. "McAllister, put the fellow with the liquor in the brig! I'll settle with you later. Keep the gang of cutthroats in line and send up the other two—they'll come if you tell them I ordered it. Did any outside the engine crew hear the fight?"

"No, just a little private party that your dainty little angels won't know about. I hated to break it up, but I needed a few sound men to run the engines, and I thought you might have some slight objections. . . . O. K., I've told 'em, and they're on the way up."

"McAllister would!" Lee slapped the phone back onto its cradle and expounded further on the beauties of a captain's life and the virtue of sundry individuals. "If he weren't the best engineer out, I'd sack him—and if there's any more drinking or fighting aboard, I will anyway. He does enough brawling at port—*Come in!*"

I don't know what I'd expected; probably pieces of man and mute, from the nature of McAllister's black gang. Anyway, I was wrong. Court was highly undirty and unscratched, which could only mean Stan had done the actual fighting. The mute's shirt would have made lint, and his general color was that of stale oil; but, except for a few slight scratches, he was untouched. I had a vision of those gorilla arms swinging all together, and began to see why McAllister had called Lee before the fight was completely finished.

"Discipline," said Court, while Lee was still swallowing enough ire to

clear speaking space in his throat, "is terrible aboard, sir. Since you will probably insist on retaining what passes for your engineer, I have asked Stan to accept his invitation and meet him after we dock; I hope you'll show better judgment in choosing the new engineer you'll need."

Lee was practically gagging by that time. "Captain Perry, you forget yourself! Only your age prevents me from confining you to the brig, sir! Keep out of my mind, Stan! This goes for you, too. If I suspect you of trying to control me, I'll brig you before I break. Angels running my ship! You will return to your quarters and remain there until we dock. During that time, you may leave to dine, only, and you will refrain from all comments to other passengers or any members of the crew. And you, Captain Perry, will remove the uniform you wear by courtesy, and dress in civilians!"

"That exceeds your authority, Lee," Stan pointed out softly. Court was radiating a cold white anger that needed no speech. "It's true that there was some trouble below, but we were not unauthorized in our search, and the fight was not of my making; I had no choice, unless I preferred to have my father and myself mutilated. There's no need to strip, dad!"

"Except that he's been scaring the angels with wild tales while his clothes give his words weight! He's ruining my crew and destroying morale—generally making a nuisance or a laughingstock of himself. I won't have the uniform disgraced. To quarters!"

THERE WAS a click of heels from Court and the sound of feet slapping down the hall before his door clicked. Stan stood a moment longer, spreading his hands at odd angles, then followed. With a glance at the clock, Lee clapped his hands down on the panel and jerked from the throne.

"Seven hours from Mars. Take over! Don't call me unless there's an emergency."

That left me alone at the controls, and the peace should have been welcome, but wasn't. I could still hear echoes bouncing from the walls, and the face of Court Perry kept getting in front of the controls. I never took sides in a ruction in a family or ship, but I'd have given half an eye to see the answer to this one. Grown men, I figured, are worse than kids, and you can't spank them as easily. And when they're hurt, I reckon the sting lasts longer.

If I hadn't been darned fool enough to worry about something that wasn't my business, I might have taken more notice of the slight quiver that touched the ship a couple of hours later, but I put it down to temporary lag in one tube, corrected it automatically, and went on roiling around mentally. In the back of my mind, I heard the door open softly and close, and was glad Lee had returned instead of getting drunk as I feared, but didn't bother to look around. A hand slid across my back and gripped my shoulder before I swung to see Court Perry.

He'd put off his uniform and most of himself with it, and now only a small, beaten old man stood there looking at me uncertainly. There's a certain kind of hell in the back of the best minds, and Court had found it. The fact that there was no pain or bitterness on his face only made it worse, somehow. I slid out of the copilot stool.

"Sit down, sir. Lee's turned authority over to me and won't be back for hours." His look toward the

chair was hesitant, and I motioned toward it again. "I'm commanding now, and if I choose to request your presence here as an adviser, nobody can do anything about it."

"Don't counter your captain too much, Sammy." But he took the stool, sinking down into it like a half-pricked balloon. "Sometime you may be running your own tick. I felt the ship lurch back there. Know what it was?"

"Tube lag. I've corrected."

"I thought so—you'd naturally make that mistake. It *wasn't* tube lag. That lurch came from Hull Section C, or everything I learned about the feeling of a ship is wrong—and I don't think so. That means a peanut from the Little Swarm clipped up too close before the repellers functioned, and it was soaked up too quickly for recoil compensation. That's dangerous business, and I couldn't stay berthed with it going on."

"Indicator's registering." I tapped out more current to the hull repeller and watched the pointer. It fluttered a second, and wabbled slowly over—but kept on going instead of stopping at the mark. "Hm-m-m."

"Exactly."

Right then I began to see meteors swarming up as thick as peas in a can. I grabbed the phone, yelled down for the repair crew to jury-rig whatever was wrong. Court tapped me.

"Make an overroll. They strike from the starboard side, and if we turn the weak section to port, it'll help." As he saw me grab for the calculator to figure my thrusts, he brushed my hands aside and laid his on the controls, feeling over the raised indicators with fingers that seemed jointless, then pulled on the firing pins. Spirit ran back over him.

THE *Kickapoo's* thwart tubes muttered obediently, and I could feel the faint press of overroll acceleration. While she was just starting, those long flickering fingers went back to the steering panel and made another lightning reset, twisted the delayed-fire dials, and punched the pins again to check when half-over was reached. I'd heard men claim ships could be handled by conditioned reflexes, but I'd never seen it tried before.

Court leaned back, his hands still playing over the indicators. "Not much chance of two meteors hitting the same spot for hours, anyway, but there's no sense in—"

SSSping-awgh-ooOOM! Something burst in front of us, white-hot and flaming hotter as it struck through the etherphone and threw

hot metal splattering over the dugout. One of us grabbed the other—which it was isn't clear—and we lurched toward the door, just as the last sounds subsided. There was a series of rolling slams, and the automatic air gates whammed shut, one, two, three, cutting the dugout in two just behind the panel. The local danger lights went off and we stopped our scramble for the door.

Then the thwart tubes burbled again, stopping the roll of the ship after the damage was done. From below came faint sounds of excitement that meant the angels were milling around with their fear on their arms, like a pack of sheep. Court snapped up and dived for the angel communicator while I began bellowing down for the checking gang to patch the holes in the outer and inner sheaths.

His voice was brisk and confident. "The small meteor you just felt drove into the control room from which I'm speaking," he announced. "No serious damage was done, and there is absolutely no danger. Passengers are requested to continue as before. The slight inconvenience caused will in no way affect them, nor the arrival time at our destination. I assure you, there is no cause for worry."

As they began quieting down under his words and I turned to inspect the panel, Lee came bursting in and thrust himself in front of me. "What happened?"

I told him quickly, and he grunted. "Etherphone gone, of course. All instruments are dead! It must have hit the relay chamber and burned out the connections. We're flying completely blind, without spy instruments! No way of contacting Earth, where the repair ships are; none on Mars at present. Even if we could get a message out, our momentum would carry us to Jupiter by the time they could reach us."

"The controls are all right, though." It was Court's voice, breaking in on the gloom. "The overroll counterset worked! They're not connected with the spy instruments, anyway."

"What good are controls without indicators? You! I thought I gave orders you were to stay berthed! Is this accident more of your work, Captain Perry?"

"Easy, Lee." I caught him just as Stan slid through the doorway, arms and all, and completely filled what was left of the dugout. "Court was helping me, at my request, and he almost succeeded in preventing this. He might still help if you'll calm down and use your head. What next?"

"What can be next? Get Stan to signal Mars with the etherphone he used before and have them contact Earth, I guess—then wait. There's no chance of fixing the fused mess the meteor would make of the relays."

Court shook his head. "We can't wait. I promised the passengers they'd reach Mars on time, and I mean to see they do. I'll fly it if you can't."

"Without instruments? Captain Perry, return to your quarters and keep this to yourself."

"Without instruments!" Court's voice was flat and positive.

"For the last time, will you get out?"

"No. I'm flying the *Kickapoo* to Mars Junction!"

That was a little strong, even for me. "You can't do it, sir. That would be mutiny." I grabbed for one arm as Lee caught the other, but the old man braced himself and refused to move.

"It *is* mutiny," he said. Then, as Lee let go and grabbed for the phone to summon help: "Stan!"

Stan stood there for a second, then moved toward us, a slow frown creeping up on his face. A flurry of arms came at us—they must have been arms, at least—and I felt myself leave the floor, twist and turn in the air, and hit something. Blackout!

Lee's voice, raging furiously and almost incoherently was the first thing I knew later, except for the ringing that went on in my head. "—behind the bars till the devil catches pneumonia! I'll—"

Stan turned from some problem he was working on, and little furrows of concentration set on his brow. "Shut up, Lee! You'll not say another word until we reach Mars. Understand?"

Lee's open mouth worked furiously, but nothing came out of it. Finally, he slumped back and gave up. The mute turned to me. "Sorry, Sammy, but I had to do it. Here, I'll fix that headache for you." Again there was a second of concentration, and the ringing was suddenly gone, though the lump on the back of my head was still there.

"Where are we now?"

"Half an hour from Mars; you've been out quite a while," Court answered me. "Stan plotted a course from the co-ordinates I remembered were on the panel before the crash, and we're using dead reckoning. Of course, there may be a slight error of a few hundred miles, but that isn't much."

SLIGHT error! Technically, it was; but that wouldn't help if we crashed square into the planet, or missed completely. Lee writhed in the corner and managed a hissing sound. Well, there was nothing I could do now. Court had the ship and there was no chance of outside help. All I could do was ride along and pray—fervently if not hopefully.

"Get a reading yet?" Court asked. "And better signal Mars to clear the field—I may wabble a little."

Stan picked up a little box with a few loops of wire sticking from it and began twisting a dial; it wasn't big enough for an etherphone, as I knew one, but a faint whisper from the headset reached me, after a brief pause.

"They say all clear down there, dad; I told them we were having a little trouble. From the directional angle I get with the loop here, we're about two seconds of an arc too high. Better correct."

"Already done. Now if I can hit into the atmosphere right, and get the feel of the air currents so I can recognize the territory I'm in, we'll be all set." He hunched himself over the panel and sat waiting for a few æons longer. Finally: "Ah, there's the first layer of thin air—we're still a little too fast! There, that should fix it. We're getting down where the air currents have character now."

"Junction on a line from us, almost," Stan reported. "Correct to port one degree five and a half seconds . . . two minutes . . . eight seconds. Good!"

"Updraft—that puts us over—Hm-m-m."

Magic may have its place, but I wasn't used to it aboard the *Kickapoo*. "Good Lord, Stan," I begged, "do something about it! No man can fly a rocket by air currents and the feel of her! I can't even tell an updraft from a hurricane in this heavy shell."

"He can." The calm in his voice was infuriating. "Dad's memorized every square inch and reaction of

the whole *Kickapoo* until he knows every quiver of her hull and pull of her controls. Flew her for a year without using the vision plate. Dad's been blind six years, Sammy!"

"But—" That was too much for even Stan's control, and Lee squeezed the one word out hoarsely.

"This time, I've been his eyes—telepathy, you know. Dad didn't want people to guess. When his eyesight began failing, he put those raised indicators in at his own expense and went ahead. And for your mental comfort, he made his last two landings with eyesight completely gone and without a hitch. If the officers' board hadn't caught on, he'd still be running a regular tick, and Lee would be copiloting without guessing the truth."

Maybe so, but the mental comfort he'd mentioned wasn't there. Those raised indicators weren't helping this trip, and Court hadn't touched a control for five years. He'd been hunched over the controls while Stan was speaking, but now he broke in again.

"There's Junction, by the feel of it. Test her, Stan; that should be the field!"

"I think it was!"

"Good! We're high, from the sound of the back-blast." The *Kickapoo* veered around in a huge circle, Court fighting the controls to hold her on a level without indicators. Stan apparently was capable of nothing but confidence, which wasn't shared entirely by his father. Sweat began popping out on the old man's face. "Can't make it this time, either!"

"Steady, dad!"

"I'm steady enough." Again the ship made a tight circle, her vanes shrieking against the air; her speed was low now, and she wabbled uncertainly. Court's hands bleached white, and his face blanched suddenly. One fist jerked away spasmodically, slapped back, and the grim fight with the controls went on. I was cooking in my own sweat.

Then something slithered under us, the rockets died, and silence reigned! From outside came a rattle, and we went into motion again in a way that meant the field tractors were dragging us in. Safe! Stan was untying Lee and myself, and then Lee was muttering something I didn't try to understand and moving toward Court.

The old captain watched his approach with a tired smile, and came slowly to his feet. "It's your throne again, Lee. It's—"

Hell splashed over his face at that moment! Stan barely managed to catch him as the legs buckled and failed him. But the salute he had started continued, and the voice went on faintly: "A very nice landing *you* made, Lee—*you* made, understand? . . . My cap! . . . Where's my cap?"

Lee caught himself and jerked his own cap up out of the corner where it had lain, making gulping motions in his throat. "Here, cap," he said, putting it on the old man's head. "Here's your cap."

Some of the agony left Court's mouth as his fingers felt it and groped up the visor. "Eagles!" The smile that suffused his face might almost have been a prayer. "My eagles!"

Then Stan was laying the body down and clutching tight at Lee's shaking shoulders. "Not your fault," he was saying gently. "Not your fault, Lee. His heart—"

I turned and stumbled out of the dugout to oversee the passengers who were landing after another uneventful trip to Mars.

THE SCIENCE OF WHITHERING

By L. Sprague de Camp

Being a discussion of whither goeth civilization —or does it? The whitherers seem to be either happy, though pessimistic or happily pessimistic.

Illustrated by Schneeman

Part II.

In the first part of our survey of experts on the "Cause and Cure of Civilization," we discussed those who take States, economic classes, and races as their units, and started in on those who take societies. We polished off Professor Sorokin, whom I described as an optimistic mystic. It would have been more accurate to describe him as pessimistic in the short run and optimistic in the long, since he holds that we are in the painful state of living in a disintegrating Sensate culture, which state will become painfuller and painfuller until the "dawn of a great new Ideational culture."

Vilfredo Pareto (1848-1923) is another whitherer who studies the evolution of societies. He was an Italian engineer turned sociologist, who wrote his magnus opus during the War of 1914 while living in Switzerland with twenty-odd cats and thousands of newspaper clippings. He could be described as a—more or less—optimistic materialist in the same sense that Sorokin—who does not approve of Pareto—is called an optimistic mystic. As Sorokin admires St. Thomas, Pareto admires Niccolo Machiavelli (1469-1527), who, wishing to see Italy united under strong leadership, wrote a famous book of advice to the princes of his time on how to win power and fool people.

Pareto's "Treatise on General Sociology" would better have been called something like "The Natural History of Nonlogical Thought." According to him, actions in the sphere of human relations are almost all motivated by nonlogical sentiments which he calls "residues." The reasons that people give to justify these actions are mere rationalizations—"derivations." The "residues" fall into six classes, of which the most important for his purpose are Class I, "Instinct for Combinations," and Class II, "Persistence of Aggregates." He might have called them simply "experimentalism" and "traditionalism."

The masses are usually strong in Class II—the conservative, traditionalist residues. Their leaders vary between Class I and Class II. A government that relies mainly on force to maintain itself is rich in Class II; one that relies on cunning, in Class I. A government too rich in Class I—experimentalism—such as a government of "speculators"—Pareto's epithet for the business class, which he dislikes—is shaky. If it is too rich in Class II—traditionalism—it is hidebound. A permanent governing class tends to be-

come richer and richer in Class II, until it invites revolution by excluding Class I-rich members of the governed, forcing them to take the leadership of the governed independently of the official government. To maintain itself it must therefore permit class circulation of the élite—the natural-born leaders.

In Athens, Class I was strong in both leaders and followers; in Sparta, both were strong in Class II. Rome had Class I—experimentalist—leaders and Class II—traditionalist—followers, and was more successful than either.

Our present societies are moving along the curve taken by the Late Roman and Byzantine Empires, in which an overwhelming preponderance of traditionalist residues dried up class circulation and weakened the élite, ending in the omnipotence of a senile bureaucracy. The present vogue for "social planning" is an indication of this. But, if present tendencies are toward an increase in traditionalist residues, the proportions between them have oscillated continuously in the past, and there will probably be an eventual reaction. And there is reason to think that, on the whole, Class I residues tend to increase slowly over a long time, especially in the arts and sciences; they are stronger in many fields than they were in the classical world. So Pareto is also a short-term pessimist and a long-term optimist, though a good deal of a cynic at all times.

For Pareto's claims to impartiality, one can allow that, instead of urging people to "do something" as do so many whitherers, he seems to be content with getting ironic amusement out of his gloomy short-term forecasts.

Oswald Spengler (1880-1939) holds a cyclic view of history. He is a cyclist with a vengeance. In his "Decline of the West" he lists the following societies: Egyptian, Babylonian, Minoan, Chinese, Indian, Classical, Arabian, Western, Mexican, Peruvian, and Russian. He shows by comparative tables how they have passed through the same stages, and locates accurately the point in its development reached by our own Western society.

The stages are:

Spring: Rural feudalism. In art, great creations from the newly awakened dream-soul. Ornament and architecture as elementary expressions of the young world-feeling—whatever all those impressive words may mean.

Summer: Formation of national States. Earliest urban and rural critical stirrings in art.

Autumn: Break-up of the State-form—revolution and Napoleonism. Victory of the city over the country, of the "people" over the privileged, of the intelligentsia over tradition, of money over policy. Zenith of intellectual creativeness.

Winter: Cæsarism—a cynical and ruthless power-seeking political policy. Victory of force-politics over money. Increasing primitiveness of political forms. Inward decline of the nations into a formless population, and constitution thereof into an "Imperium" of increasing crudity of despotism. Luxury, sport, nerve-excitement. Rapidly changing fashions in art. Extinction of spiritual creative force. Primitive human conditions slowly thrust up into a highly civilized mode of living—

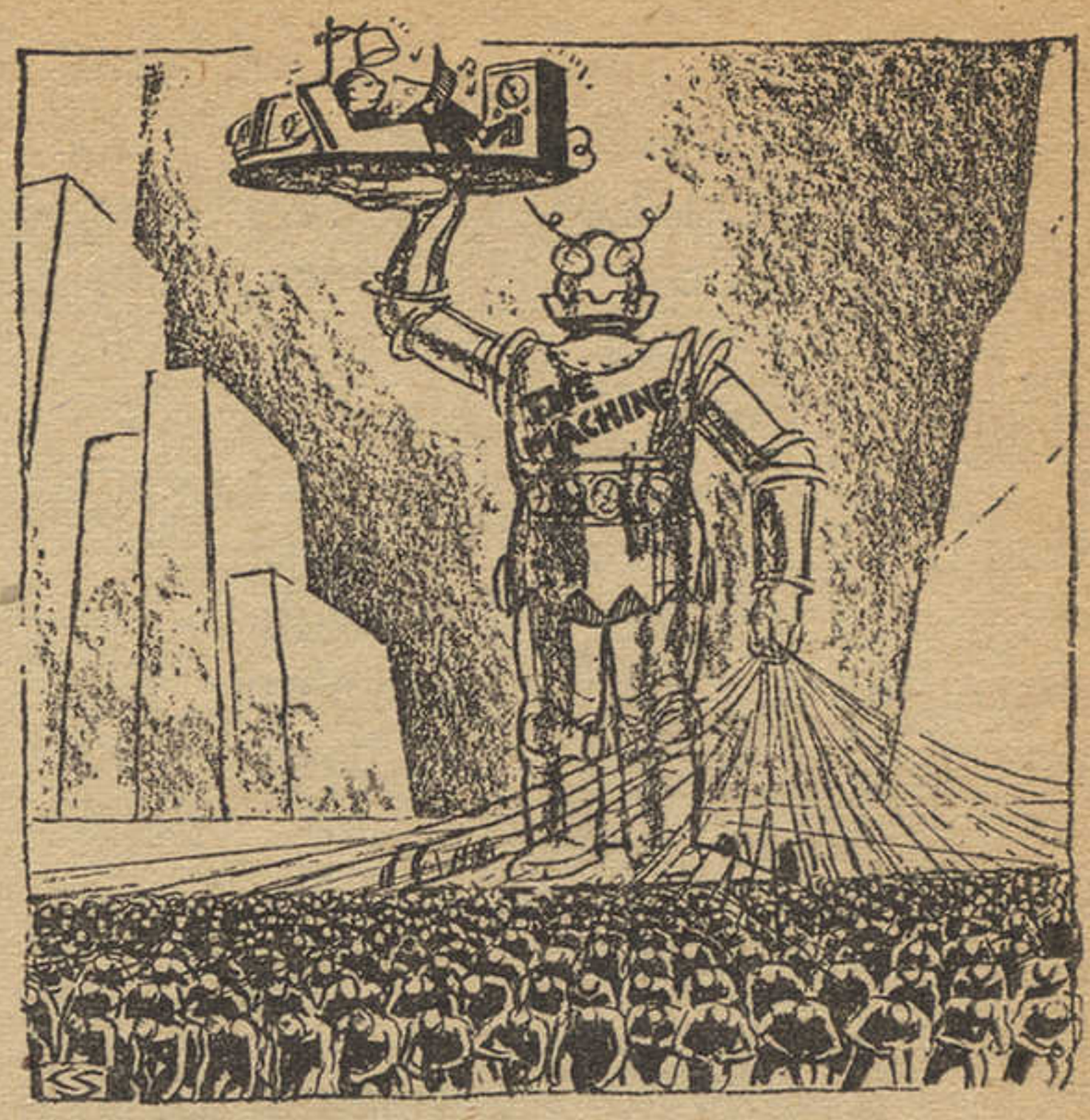
On Spengler's calendar, we Westerners ought to be near Labor Day. We are due for our dose of a despotic, society-wide "Imperium" about 2000 A. D. About all that is left for a creative-minded Westerner to go into are engineering and colored-

shirt politics. People will soon lose interest in science, and desire only a faith to cling to. "For us, too—the age of theory is drawing to a close." "Once the Imperial Age has arrived, there are no more political problems. People manage with the situation as it is and the powers that be." "The realm of books and problems petrifies or vanishes from memory."

There is much more, about the Apollinean Soul of Classical society, symbolized by the nude male statue; the Magian Soul of Arabian Society, symbolized by the dome; our own Faustian Soul, striving after and symbolized by infinite space, et cetera.—But type is not made of rubber.

Spengler mustered a vast amount of evidence for his cyclical theory. He was an eloquent and highly quotable writer, but a strong streak of irrationalism runs through his work. It can be argued that all his talk about our Faustian souls is encyclopedic nonsense. And his reasoning is admittedly by analogy—unsafe from a scientific standpoint. He can be classed as a pessimistic mystic, for while his theory calls for the eventual appearance of a new society to take the place of ours, he is fully occupied with the drawn-out and painful future of our own. His prediction of the victory of what Bell calls "upright ignorance and stalwart irrationality" would not give a materialist much cause for optimism; even the mystical Spengler himself seems to get little pleasure out of it.

ANOTHER pessimistic mystic is Arnold J. Toynbee of the Royal Institute of International Affairs, author of "A Study in History." He is the most erudite, and perhaps one of the most humane and reasonable, of the "Cause and Cure" experts we have met yet.



Some view man's machine slaves with alarm, some view man's slavery to the machine. And some just view it—

He defines civilizations as intelligible fields of historical study, and lists the following societies: Egyptiac, Sumeric, Babylonic, Hittite, Minoan, Sinic (early Chinese), Far Eastern (late Chinese plus Korean and Japanese), Indic (early Indian), Hindu (late Indian), Hellenic, Orthodox Christian (Byzantium plus an offshoot in Russia), Syriac, Arabic, Iranic, Western, Mayan, Yucatec, Mexic, Andean. Spengler's Babylonian is his Sumeric plus Babylonic plus Hittite. Spengler's Classical is his Hellenic plus Byzantium. Spengler's Arabian is his Syriac plus Arabic plus Iranic, the last two of which have merged into a single Islamic society. And Spengler's Mexican is obviously his Mayan plus Yucatec plus Mexic.

The societies still living are the Far Eastern, Hindu, Islamic, and Orthodox Christian, plus the Western, which is today rapidly absorbing all the others. There is also a fossil of the Syriac, comprising the Monophyte Christians of the Near East and the Orthodox Jews, and a fossil

of the Indic comprising the Buddhists of Mongolia, Tibet, and Siam.

The typical history of a civilization is as follows: It arises when a group of people meet a challenge severe enough to stimulate them without being so severe as to crush them. Example: The challenge of migration to Iceland stimulated the Scandinavians to develop their promising Icelandic culture; when some went on to Greenland the challenge was too severe, and the Greenland colony failed.

During growth, the civilization radiates its influence among neighboring peoples, who are drawn into its orbit by its attractiveness and advantages.—Creative minorities set the pace for the rest.

Growth can continue as long as the civilization, or its creative minority, continues to meet successive challenges. But institutions and techniques that worked very well once may fail when applied to new conditions—though their possessors are likely to continue idolizing them nevertheless. When a challenge is not met, trouble begins. It is likely to take the form of a "Time of Troubles," wherein the States comprising the civilization fight until one knocks out and conquers all the others. (Example: the wars of Hellenic society, 431-31 B. C.) Often it is a unit on the periphery, the "backwoodsmen," who are enabled to beat the others by the practice they have had in fighting the surrounding barbarians. (Timur was an example of this in Iranic society.)

The winning contestant establishes a Universal State. (Examples: the Roman Empire, the Tokugawa Shogunate in Japan.) People by then have become so sick of war that they welcome, or at least put up with, a Universal State, even one of alien origin. The Syriac civilization had a succession of universal States established by the Persians, the Macedonians, the Romans, and the Arabs, before its final dissolution during the Turkish and Mongol invasions of 1000-1300 A. D. The Universal State of Orthodox Christian society was the empire of the Osmanli (Ottoman) Turks. The Hindu society has had two such: of the Turks—the Mogul Empire—and of the British.

The Universal State tends to become a despotism tempered by assassination, with occasional relapses into anarchy. The Creative Minority becomes a Dominant Minority which merely holds down the lid. The rest of the population becomes an Internal Proletariat, with no stake in their civilization and no love for their masters. The surrounding barbarians become an External Proletariat, exploited by the Dominant Minority, and eventually rising against them in a *Völkerwanderung* (tribal migration). The Universal State may expand while declining, conscripting surrounding people into its Internal Proletariat by *force majeure*.

It still radiates cultural influence, but principally in the military field, so that the barbarians improve their fighting technique until they can meet the Imperial troops on an even footing. Often the Universal State hires them as mercenaries, giving them free training in advanced warfare and opportunity to bore from within.

Thus we have Stilicho and Aëtius in the West Roman Empire, barbarian soldiers turned politician who work themselves up to high office. After them come Ricimer and Odovakar, who make and unmake puppet emperors. Then comes Theoderik, with the ambiguous positions

of Imperial general and leader of a barbarian war band, who seizes a piece of the Universal State, not to destroy it, but to exploit and defend it. Finally Alboin the Lombard sets up a real barbarian successor State on the ruins.

Symptoms of the decline of a civilization are archaism (revival of antique customs and institutions); hostility between the Dominant Minority and the Internal Proletariat; a sense of sin that finds expression in ascetic religion. The last may give rise to a Universal Church spreading first through the Internal Proletariat and thence into the Dominant Minority (Christianity in Hellenic society; Islam in Syriac; Hinduism in Indic). The Universal Church may serve as a chrysalis for the new civilization which will arise on the ruins of the old.

When the Universal State has been dismembered, the barbarian war bands set up successor States—usually short-lived—on its ruins. There follows an "interregnum," a period of bloody disorder that will be known long after as a "heroic age." Its main product is epic poetry of the Homeric type. (Examples: the Sanskrit and Irish epics.) This poetry has practically nothing to do with history. For instance, the poetic cycle of Dietrich von Bern shows practically no resemblance to the life of the man on whom it is based, Theoderik the Great. It does not mention the Roman Empire, which is rather like a life of George Washington that did not mention the British.

This entire cycle may not be followed. A civilization may be absorbed into a stronger one, as the Arabic has been absorbed into the Iranic. Or it may be cut short by military destruction, as were the Andean and Minoan. The decline of a Universal State may be drawn out by a succession of rallies. Or it may reach a static phase which it maintains for many centuries with little visible change, as did the Egyptian.

Toynbee suggests that we may now be in the "Time of Troubles" of Western civilization, which began in the Wars of Religion, died down, and has broken out again in the Wars of Nationalism. With true scientific caution he refrains from pushing his analogies too far. The one thing that is certain is that we have not yet got our Universal State, though Napoleon's Empire might be considered a preliminary attempt, as Alexander's was in Hellenic society.

Anyway, Toynbee does not like the present state of Western society, which, he says, is in a "wintry age." This dislike seems due almost as much to its materialistic, irreligious tendencies as to its warlike ones. He suggests the possibility of a Universal State consisting of a scientific despotism which, once established, would continue indefinitely, as there would be no more warlike barbarians left to overthrow it.

THE ANSWER to that is given by the small school of pessimistic materialists. Unfortunately these people are few in number, and are not as a rule full-time whitherers. One of them is the English archeologist and detective-story writer Stanley Casson—"Progress and Catastrophe"—who points out ominous parallels between our situation and that of people before each of the two great previous European interregna, 1100-600 B. C. and 500-1000 A. D. It will not be necessary to go to Africa or the upper Amazon for barbarians; we are producing a crop of quite effective ones at home.

Others, such as E. T. Bell and Jose Ortega y Gasset, claim that,

despite the manifest benefits of science to the average man, he shows little inclination to support it financially or politically. Rather, he suspects and dislikes the type of skeptical, empirical, materialistic thought on which its progress depends. So they fear that the cult of irrationality characteristic of, say, the National Socialist leaders in Germany is the forerunner of a great wave of antiscientific reaction.

THERE REMAIN the optimistic materialists, who concentrate on man's technical development. They tend to be men of technical background, and, unlike the mystic whitherers, they actually know something about the Machine (with a capital M). (Spengler, a mystic, gives the Machine nine of the nine hundred pages of his big book.)

Lewis Mumford—"Technics and Civilization"—says that, while previous civilizations had good enough rule-of-thumb engineering to produce Roman roads and Egyptian pyramids, ours is the first to develop a distinctive logic and discipline of the Machine. It was not long in starting, either. The barbarous period of 900-1200 A. D. saw the introduction of such important inventions as the iron horseshoe, the horse collar, the lens, the windmill, and central rudder, and the magnetic compass—despite the alleged "Ideational" nature that Sorokin ascribes to this period. These inventions started the first wave of Western technical development.

Technics arose from the need of the monastery for accurate timekeeping, of the countinghouse for convenient arithmetic, of the army for knowledge of metallurgy, ballistics, and the geometry of fortification. (The answer to the last problem, descriptive geometry, was a French military secret for some years.) Europe adopted and improved all the inventions of other societies it could find. By the sixteenth and seventeenth centuries people like Sir Francis Bacon were talking about what a wonderful place the world would be once the Machine got properly started. A lot of that early optimism has gone, but the machines are certainly with us, and are beating guinea pigs at the latter's specialty.

The next wave of technics, the Paleotechnic, was started by the invention of the steam engine. The Paleotechnic period (1750-date) saw great technical advances. But it was characterized by waste of resources and degradation of living conditions. The next period, the Neotechnic, is just getting started. It is characterized by electric power, and has great possibilities for giving people pleasant living conditions. The main obstacles to its blossoming is our present capitalistic system, which will have to be replaced by something more equitable and efficient. So says Mr. Mumford.

This is a linear view. Technical development does contain elements that make such a view plausible. Burlingame—"March of the Iron Men"—points out that once the printing press is established, a serious recession in technics is hard to conceive. With so many thousands of copies of technical books lying around, it would be hard to get rid of them all short of blowing up the planet.

Moreover, organized science introduces a new dynamic factor into social development. Toynbee worries about the possibility of an eternal and unchanging scientific despotism. It seems to me that, as long as scientific work is being done, it is likely at any time to erupt some new dis-

covery like ectogenesis—test-tube babies—which will drastically affect people's lives. The result might be better or it might be worse, but it would certainly be different.

THE "Cause and Cure" experts remind one of a lot of men looking at those groups of colored spots used for color-blindness tests, and all seeing different patterns. The trouble seems to be that the spots are so many that by looking long enough one can find almost any pattern. Under these conditions, reading one's private prejudices into the data is almost inevitable.

The test of a science is its ability to predict—either in the sense of "such-and-such will happen at noon next Tuesday," or "if you do A, B will happen 943 times out of a thousand." The record of the science of whithering's prophecies, what there is of it, is not encouraging so far.

A century ago in America, such intelligent men as Clay, Calhoun, and Webster knew the slavery issue. But only one man, John Quincy Adams, is known to have foreseen the Civil War. He, not wanting people to think him mad, prudently confined his prophecy to his diary. Before the War of 1914, all the experts, professional and amateur, were wrong about its course—with one exception again. A Polish banker named Bloch alone foresaw the trench-warfare stalemate that would ultimately be decided by famine. And neither Adams nor Bloch, as far as we know, wore any halo to enable their contemporaries to pick them out as the true prophets.

WITH THESE reservations, let us see whether we can find any common denominator among the whitherers' ideas. I warn you that, despite the bad record of previous whitherers, I am going to insert a few ideas of my own.

A lot of them agree that Western culture is in a precarious fix. These people mostly hold the cyclic conception of history. If the cycle is as grimly inevitable as some of them think, we might as well relax.

But consider these possible alternatives: (a) Societies may evolve in a linear manner on the technical plane, but in a cyclic manner on the social plane. (b) Societies may have behaved in a cyclic fashion until the Machine introduced such a powerful new linear factor as to start us off on a new course of historical development. (c) Instead of our living near the end of the cycle, or at the beginning of the decline, of Western culture, this culture may be already disappearing down the gullet of a new culture, the Industrial, which is at the beginning of *its* cycle.

I should say that (b) looks the most probable. There are reasons for believing that machine technology has broken whatever cyclical series existed, largely because people seem to remember and profit by experience in technical development much more than they do in political and social development. This in turn, I should say, was not due to shortcomings on the part of people so much as to the fact that most of the lessons of technical experience are written in much plainer language. A properly designed rudder will always steer a boat, but a "properly" chosen statesman may, for no visible reason, turn into a bloody tyrant.

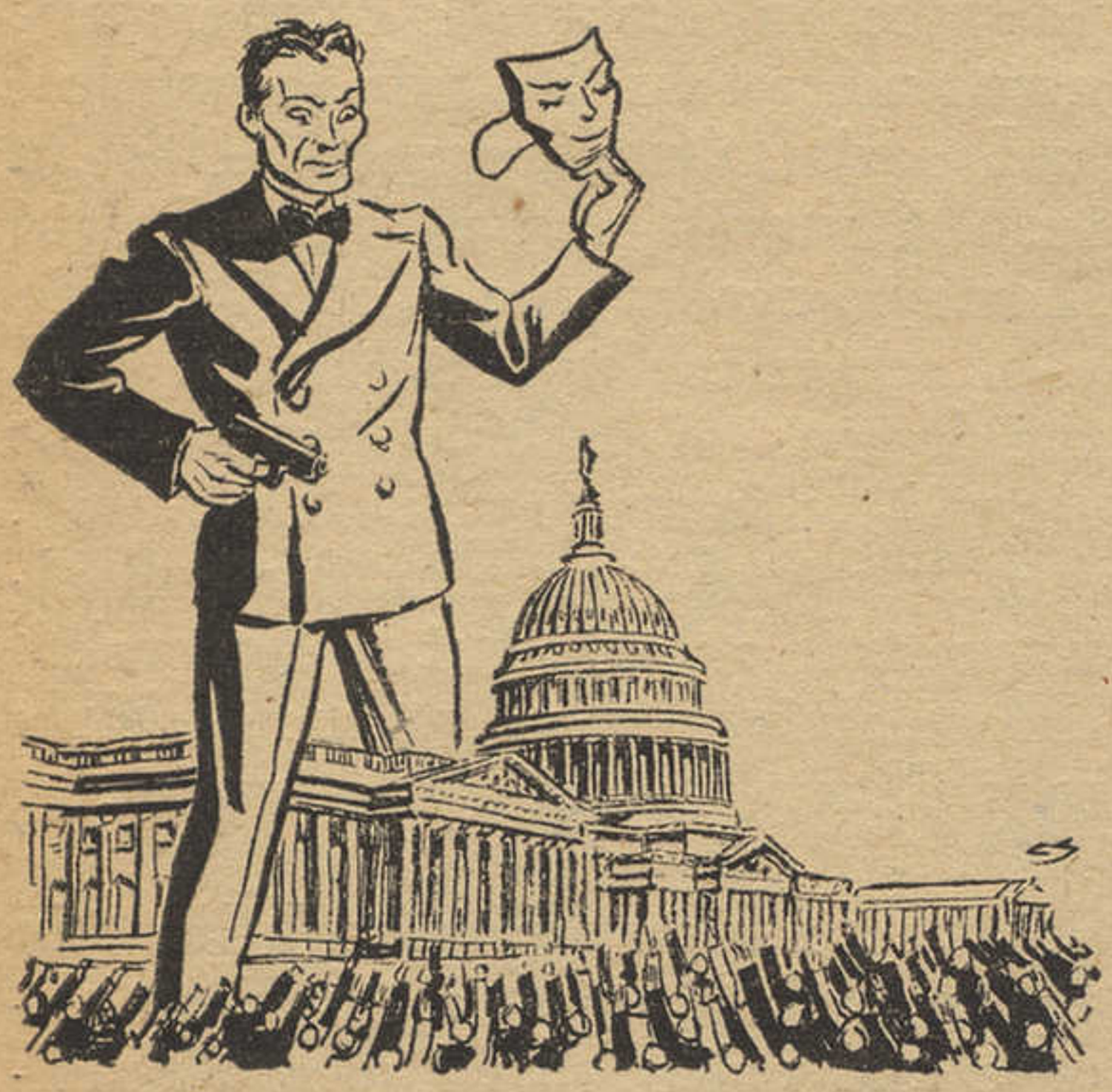
QUITE a few whitherers believe in an impending swing away from science and materialism toward religiosity and mysticism. This belief is supported by the recent efforts to squeeze science into the mold of a political dogma, especially in Ger-

many and Russia. The success of such moves would certainly handicap or halt progress in those fields. But they might or might not prove the start of a world-wide movement. After all the Church did to Gallileo, we have still come around to believing that Jupiter has moons.

Possibilities: (a) Men may require hope of some sort of heaven and/or fear of some sort of hell to make them behave, whether or not such things exist. (b) Men may have a deep-rooted desire for a faith in which they can irrationally believe, regardless of whether such a belief is either necessary for their welfare or true.

Personally, I consider both propositions possible but improbable. *If* (a) is true, the loss of religion may result in the kind of ruthless, tricky struggle of everyone against everyone else that Spengler calls Cæsarism. But such a state of affairs has existed before in quite pious communities, so religious faith, whatever its virtues, seems inadequate to prevent it, anyway. If (b) is true, and if science finally leaves the churches no ground to stand on but a vague benevolence, we might see this alleged urge appear in the form of political or economic fanaticisms.

To illustrate: Since Communists consider their outlook scientific, they would call a triumph of Communism a victory for science. But to an empiricist it would look more like the triumph of a religion of a newfangled, politico-economic kind. If Marxism is not a religion in a strict sense, the outlook and tactics of the Marxists look suspiciously like those of the early leaders of Protestantism and Islam.



Benevolent despotism is a wonderful thing—while it's benevolent. Trouble is, it's apt to change from "benevolent" to "fanatic"!

Several whitherers foresee the growth of the size of governmental units, in many cases until the world is under one single government. There seems to have been a tendency for some centuries for the larger States to swallow the smaller. This tendency has been interrupted at times, the last time after the War of 1914. But it now seems to have resumed its course. As far as one can tell, large States are, on the average, neither more nor less efficient, honest, humane, democratic, et cetera, than small. But they *do* have greater manpower, and, other things being equal, greater strength.

Toynbee points out that a civilization often springs up with a group of little States, and that under its influence a set of great powers grow up around the margin which eventually swallow the little States. Thus we have Macedonia, Carthage, and Rome growing up around the Greek patchwork, and the powers of Europe growing up around the medieval Italian patchwork. There may be a parallel with growth of the British Empire, the United States, and the U. S. S. R. on the fringes of subdivided Europe.

A world State does not seem impossible eventually, though as yet the components seem pretty heterogeneous for world-union material. It would probably give us a peaceful world—at least most of the time. But the type of government at the top might or might not be the kind we'd like. It might be a predatory tyranny. As Spengler remarks: "—world peace—which has often existed in fact—involves the private renunciation of war on the part of the immense majority, but along with this it involves an unavowed readiness to submit to being the booty of others who do *not* renounce it."

FOR THE prevailing form of future governments—whether world-State or parochial-State—lots of people have made assertions, but McKinley's theory of connection between the technique of war and the form of government seems to me like the only one with a factual basis.

We may consider some tendencies on the part of human beings that seem to be well established:

(a) People having a community of interest, and means of getting together, sooner or later combine to make their common interest effective. That's one of the ways you know that men are more intelligent than other animals. It follows that the free-trade, open-market, free-competition ideal of Adam Smith and his successors seems unattainable; or, if imposed from above, would likely prove unstable in practice. Sooner or later the businessmen would get together to force wages down and prices up, to raise tariffs, et cetera. The workingmen would get together to force wages up, to prevent immigration of persons who would compete with them, et cetera. Each would, of course, accuse the other of doing very wicked things. But the fact is that groups *will* organize, and unless other groups keep them in check they will proceed from the defense of what they consider their "rights" to the suppression of the "rights" of everyone else. But any representative government is, inherently, not a power in its own right, but an instrument for whose control the various interested groups wrestle. The spectacle distresses some people. But when the wrestling ceases, the meaning is not that all the groups are now working in harmony, but that one of them has gotten exclusive control of the instrument, and the others are out of luck.

(b) No really large group of people can all take part in the running of their common affairs. So there has to be delegation of power. Hence there is really no such thing as the dictatorship of a class. There may be dictatorship of a small group of executives within a class, the rest of the class retaining a greater or less degree of control over them. The ruled will in general retain just as much control over their rulers as they are both anxious and able to. When scientists learn to grow pussy cats on pine trees, then maybe it will be possible to trust a ruler with irresponsible power without his using it to reward his friends, suppress his enemies, and perpetuate and aggrandize his own position.

Incidentally, there is no reason to suppose that (a) we shall ever be governed by a soviet of engineers or scientists, or (b) that such an arrangement would be any more satisfactory to the governed than any other form of irresponsible rule. Scientists and politicians are both merely human beings, some good, some bad, and the majority indifferent. Each occupation is a full-time

job requiring certain special abilities. The qualities that make for political success under a responsible government differ somewhat from the corresponding qualities under an irresponsible one; oratory is more important in the first and skill at intrigue in the second. But neither quality is one for which scientists, as a class, are noted. And the mental equipment of a good scientist might well prove a hopeless handicap in a political career.

TECHNICAL development seems likely to go on at a swift pace for as far ahead as we can see. Note that, whereas some of the earlier theorists thought a degree of mechanization as high as ours would surely abolish poverty, we still have plenty of that. A possible clue to the reason is the little-noted fact that most of our technical developments have taken place in the field of pleasing but nonessential gadgets, while the production of food, clothing, and shelter, although somewhat improved during the last few centuries, is still relatively primitive. Hence a man with a low income, having to spend nearly as much on the necessities of life as he would have a century ago, has little margin left over for the enjoyment of all our wonderful nonessential improvements. Today we see the first stirring of what may turn out to be revolutions in the production of food and houses. Until such a change occurs, we had better not count on an era of plenty for everybody.

Another mistake we may make is in assuming that technical development will continue in all fields at a headlong pace forever. There will be discoveries in some field or other as long as there are men on Earth, perhaps. But it is not inconceivable that, at least in fields of applied science such as automotive engineering, progress may not eventually slow up to a dawdle as design approaches the maximum possible efficiency and comfort. Of course, such an idea is heresy in modern scientific circles. The example is pointed out of the Patent Office official who resigned, back in the last century, because he was convinced that all the important inventions had already been made. But remember that until a few centuries ago, men lived in a world that changed so slowly that they believed it did not and would not change at all, ever. They were wrong. If we, simply because we live in a changing world, assume that change will continue forever, we may be making the same mistake in another form.

THESE SUGGESTIONS of mine about the future don't pretend to be more than guesses; too many other whitherers have come to grief with confident predictions for me to care to imitate them. I am willing to prophesy confidently that for many years to come American men will wear pants and speak English. But that's about all; for detailed prophecies about the future of Western civilization, the data simply don't exist.

Perhaps time will give us enough extra information to build an exact science of whithering. If we are on the threshold of a single long-lived world-civilization, we may never solve the problem of the rise and fall of societies, because the number of specimens available—as Spengler's eleven or Toynbee's nineteen—is too small for effective statistical treatment.

Meanwhile, let us encourage the fascinating study of whithering, in the hope that it will grow up from its present embryonic state into a big, healthy science. Until it does,

we must, as far as the future is concerned, agree with the late Justice Holmes that "we are private soldiers in an army, and the plan of campaign, if there is a plan, has not been confided to us."

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L. S. DE C.

THE END.

The tank shuddered to a stop at the brim of that frightful, unscalable chasm. And down there was the only hope of life—

CLERICAL ERROR

By Clifford D. Simak

It's easy for a shipping clerk on comfortable Earth to make a minor error—but God help the boys on Jupiter when that wrong shipment comes through!

Illustrated by W. A. Koll

FRED FRANKLIN knew, better than any of the rest, that death was closing in on them. But he wasn't scared. He was just hopping mad—sore clean through because those beautiful engines of his down in the Hive's sub-floor wouldn't run much longer.

Fred lived for his engines. He liked the swift, smooth hum of power, the blurring whirl of alternators, the exact meshing of whirring gears.

His great, grease-stained hands twitched—as if they were groping for someone's throat.

"If I could just get my hands on that guy back on Earth," he bellowed.

"Whoever he was, he'll probably get canned," said Bill Vickers. "Some shipping clerk, perhaps. A mistake the inspectors should have caught."

"Sure," growled Fred, "the shipping clerk'll get canned. We'll die."

Vickers looked at the atomic engineer soberly. "Just how much longer can you keep them going, Fred?"

The engineer exploded. "You ask me that? I'll tell you this—I'll keep them going until the combustion chamber goes up in smoke, and when that happens we don't need to worry any more."

Vickers shivered, envisioning what would happen when that occurred—if it did occur. He could see the force of uncontrolled atomic power lashing through the engine rooms, ripping through the entire dome.

"The *mercotite* is wearing thin," said Fred. "Too damn thin for safety. If we keep that blast chamber going, we have to have *mercotite*—the *mercotite* that should have been in those boxes and wasn't."

He spat bitterly.

"Copper! What the hell would we want of copper?"

"I've called in all the tractors," said Vickers. "All of them have reported except old Cal Osborn, and he was drunk the last time I talked to him. Maybe he'll show up after a while. As fast as those tractors come in you rip out the *mercotite* in their combustion chambers, use it to patch up and strengthen the big chamber. I know it won't go far, but it will help. Every minute we keep those engines going, every minute we keep juice pouring into these walls is just that much longer for us to live. When those engines stop, we stop, too. We all know that."

"You've called in the men?" asked Dr. Norman Lester. "Does that mean you've given up finding the ship?"

Vickers swung around to face the gray-haired man.

"No," he snapped. "We have to call those tractors in to get *merco-*

tite. But we aren't giving up the search. I'm going out myself, and I'm coming back with the *mercotite* the *Jovian Ark* was carrying or I don't come back at all. Benny here claims the ship was coming in over Mount Bellow when the signals cut off. It must have struck somewhere over on the other side."

"That's right," said Benny Kern, the radio man. "She was coming in just north of us, still pretty high up, and having a bad time in the storm. Reception wasn't so good, but I was dragging her in. She was riding the directional beam, although it must have been pretty spotty. The sky was full of lightning."

"All very pretty," said Dr. Lester, "but not very convincing. The men who were out searching combed that mountain. How do you figure you'll find anything when they didn't?"

"Look here," snarled Fred, "you keep out of this. A hell of a lot you've done. We tried to get you to help develop a substitute for *mercotite.* All the scientific equipment in the world, all the metal on Jupiter, and what did you do? Not one damn thing."

"I'm a biologist," said Lester, "and I don't know a thing about metals. Neither do my men."

"If it hadn't been for the storm," said Vickers, "we would be all set. The rotors were ready to operate, but the wind twisted them into scrap metal—"

ONE EXPECTS a two-hundred-mile-an-hour wind on Jupiter. It is just an everyday affair—a gentle breeze that eddies and whirls about the giant planet. It doesn't really get gusty until the wind starts blowing at five hundred miles an hour. When it gets up over the thousand-mile-an-hour mark, it might be called a gale. Beyond that it would be a storm.

Jupiter's atmosphere is thick and heavy, composed of nitrogen and hydrogen—mostly hydrogen—and of a souplike consistency. At two hundred miles an hour such an atmosphere would turn mighty rotors, be the source of tremendous power, power such as was needed to maintain the Hive under the ghastly pressures on Jupiter's surface. But at a thousand miles an hour, it would simply smash rotors into junk heaps. That was what had happened.

The Hive had been built five years before by the first spaceships ever to reach the surface of the Solar System's largest member.

It had been built by robots, operated from the ships by remote control. For while man might build on Jupiter and live on Jupiter, and even, in time to come, conquer Jupiter, man never would be able to walk on Jupiter, never would dare to venture out on solid ground.

The gravity wasn't so bad. Only two and one half times Earth gravity. Bad enough, but possible to fit men for it in Earth's conditioning chambers.

But the pressure was something else. Pressure that would make earthly sea-bottom pressure seem almost like a vacuum. Pressure that would turn even steel brittle and shatter it into a million flaky shards.

Men had lived on Jupiter for five years now, but in all that time no man had ever set foot upon the planet, had ever viewed its surface with the naked eye.

The Hive was constructed of an inner shell of durasteel, the toughest, most stubborn alloy man had ever devised, and yet, in itself, not capable of standing up under the weight of Jupiter's vast atmosphere.

Stepping up of the durasteel's

electronic tension had made it possible to construct the dome. But to maintain that electronic tension tremendous power was needed—power such as only could be supplied by bursting atoms, or the winds of Jupiter's own atmosphere.

Over the shell of durasteel was fused another shell of quartz, this to protect the alloy against the alkaline rains that poured almost continuously from the heavy clouds.

The same construction applied to the spaceships which ventured down to Jupiter's surface, to the tractors that carried men over its surface, to the scurrying mechanisms, the robots that serve as men's hands on the Solar System's weirdest planet.

No mere haphazard adventure had led men to brave the dangers of Jupiter, but stark necessity. The establishment of the Hive had been almost in the nature of a last desperate effort—a final fling of the dice that might spell life or death for every living thing upon the planets.

For out beyond Jupiter's dense atmosphere stalked a plague, a deadly plague that defied all medicines. It had originated on Mars, which probably explained the fact the first men to reach that planet had found no trace of life but ample evidence life had existed in the past.

For years that deadly germ had lain in wait, and with the coming of man had sprung to life again. From Mars it had gone to Earth, carried there in spaceships, in the bodies of its victims. From Earth to Venus and Mercury, to the few inhabited asteroids. A plague that swept the worlds, that fastened not alone on man, but on every living thing, threatening the extinction of all life.

Frantic research netted exactly nothing. The germ was isolated and recognized, but defied every attempt at control.

In desperation, overlooking no possibility of checking the plague's advance, a Jupiter expedition had been fitted out. For on Jupiter, it was said, one would find a completely alien chemistry—a chemistry that might give some clue, might lead to some method that would stop the plague.

The first expedition failed, one lone ship winning its way back to the Earth. The second expedition failed. But the third, profiting from the tragedies of the other two, won its way through, built the Hive, installed in it the machinery necessary for life.

A fourth expedition brought the chemists and biologists.

Three years of fruitless effort followed.

Jupiter's chemistry *was* alien, there was no doubt of that. So alien, in fact, the research staff took months to orient itself.

There was life on Jupiter—weird plant life, weirder animal life. Life based on ammonia and hydrogen, life that simply evaporated at pressures and temperatures normal to Earth.

Animal life was small and vicious, its metabolism the reverse of Earth-animal life, based on oxidation, foods and reducing air.

Examined microscopically, chemically, bacteriologically, spectrographically, Jupiter's life yielded many secrets—yet not the one the scientists were seeking.

But success finally came. In the gland of one small animal—dubbed the rooter because of its manner of getting food—was found the cure for the deadly plague, and suddenly the Hive on Jupiter became the center of the Solar System's hope.

Now, two years after the discovery of the gland's properties, the fight against the plague was still go-

ing on, and the tide was turning, slowly turning, in mankind's favor. But, as was to be expected, man could extract that product of an alien metabolism—but couldn't make it.

BILL VICKERS stared at the television screen and groaned.

It was raining again, driving sheets of liquid ammonia, deathly cold, lashing against the eastern cliffs that were the lower slopes of Mount Bellow. Rain driven by the ordinary everyday wind howling along at two hundred miles an hour.

He shifted the screen's vision angle, saw the pens in which hundreds of rooters were kept. The rooters that were the hope of the Solar System, tenderly cared for, bred, raised, killed for their miraculous glands.

A half dozen robots were coming across the valley, carrying loads of the tubers which served as the rooters' food. Not the manlike kind of robots many families on Earth kept as servants, but complicated, complex machines, adapted to do the work man himself could not do—the machines that must serve as proxies for men on this outlandish planet.

"Fred," said Bill, "when the Hive goes it means the lives of millions of people out on those other planets. It will set back the fight against the plague a good five years. They'll have to build another Hive. They'll have to round up a new rooter stock."

"And all," said the engineer bitterly, "because some muddle-headed clerk sent out copper instead of *mercotite*."

Bill nodded.

He could remember that day, weeks before, when they had ripped open the boxes to get a new supply of *mercotite* to reline the atomic combustion chamber. Box after box—all copper, no *mercotite*.

Mercotite—a wondrous metal, found only on the sunward side of the planet Mercury. The only metal known that would stand up under the blast of disintegrating atoms. Without *mercotite*, one could not control atomic power—and without controlled atomic power, the Hive was doomed. Once stop the flow of energy into the durasteel walls and the dome would be shattered by the pressure.

Somewhere out there on the other side of Mount Bellow lay the *Jovian Ark*, carrying a new supply of *mercotite*. Out there on the rim of the valley, also wrecked by the same storm which had wrecked the spaceship, lay the twisted rotors, set up after long weeks of work in the hope they would supply sufficient power to maintain the dome in case the ship failed to arrive on time.

"I got enough metal out of the tractors to patch the chamber up some," said Fred, "but at the best it won't hold out long. It's getting thin in places again. Let that atomic blast once hit steel and it's all up with us."

He stared at the televisor.

"Maybe we ought to pull in all the robots," he said. "Their combustion chambers are pretty small, but we could get some metal out of them."

"Pull in all you want," said Vickers. "I'm going out and have a shot at finding the *Ark*, but I guess Doc Lester is right. There isn't much chance of my finding it when all the others failed."

"Any word from Old Cal?" asked Fred.

Vickers shook his head. "He was blind drunk when he called in last time. He has a stock of liquor cached somewhere and slips out with a bottle every once in a while. It's

a wonder he hasn't killed himself a dozen times. Out wandering around with a tractor, carrying a bellyful of rotgut."

Benny Kern stuck his head out of the radio room.

"Call for you," he shouted. "Old Cal."

Vickers' thumb tripped a tumbler on the panel set in his desk. The vision screen flickered for a moment, synchronizing. Then the face of Old Cal Osborn stared out at him.

"Hi, kid," yelped Cal. "How are you? Have a drink on me."

He waved a bottle aloft, took a gusty drink and wiped his mouth.

"Where are you?" Vickers raged. "Didn't you get my call? Why didn't you come in?"

Old Cal stared owlishly out of the screen.

"What the hell?" he said. "We're going to die, anyhow, ain't we? No *mercotite*, no power—no power, no Hive—"

He hiccupped and looked embarrassed.

"You're drunk," snapped Vickers.

"Look, sonny," Old Cal mumbled, "don't be too hard on an old man. An old bird that knows he's going to die has got to have a fling. Just one more drunk, I tells myself—just one more, so I sneaked aboard a couple gallons of the stuff. I says to myself: 'Billy Vickers won't mind, because he'll understand.' Besides—"

"Besides what?" yelled Vickers.

"Well, I found the ship."

"The ship?"

"Sure, sonny, you know the ship I mean. The *Jovian Ark*."

"You found the *Jovian Ark!*"

"That's right, but it won't do us any good. Not one damned bit of good, sonny. Because, you see, it's at the bottom of a canyon. All smashed to hell and you can't get to it."

Vickers smashed the top of his desk a blow with his fist.

"I don't care where it is," he shouted. "Just so we've found it. We'll reach it somehow!"

VICKERS drove savagely. In the television screen set in front of the controls he saw his fog lamps cutting deep swaths of light into the fury of the slashing, howling elements.

The liquid ammonia rain, whipped by the shrieking wind, was a blinding maelstrom. Jagged lightning streaked across the clouds and ripped around the top of Mount Bellow. Weird vegetative formations seemed like gray ghosts in the driving rain, while ahead of the tractor rolled four metal machines, four robots to help get at the shattered *Jovian Ark*.

Scurrying gray and red things scuttled out of the path of the light. Once one of them hurled itself in a streaking charge at one of the robots, slammed hard against the metal of the machine, rolled to the ground and charged again, retreating into the dimness of the rain only after its fury had worn out.

Vicious little things. Poison mean. Intelligent, too, many of them—but just how intelligent it was almost impossible to know.

No big life on Jupiter, for big life simply couldn't live under the awful pressure. Here life had to be small and quick, life built to hug the ground.

The tractor skidded dangerously as the treads slid on smooth rock. Vickers spun the wheel, cursing. An upset now, damaging the machine, would spell the end. For this was the only tractor available. All the others had been dismantled to supply metal for patching the disintegration chamber.

But speed was necessary. The

mercotite would hold out a few more hours, and that was all.

He cursed as he thought of it—but his curses were more like a chanted prayer.

Damn this planet! Damn Jupiter! A place where a man couldn't walk on the surface, couldn't see with the naked eye. Had to crawl around in tractors. Had to use television because it was simply impossible to build vision ports that would stand up. A place where radio would operate only a few miles, and at that was erratic. No chance of talking to Earth—for no signals could reach higher than fifty miles into that seething atmosphere.

He checked his directional charts, holding his breath, hoping they were right. A man couldn't always be sure on a world like this. A world of terrible cold—120 below Centigrade—of vast pressure, of alien chemistry and metallurgy.

He could hear the roaring of the wind in the high notches and passes of Mount Bellow, the thunderous roaring that had won the peak its two names—Mount Bellow on one side of the valley, Mount Shriek on the other side.

He flipped over the radio control, yelled into the mike.

"Cal. Cal Osborn!"

The radio crackled and chortled, then Cal's ghostly voice came through.

"That you, sonny?"

"Yes, Cal. Have you found anything?"

"Not a thing," Cal replied. "I've looked her over from stem to stern, and there ain't no way of getting down. Its source is right under a cliff, and its mouth is blocked by a landslide. If we had the time we might turn heaters on her, wear it down."

"We haven't got the time," snapped Vickers. "And if we tried heaters we'd probably bring the whole mountain down on top of us."

"Boy," said Cal, "them fellows must have hit that canyon like a ton of bricks. They ironed out like a pancake."

"Listen," said Vickers. "Send your robot down on a line. See what he can do."

"O. K.," agreed Cal, "but I sure ain't fostering no hopes."

Vickers switched the radio off and gave his attention to driving.

SUDDENLY he felt lonely—lonely and hopeless. Fred would have been a good man to have along in a time like this, but Fred was needed back at the Hive, and anyway, the tractors were built for only one man. Once again the old rule that anything, to survive on Jupiter, must shun size and be shaped like a turtle.

He skirted a mighty cliff, a white, chalky cliff, composed of stuff that on Earth would have been water, but on Jupiter, because of the terrible cold, the crushing atmosphere, was a solid instead. A blue waterfall of liquid ammonia spewed over the cliff, rushing down the mountainside in a swirling torrent. The waterfall was shrouded in a steamy vapor.

The rain still slashed down. From far above came the steady howling of the boisterous wind in the passes.

Vickers flipped on the radio, tried to contact Cal, but there was no answer. Perhaps just another vagary of this giant planet. Radios at any time were poor.

Or it might be Cal had simply passed out.

Vickers spat in disgust. If only there were a real *man* over there at that canyon where the *Jovian Ark* lay shattered! A man like Fred or Eric, or any of a dozen others. But

instead the man out there was Old Cal Osborn!

The tractor nosed its way around the cliff, climbed the mountain shoulder, slipping and skidding on the slippery surfaces. Had it not been for the greater gravity, that shoulder would have been impossible to negotiate, but the tractor made it, angled downward to head up a second spur.

The radio suddenly gurgled to life, and Cal's faint voice, distorted and ghostlike, whispered at Vickers.

"Listen, lad, my robot can't do anything. He needs someone down there to work with him. He's pawing around in the wreckage, but he don't know what he's looking for."

"Can't you direct him?" snapped Vickers. "What's the matter?"

"The canyon's deep," said the ghostly voice. "Even with my spot turned on full power I can just make out the wreckage. I can't make out much. If I could just see what that doggoned robot was doing I might be able to help him get somewhere."

Vickers considered. Old Cal was right. It would be hard to see the bottom of a deep canyon. The thick atmosphere played tricks with vision, distorted it, broke up and dissipated light.

"Look, Cal," he said. "We have to get down some way. One of us has to be down there to direct that robot."

An alcoholic hiccup, a ghostly hiccup, blurted out of the radio. Then Old Cal's voice: "O. K., lad. I'll find a way."

The radio went dead. Frantically Vickers tried to raise the old man, but only silence met his efforts.

Vickers bent to his chart, figured swiftly. Only a few miles now. Just a few minutes more to get there. He barreled the tractor savagely up over the spur, turned and flung it at an incline on which the treads spun crazily. But the machine, as if driven by the fierce will of the man at its wheel, moved ahead, protesting, groaning in every beam and plate. It reached the crest of the inclined, charged, weaving and bobbing, over upended terrain.

The radio blatted hoarsely.

"I found a way," said Old Cal's voice. "Not much of a way, but maybe I can make it. A sort of trail leading down into the canyon. Looks like some bad turns and pretty narrow—"

"Wait," yelled Vickers. "Wait for me. You're drunk, you fool. You'll never make it. You'll crash."

"Who says I'm drunk?" demanded Cal. "I'm just stimulated. I'll do it better'n you could, sonny. I got —*blurp*—experience."

"Listen to me, Cal," snapped Vickers. "This is an order. You wait for me. I'm going down that trail. I have a chance to make it. You haven't."

"Your orders, mister, don't mean a tarnal damn to me," roared Cal. "Keep your radio open and keep a-coming. I'm going down into that canyon."

Vickers shouted at him, but there was no reply.

The ornery old fool! Vickers knew to a fraction how drunk he was. If he'd been walking, Cal's tracks would have been a sine wave. He'd never reach the bottom of that canyon alive.

Cal had reported before there was no way into the canyon. And now suddenly he had found a way. How did that happen? Was he sure it was a trail—not just a ledge that ran down part way and then snapped off—

He shrieked at the radio again, but only silence greeted him. He heard the hiss of rain against the

tractor's hide, the grating of the skidding treads, the screaming of the wind in the passes just above, but that was all.

IN THE fan of light ahead, the four robots looked like weird goblins, their quartz-covered bodies shining, the deep-blue rain sluicing over them. A monstrous bolt of lightning split the sky and the surrounding landscape, and their bodies were painted a bloody red. Thunder bellowed with mountain-shaking violence.

Then suddenly the tractor was dipping down into a region of upflung topographic nightmare. Fantastic formations loomed in the gray dusk of the rain.

Vickers slowed his speed, wormed his way downward cautiously. He was nearing the canyon's rim, and he couldn't take a chance of overrunning it, flinging the tractor into the depths below.

Ahead of him the robots wheeled to right and left and waited. They had reached the rim.

Vickers stopped the tractor, took readings, found he had struck the canyon too high up the mountainside. Cautiously he edged his way along its edge.

The radio howled at him, loud and clear now: "I'm down, Vickers. Who said I was drunk? And what if I am, but I ain't. The robot is going after the *mercotite*."

"Are you all right yourself, Cal?" Vickers yelled.

"Sure, kid. But hurry. Throw a line over the side and I'll send it up."

The tractor edged along, its beam flinging a spear of blinding light into the yawning depths.

That beam picked out another light far below, a crumpled mass of wreckage, a tiny form that scurried and ripped and tore at the wreckage.

Swiftly Vickers squared his tractor around. One of the robots grasped the end of the heavy cable wrapped around the drum in front of the tractor. Inside the tractor, Vickers depressed a stud that set the drum in motion.

The robot scurried forward, dropped over the edge of the rim, hanging to the cable. Another robot lowered itself over the edge, grasped the cable, rode down above the first.

"Got the first box out," reported Old Cal's voice. "Those robots just got down here. They'll help a lot."

Minutes passed, breathless minutes, that seemed to drag like eternity.

Then Old Cal's voice again. "Heave away, lad. First three boxes."

Vickers started the drum, used reverse power as an anchorage for the straining tractor. Swiftly the cable rolled in, and over the rim came three lashed metal boxes, ridden by a robot.

Down again and up again with three more boxes. And then three more. And then the final three. Twelve boxes of *mercotite!* Twelve boxes of life for the Hive and the men who lived within it! Twelve boxes of hope for the Solar System!

Old Cal's voice came again, fainter, as if from a long distance away.

"O. K., kid. Load up that stuff and hit for home. I'll be coming up in a little while, but don't wait for me."

Apprehension swept over Vickers.

"Look, Cal, are you sure you're all right?"

"Sure, everything's fine, kid." A long pause and then: "Listen, lad, something I want to tell you—something important. Still got a bottle of good Scotch hid out at the Hive."

There was a longer pause, and when the voice came it was scarcely more than a whisper.

"Up in the room next to the radio shack. No one goes there. Good place to hide it!"

"Cal!" shouted Vickers. "Cal, I can hardly hear you. What's the matter, old man? What's the trouble?"

The whisper, even fainter, was jerky, tremulous: "Maybe you'll want to drink a toast or something."

"Cal!" Vickers yelled. "Cal, answer me!"

But there was no answer. Just the wind screeching in the passes, the growl of thunder in the distant ranges, the hammer of the rain against the tractor's sides.

SAVAGELY, fearfully, Vickers leaped at the controls, swung the machine around, hugging the rim, sweeping the walls with his beam.

Then he saw what he was looking for. A broad ledge, angling sharply downward, starting at the lip of the canyon and reaching far into the depths. But a ledge that cut off before reaching the bottom, a ledge that opened off on empty space. And directly below that blind, blank end lay the pile of wreckage that had been the *Jovian Ark*.

Down there, too, was another pile of wreckage—a pile of wreckage in which a man had lived long enough to accomplish a certain purpose. A man who had taken a chance. A chance his tractor would hold together for a few minutes after that plunge into the canyon. A chance that he himself would not be killed outright.

Vickers cursed softly to himself. He knew to a fraction how drunk Old Cal had been. He was just drunk enough to wabble like a cyclone when he walked, and, being of the breed that started exploring planets when planetary exploration started, he'd been driving explorer tractors the major portion of his lifetime, drunk and sober. He might wabble when he walked, but he'd still drive straighter than most sober men.

And he was just drunk enough to be highly incensed at the suggestion he was drunk, and absolutely determined to prove he wasn't drunk. And, of course, to have lost his sense of judgment. Only a nitwit would-be hero or a thorough and consistent souse like Cal would have thought for an instant that a tractor driven off that ledge, under Jupiter's gravity, would hold together long enough. The blasted machine should, by rights, have opened out like a dropped melon. Instead, the quartz protective layer had simply shattered off, leaving the metal to go a little later as the hydrogen of the atmosphere turned it into sugary-brittle iron hydride.

"Cal, you damned, drunken fool to do—"

The wind swooped down into the canyon, across its lip, and heaved a few hundred tons of ammonia rain on the wreckage with a howl of rage. The wreckage of the *Jovian Ark* didn't change; that was already completely flattened. The shape of the tractor over there, however, suddenly slumped a bit more, and abruptly turned a very deep and lovely blue in the glare of Vickers' lights. The ammonia had gotten into the copper wiring and was washing it out.

Vickers started back for the Hive. "We'll drink a toast," he growled, "but it will *not* be a toast to the *mercotite*. It'll be a toast to a shipping clerk, a little grounded shipping clerk back on Earth—and his speedy and very complete damnation."

SHHHHH—DON'T MENTION IT!

By Arthur McCann

Being an article on atomic power possibilities as they now appear—and on the sucker-bait possibilities certainly present! Moral: don't buy Uranium-bricks—don't sell coal and oil short!*

In practically every Sunday newspaper in the country, a couple of months back, there was an article on atomic power. In about as many Monday morning papers there was a follow-up article that did everything but retract the glowing accounts of the nearness and simplicity of atomic power in Sunday's papers.

There was, of course, a reason—and it was not because there had been serious misstatements of fact in the earlier, and more enthusiastic, article. It wasn't physics that was wrong; it was psychology and human nature. That first article had been something of a nation-wide, wide-open invitation to all sellers of blue-sky real estate, phony stock schemes, and gold-brick manufacturers to step in and clean up. It sounded as though someone next door could, tomorrow, produce an atomic power engine worth millions to the early birds that jumped on the band wagon before it turned Prosperity Corner. The professional sucker—or perhaps one should say the professional sucker-hunter's favorite—is usually unalterably convinced that all really great inventions are made by a guy in a garret, but are apt to get stolen for lack of financial backing.

Hence all that's needed is to find him before the invention's stolen, and finance him to make millions. Many men make a life work of furthering this belief and collecting on it. Nobody, generally speaking, collects on "inventions" so financed.

That honestly enthusiastic article on atomic power was a too-perfect set-up for the professional fool-and-his-money separaters. In the interests of public-welfare, therefore, a second article, retracting the emphasis and enthusiasm, but none of the facts, which had been correct in the first place, was equally widely published.

For our own interest, for those who have been mildly vaccinated against the atomic-power fever by doses of science fiction, let's try to form a balanced analysis—as seen from the viewpoint of here and now.

Basically, the recent Columbia University experiment, which gave rise to the atomic power articles, consisted of a test of the reactions of a sample of pure Uranium-235 to neutron bombardment. It was found to react as predicted. It blew up atom by atom under slow-neutron bombardment. The reaction of most physicists I've seen was a mild, "Hm-m-m, that checks." They were, seemingly, greatly surprised only at the fact that the newspaper seemed to be surprised; they'd been expecting that experiment to be performed for some months. It was an obvious point to check their

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* See Arthur McCann's letter in Science Discussions.

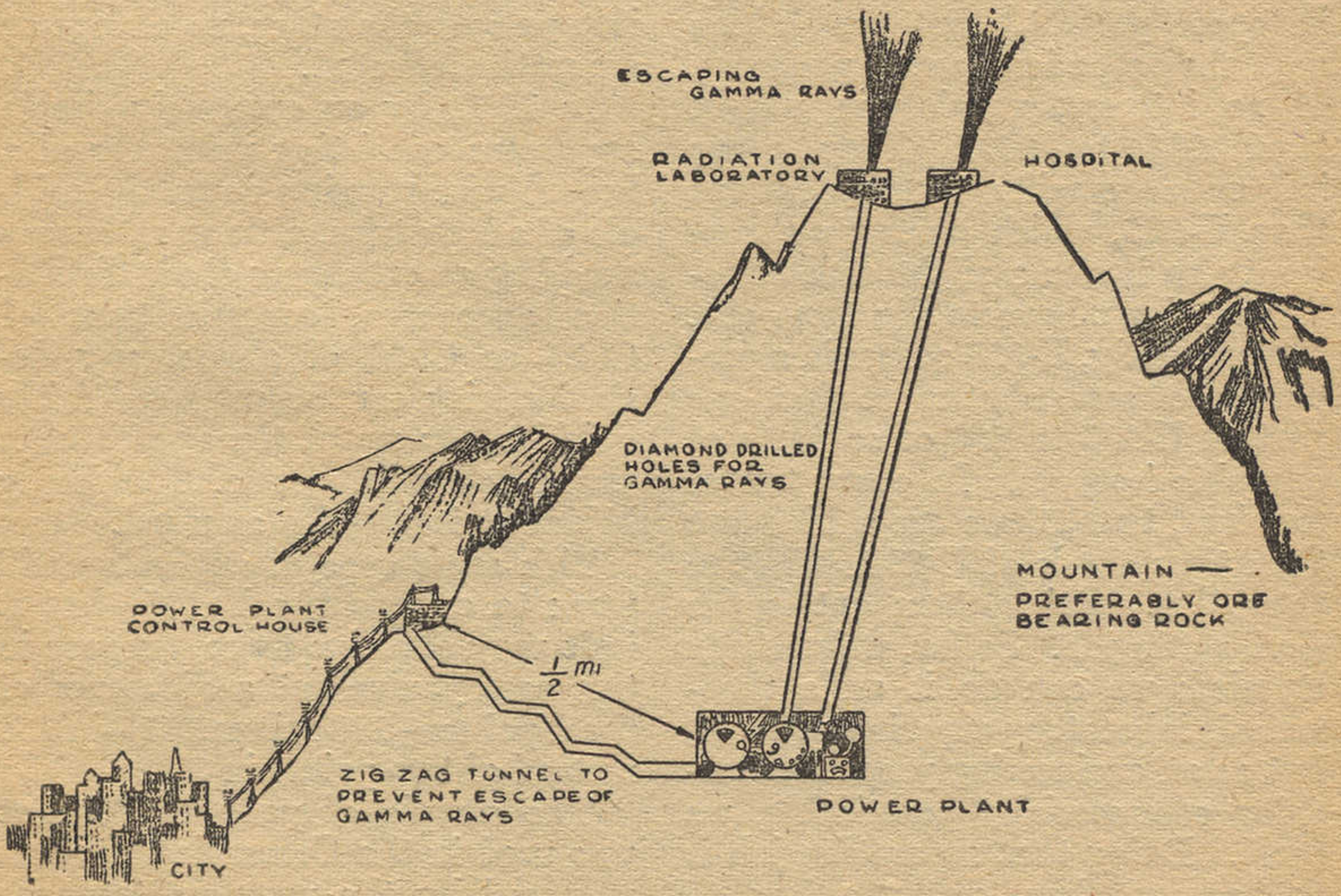
theoretical work, a job that was rather difficult, and badly needed doing, but an experiment whose answer was known beforehand.

The physicists would have been surprised—practically shocked out of their chairs—if it *hadn't* done as it did.

However, it reacted properly. That checked their theory that atoms of Uranium isotope of atomic weight 235 were explosive when bombarded with slow neutrons, but were not affected by fast neutrons, and that more high-speed neutrons were produced than low-speed neutrons were used in the desired reaction.

This makes it seem probable that a reasonably large mass of pure U-235, once started with a few neutrons, would continue to disintegrate as long as the high-velocity neutrons produced were slowed down and returned to it, as by surrounding the uranium with a water bath, where the hydrogen atoms would slow down the escaping neutrons and return them. Ever-present cosmic rays normally produce a few free neutrons everywhere, at all times. Thus merely surrounding a fair-sized chunk of U-235 with plain water is the answer to the mighty secret—atomic power.

In one way, it sounds rather foolish. Given U-235, the secret of starting atomic fire is no end simpler than the secret of making ordinary fire. It took men thousands of years to find a decent way of getting a fire started. With the vastly more potent atomic fire, all you need do is drop a hunk of rock—oxide of U-235 would do as well as the pure metal—in a puddle of water. Instantly—and the word applies literally—the water in the neighbor-



Suggested location for an atomic power plant. Nature—in the form of half a mile of solid rock—supplies the shielding to stop the deadly gamma radiation that accompanies atomic burning as light accompanies normal fire.

hood bursts into steam, the rock becomes incandescent, the water rapidly boils away—and the rock becomes quiescent again. When the water is all gone, there is no longer anything to slow down the fast neutrons released, they escape without reacting with more U-235, and the action naturally stops itself.

The catch in this is evident; nobody's given or, at present, can get, any hunks of U-235 or its oxide. "To make rabbit stew: Fust citch yer rabbit."

THE rabbit hunters—for this particular variety of rabbit at least—have yet to perfect a decent trap. Uranium is not rare—see the material on that point further along. In uranium as normally found, there is a fraction of one per cent of the desired U-235; the main portion is practically all U-238. There are, however, various other isotopes present, isotopes which are, for atomic power purposes, of no interest, varying in weight from 234 to 240. They occur in even smaller concentrations than U-235, which gives us opportunity to heave a slight sigh of relief; we don't have to dig *them* out.

Apparently, U-235 occurs in a proportion of somewhat more than one part of U-235 to 200 or so parts of unusable isotopes. In every ton of uranium, then, there are a bit more than ten pounds of U-235. They're there, but getting them out is the devil's own job. So far, we're badly stymied; we can do it on a theoretical, laboratory-experiment scale, but as an engineering process, something commercially practicable, we can't. Doing that separation job is the present key—not the key to atomic power, because we have that, but the key to commercial atomic power.

Private opinion, purely personal: They'll do it within three years. If you want something safe to bet on, however, better stick to horse races.

Nevertheless, there are reasons for making such a guess. In 1930, some chemists tried separating the two isotopes of chlorine—Cl-35 and Cl-37—by advanced, highly intricate, extremely delicate distillation methods. Theoretically there should be a slight difference in the physical properties of the two isotopes, and in the compounds of the two isotopes. Working with something like HCl—where they didn't have to worry about molecules containing both isotopes, and having hybrid properties, as they would have with chlorine gas itself, which has two atoms to the molecule—they performed a tedious and careful experiment. The result confirmed the beliefs of other workers in the field; there was no concentration of one isotope over the other, no change or separation effected.

In 1940, by an extremely simple apparatus consisting primarily of a heated wire running down the middle of a long tube, a thing rather resembling an extremely crude distillation apparatus, concentrations of Cl-35 or Cl-37 of almost any desired purity can be prepared fairly quickly. As usual, the apparatus is simple as a child's game. The theory behind it isn't—also as usual.

This same type of apparatus will work to concentrate U-235—but it isn't very effective there, because in this case you've got a difference of three points—238 minus 235—in 238 instead of two points in 37.

The sample of pure U-235 that was used in the Columbia tests was prepared by the mass-spectrograph technique. Uranium was ionized, the ions driven—electrically—across a magnetic field. The magnetic force

applied was the same for both types of ions; their masses were different, so a noticeable difference in their course across the magnetic field resulted. The U-235 could be collected separately. The quantity, however, was something that not even a microchemist would have called a "sample." Somebody figured that a usable quantity could be collected in about three hundred years of steady operation, at a cost approximating the national debt.

Be it noted: The methods so far used are methods developed *by* physicists, *for* physicists. They are completely and unqualifiedly successful methods of doing what the physicist wanted to do—test isotopes. Only in the last few years has he had any desire to collect quantities of separate isotopes—and that want has, up to the present U-235 point, been slightly half-hearted.

Trouble is, there's something of a contest on. It's between the biochemists and medical people on one side, and the nuclear physicists on the other. The biochemists are using isotopes, mostly radioactive ones, in trying to find out what an organism does with a given substance, element or compound, after it gets it. For this work, they want quantities of isotopes whose properties are well and accurately known. (Naturally, they don't want unexpected and unsuspected side reactions messing up their results.) The physicists are, naturally, their source of supply—the physicists and their cyclotrons and isotope-separating methods.

The physicists don't love them. They are always coming around demanding quantities of stuff of a most uninteresting nature—its properties are already reasonably well worked out—and tying up the cyclotron which is needed for really important, new-fields work while their blasted junk gets its bombardment. And every time some physicist works out a new transmutation, a new corps of bug chasers comes howling around for a new supply. The old gang never drops out—only new ones, with additional demands on the cyclotron, show up. There are under-the-breath remarks about "—turning this into a damned factory—" Each has understandable human reaction to the problem.

But, until now, massive separation of pure, heavy-element isotopes has not been a major point in the physicists' minds. Wherefore, considering the fact that science practically invariably solves a given, set problem, known to be capable of solution, and already half-solved, in short order, I'm betting it gets answered quickly.

Basically, the question of atomic power is no longer a problem of physics; it's an engineering problem. The answer will quite likely, in consequence, come from engineering laboratories. Both General Electric and Westinghouse Electric companies, for instance, are working on different phases of nuclear research. (G. E., incidentally, is in the cyclotron-building business; they constructed the coils for M. I. T.'s cyclotron—one of the first cyclotrons to be built to be a cyclotron. Most of the earlier ones were revamped magnets originally intended for the old quenched-arc type radio transmitters. Westinghouse has built and is working with a pressure-type Van de Graff high-potential generator for nuclear research.)

Further, it's an engineering problem indeed. Let's take a step ahead; assume they have solved the problem of U-235 separation, and see what remains to be done. It's con-

ceivable that there are reactions absorbing neutrons unproductively—for instance a U-235 atom might be able to absorb a high-speed neutron after all, thus forming a hitherto unknown uranium isotope U-236 that remains stable and doesn't explode. If this should take place, the reaction wouldn't be self-sustaining. It's still possible the thing won't work; the probability is very strong it will, however.

Say it does. Then our piece of U-235 plunged into water is started off by stray cosmic rays, begins the bombardment that rapidly—nuclear reactions take hundred millionths or billionths of a second!—heats the water. Hot water molecules move fast—and neutrons colliding with fast water molecules won't be slowed enough to react with the U-235, which promptly slows the reaction to a manageable intensity.

Then all we need at first glance, seems to be a boiler tube with a lump of U-235 over which water is passed, being instantly converted to steam. More water simply means more steam, without apparent limit to rate of volatilization. U-235 is not particularly radioactive; it doesn't have a "half-life" as does radium with its 1728 years, or radioactive carbon with its twelve minutes. This disintegration of U-235 is not limited in rate by any known inherent rate-limiting factor; it's due to an external bombardment, not to an internal rearrangement of its constituent protons and neutrons as in the case of true radioactives.

The unlimited rate of disintegration is probably correct. It would convert whatever amount of water was brought near it to steam as rapidly as the water were forced in. The heating would be brought about by three factors; the disintegration of the uranium would yield high-speed neutrons, and large chunks of the original uranium atom, also moving

fast, plus quantities of hard radiation, of the general nature of X rays and gamma rays.

Naturally, since heat in matter is motion of its molecules, these fast-moving particles, colliding with water molecules, are slowed while speeding and heating the water. Incidentally; the reason why water will act to slow down neutrons so that they will react with the U-235, while the U-235 atoms themselves won't effectively slow them down enough, is due to mass and momentum factors. It works about as things in the large-scale universe do. If a fast-moving golf ball strikes a boulder, it bounces off in a new direction, but with practically all the speed it had originally, while the boulder remains unmoved. If the ball hits a pebble of about its own weight, the pebble goes flying off with about half the speed the ball originally had, while the ball is appropriately slowed due to loss of energy and momentum to the pebble.

Similarly, when a neutron collides with an enormously massive U-235 nucleus, if it's moving rapidly, it bounces without appreciably disturbing the majestic movement of the 235-times heavier uranium nucleus. If, on the other hand, it strikes a hydrogen nucleus, the hydrogen has about the same mass the neutron has, and the momentum and energy are shared between the two particles. After a few collisions of this order, the neutron has been slowed to the normal velocity of hydrogen—or water molecules. At room temperatures, or slightly above —in this case slightly means up to a bright-red heat—these velocities are low enough to permit the neutron to react with U-235. The water molecules have acquired the energy the neutron started with.

The fate of the massive atom chunks driven out from the riven uranium is more or less parallel. They have a mass of about one hundred times that of hydrogen, and are quickly brought to "rest" by collisions, whereupon they take up life as individual atoms of the particular element they now represent—barium, tellurium, whatever it may be.

HERE, however, beginneth the sad tale. Very presently, the atom chunks that have settled down so peaceably in the water surrounding the parent U-235, blast loose with secondary explosions. They start throwing off neutrons in turn, plus electrons, positrons, protons, gamma rays, or whatever seems to the particular fragment the least desirable portion of its anatomy. They're potent radioactive isotopes on their own account.

We will have to do some adding to the lump-and-tube atomic engine. First, we'll have to do something about the quantities of gamma-radiation thrown off by the U-235 in its original fission. Water isn't a good absorber, so we can add a few layers of, say, the new copper-tungsten alloy they're beginning to use to shield out the gamma radiation from radium. Gamma-stopping power increases with atomic weight and with density. Uranium, if it weren't that the darned stuff generates gamma rays of its own, would be the best of radiation-stoppers; density above nineteen—nearly twice that of lead —and the highest known atomic weight.

Copper-tungsten is, however, expensive, and we're going to need more than sample amounts to stop the radiation from that atomic reaction on a commercial scale. Lead it will probably have to be. One centimeter thickness of lead absorbs

forty per cent of the incident gamma radiation, and passes the other sixty per cent. *Nothing in the Universe is opaque to gamma rays; all substances are simply more or less murky.* Light penetrates metals only a few atomic diameters; there is no substance known which has this opacity to gamma rays, It is believed that none does or can exist. Light is a large-scale thing that cannot filter through the mostly empty space of atoms; gamma rays are so fine a structure that atoms are mostly empty to it. Only if neutrons could somehow be bound together in a solid could gamma be stopped dead. But nothing could then hold the bound neutrons in place!

It then appears that atomic engines will require shielding, foot after massive foot of solid lead. Or, probably, shell after massive shell of lead, with cooling water forced through it to absorb the heat generated in stopping that deadly and violent flood of hard, radiation, the like of which nothing save a sun has ever been forced to endure.

And not merely the reaction chamber must be protected; the entire system, from uranium burner through water tanks, steam lines, turbines, feed-water pumps and back to reaction chamber must be buried and blocked in immense masses of dense metal. For every particle of water that has once passed that reaction chamber will emerge supercharged with radioactive stuff. Some will be solid and non-volatile, some will be permanently gaseous, some will be volatile material. Every part of the line must be shielded, though not necessarily with the same vast layers of dense metal.

The scale of the thing is what must be considered. Radium is adequately shielded behind a few inches of lead. It produces a few calories of energy an hour, its radiation is horribly penetrant, but there is little of it, so that a few successive forty-percent reductions quickly reduce it to a negligible quantity. But where thousands of horsepower, perhaps millions, are being released in the form of that same deadly and superpenetrant radiation, hundreds of forty-percent reductions are necessary if human life is to survive anywhere in the near vicinity.

There are two possibilities; locate the power plant in the depths of a mountain, tunneling in through a half dozen miles of solid rock—preferably dense ore rock—and operating the plant by remote control. Enough rock will serve as effectively, and much more cheaply than lead.

The other is to place the plant in some place beyond the horizon from any habited point—a south seas island, perhaps. Only there, no one would have any use for it.

We can, however, recognize it simply as another engineering problem. No known matter will stop gamma very well; there may be unguessed ways that can be attained reasonably quickly. But don't sell oil stocks yet; uranium fuel may displace coal somewhat, but lead-shielded uranium plants won't be used in automobiles or airplanes very quickly.

That constitutes something of a review of what is in the way of atomic power. They'll get U-235 all right, but not by any present method. That new method will not be discovered by a guy in a garret; it'll come from a team in a laboratory. Then they'll have to lick the gamma rays, or locate their plant where nature will do it for them.

And one added factor. Neutrons are rather easily slowed down—

water does it—but they are *not* easily stopped. If you slow down a proton, it immediately grabs an electron and becomes a hydrogen atom. If gamma rays are slowed down, they cease to exist. If alpha particles are slowed, they're simply inert helium.

If you slow down neutrons—they're still neutrons, and as dangerous as they were in the first place. In the case of some atoms, such as U-235, they're more dangerous. The neutrons are fired out from the exploding U-235 in all directions, slowed by the surrounding water, and wander in all directions. Some wander back into the atomic fuel and carry on the good work, but some will wander out. Thus, in all probability, the fuel mass will be shaped in the form of a series of concentric cylinders, so that a maximum utilization of neutrons can be attained.

But some will still simply drift out in a fine mist. They drift casually through water, migrate freely, gently, through feet of solid lead, wander through half a mile of solid rock with the greatest of ease. And every now and then they drift into an atom that happens to go off, with fireworks, when a slow neutron drifts in. They are not good for the human system. They are much more penetrant than gamma rays.

They can be stopped, however. Slow neutrons drift into cadmium metal—and stay. They slip gently into the cadmium atom, settle peaceably, and do absolutely nothing. Therefore, the atomic power plant will have to be entirely inclosed in heavy cadmium shielding also. Cadmium, fortunately, is not too expensive—many tools such as pliers, wrenches, et cetera, are being cadmium plated instead of zinc plated now. However, while cadmium will absorb neutrons as placidly as a cow absorbs grass, unlike the cow, the

cadmium presently ceases to be cadmium as a result of its diet. Cadmium can absorb these particles unspectacularly because there is a long series of stable cadmium isotopes, one after the other, each just one neutron heavier than the preceding one. The series has a limit, naturally. The cadmium shielding will have to be renewed every now and again, therefore. This would not be a serious problem, however, as the life of the shielding would be long.

THERE ARE some other things to consider, though. The early ways of isolating U-235 may—will!—be expensive. Perhaps a power plant will be built using U-235 before U-235 is cheap enough to make such a power plant practical, and yet be practical! That's not a contradiction; its simply that such a U-235 burden would be a lot more than a power plant.

As mentioned above, physicists and biochemists have a slight feud on over the use of cyclotrons. Cyclotrons produce ion-currents of the order of thousandths of an ampere; their output is in proportion. If they were one-hundred-percent efficient in adding neutrons to atom A to make it into B, it would take an ion current of practically 100,000 amperes to change one gram-atomic-weight of A to B, in one second. At one milliampere, it would take 100,000,000 seconds to change A to B—provided B isn't radioactive or unstable. If it is, as in making radio-sodium for instance, you never will arrive. You'll simply reach a point where the product breaks down as fast as you make it!

A small-scale atomic power plant will work at a rate of amperes. It would generate power—but as a by-product industry, it would put radium out of business, make desired radioactives by the gram and make 'em in seconds. Radioactive isotopes with half-lives of a few seconds cannot be made today; they break down faster than cyclotrons can build them up. The by-product radioactives of a uranium plant would make them faster than they broke.

Gamma rays will be an unholy menace—and also another very useful by-product. If the plant's located in a mountain, a diamond-drilled hole that leads down to the reaction chamber would act as a gamma ray spotlight of frightful power. A few thirty-foot lead plugs to tame it down to usable intensities, and a half dozen such holes would be needed! A hospital for gamma ray treatment—of limitless intensity!—a number of laboratories for crystallographic and metallurgical study, some commercial large-casting testing plants, where gamma ray photographs of the internal flaws or lack thereof could be made in any casting up to and including thirty-foot-thick lead!

Not all desired radioactive elements can be made by neutron bombardments; sometimes protons or electrons are desired. All right; we could put a little substance A in the water passing the U-235 mass, of such a character that A, under neutron bombardment, yielded protons, or use B if electrons were desired.

These radioactive substances will be vastly important, and extremely valuable. Huge quantities of long-half-life isotopes for such things as luminous paint would be useful. Biochemists want long-lived radioactives to trace metabolism—but if an isotope is long-lived, its radioactive explosion is apt to be weak, and sparse in the small quantities a cyclotron can make. All of which can be overcome if we make a real

quantity in our by-product power plant.

So, long before atomic power pays, an atomic power plant can be made to pay. For one thing, it would be extremely valuable in finding out what other reactions could be used to make power alone pay!

Man being the general damn fool he is, the question of atomic explosives follows naturally. They'd be useful, but they'd also wind up on the battlefield. U-235, fortunately, is not the answer. It takes a sizable lump of the substance to make the reaction self-sustaining. All U-235 will do is boil water. It's atomic coal, not dynamite. You could make a sort of steam bomb, but it would be rather feeble.

However, give them time. A match won't explode, but it will touch off dynamite. There are some atoms that, once started, are mutually self-destructive. There's one combination, for instance, where A, bombarded with protons, gives off alpha particles, while B, bombarded with alpha particle, gives off protons. It takes an enormous concentration of either alpha or proton particles to start the thing, hence no one has been able to start it—so far.

Another futuristic feature of man's science reminds one of the old Roman method. Story goes, the Romans conquered Carthage once or twice, and had to do it over again each time. They finally fixed that by leveling the city, then plowing salt into the fields around so that nothing could grow. That time Carthage stayed conquered. The modern equivalent would probably be to bomb the undesired city with a few pounds of a long-lived radioactive isotope. There would undoubtedly be plant life left—rather weird stuff, probably—but humans would find it expedient to get out and stay out for one hundred years or so. A few uranium power plants could rather easily manufacture the necessary isotope bombs.

Man's rather apt to develop that sort of thing before he gets the problem of hitching uranium to his star wagon solved. There are some real headaches in trying to tame the reaction in a light-enough form so that the first men to try for Mars don't get burned out by gamma rays from the power plant.

Those desiring to bet on how soon they will—or will not—do that are also advised to pick something safe, like the three-shells-and-a-pea game.

ONE QUESTION remains; all this is interesting, but is there enough U-235 available, even if the perfect separation method is developed, to do anything with?

Unequivocally, unquestionably, *yes*. There are thousands of *tons* of U-235 available in now-known uranium ore deposits. There is atomic fuel enough for all the world, and it's well and widely placed, in good, concentrated ore bodies. There are two factors in an element's availability. Total quantity, and quantity in reasonably concentrated deposits. Yttrium, a "rare earth" element is actually comparatively common. Unfortunately, it's rather literally all over the Earth. There are, too, some twenty-five thousand *tons* of pure radium—which is really rare—in the sea water of the Earth. Uranium, fortunately, occurs in concentrated deposits.)

The greatest uranium-ore deposits are those in the Belgian—at this writing!—Congo, in the northern Canadian deposits, in the Colorado beds, and in the Austrian section of Germany. Africa is barely explored; there are probably more deposits there. South America is so

thoroughly supplied with minerals—particularly of the Uranium group, too—that it's fairly certain there are deposits somewhere there. Australia probably has some yet undiscovered, and if China doesn't have some workable deposits somewhere it will be practically the only element that isn't available there.

The quantities of uranium—all isotopes combined, of course—in the known deposits are such as to make uranium a metal of major availability. Molybdenum and vanadium, two common steel-alloying elements, are less available. Uranium is rather rare in general commerce for much the same reason titanium, a very widely available metal is; there's little present use for it.

It is used for two things; uranium ore is mined because it always contains a trace of the impurity radium. It is mined and used for its own sake as a ceramic agent. In glass and pottery, uranium imparts a powerful coloring action, giving a unique yellow-green effect that, once recognized, can almost never be mistaken. It's yellowish by reflected light and green by transmitted light, which, in glassware, gives a curious air of insubstantiality. Though this is the major demand for uranium at present—and a pound of uranium can color an amazing quantity of glass—the United States, in 1937, produced fifty-one thousand pounds and imported an additional two hundred thousand pounds.

As a coloring agent, uranium is expensive. It's competing with cobalt oxide, iron oxide, manganese dioxide, selenium, chromium, similar commoner materials. Still, with that slight pressure for production, we consumed one hundred twenty-five tons of the stuff.

That included one thousand two hundred and fifty pounds of pure U-235, which is now distributed in glassware all over the country.

In terms of fuel value, U-235 is about five million times as potent as coal. One pound of U-235 equals twenty-five hundred tons of coal. The U-235 consumed unseparated in glassware in 1937, was the equivalent of three million, one hundred and twenty-five thousand tons of coal, in other words.

To bring things into proportion, however, remember that it is probable that the glass industry that year used more than three million tons of coal as fuel. Though we have atomic power, a nation that uses mechanical power as we do is going to consume huge amounts of even such potent stuff as U-235. Coal is consumed by the hundreds of millions of tons; to completely replace it with U-235 we'd still need hundreds of thousands of pounds.

So—don't sell coal short yet, either.

MOON OF EXILE

By Harry Walton

Callisto was the one-way moon. And there were no successful escapes, because it wasn't a man-made law that held men there!

Illustrated by R. Isip

"No, sir!" said the senior officer. "You don't get *me* to land on Callisto. But it's a queer place." He punched buttons on the astrogate calculator, slyly waiting for Ensign Wilkins to rise to the bait. They always did.

"Queer—how?" asked Wilkins,

conforming to precedent.

"We-ell, for one thing, it's a port o' call—in a way o' speaking—but you'll find an asterisk alongside it on any call list you'll ever see. That means you aren't to land your ship there—ever."

"But how about an emergency—burned tubes, or a smashed hull, or—"

"Landing on Callisto," said the senior officer sententiously, "*is* the emergency. What's more, it would be your last one."

He was enjoying himself. Instruction of these rookies was part of his job, but he did it in his own way.

"Gee-sparks, Mr. Holt," protested Wilkins, teen-age and full of cold logic, "I don't get it. The purser told me you landed two passengers here last trip. How come?"

The senior officer rolled his chew over to the other side of his mouth before answering. "Guess they wanted to get there pretty badly. People have reasons—sometimes. So if they're willing to sign that they're of sound mind and going of their own accord and not under duress, we land them. By themselves, in a 9B automatic lifeship. Is that clear?"

"No, sir," retorted Wilkins. "What have you got to land them in an automatic for? Why not use the tender, same as you would anywhere else? That's what it's for—"

"Not for Callisto landing, it isn't, son. We need that tender other places. Besides, the fellows who pilot it have wives and children they want to get back to. So we use a 9B automatic, because there isn't a man aboard who'd willingly set foot on Callisto."

"Maybe I'm dumb," said Ensign Wilkins morosely, "but I don't get it. If it's that dangerous, why land *anybody?* And, anyway, why would they want to land? There's lots cheaper ways of committing suicide, seems to me."

"Who said anything about suicide? Callisto's as nice a little spot as you'll find in twenty years' cruising. Good air, even if it is a bit thin, and good water. Cold outside, but cozy enough under the city domes. Plenty of jobs because labor is always scarce, and your neighbors are some of the best and smartest peolep who ever retired. Some of them are a bit screwy—eccentric, they call it—and plenty of them are rich. Oh, you can do all right by yourself down there."

"So," pursued Ensign Wilkins, "what's wrong with it?"

"Not much. There's just one thing that makes Callisto poison to young fellows like you who want to see the System before settling down, or to us older ones who have settled down and have wives and kids back home. Just one thing's wrong with Callisto. You can't leave."

"Oh, is that it?" asked Wilkins scornfully. "I thought conscriptive colonization was outlawed long ago. How do they get away with it? Gee-sparks, one of our patrol squads could clean up the whole pill and put in a legitimate government that—"

"You're accelerating way ahead of your jets, son. The government's legitimate. Callisto's conscriptive colonization isn't *its* fault. It's Callisto's. You just can't leave."

Wilkins shook his head in bewilderment. "They never told us about this at the academy. They always told us Callisto would be covered on our first training flight."

"Sure. I'm covering it, ain't I? Fact is, the Bureau of Correction doesn't want the facts spread any more than can be helped. Callisto is a taboo subject, back home. You'll be cautioned when you leave ship. Of course, the big-time crooks know

about it, and it sifts down to the little ones more or less. But we aren't advertising it. To get back, though—I slipped up a bit, when I said you *can't* leave—"

"I thought that sounded funny. You can, huh?"

"WE-ELL, yes. You see, Sperry was the first to land here, in '93. He found things pretty good—no dangerous animals or savages, no particularly bad magnetic storms, suitable air and water. He filled his diary with enthusiastic plans for a colony, and after twenty days took off again without any trouble. You know how his ship was found drifting, four years later. The only traces of Sperry and his men were their clothing, watches, a ring or two, and the fillings out of their teeth. Nothing organic, not even bones. The ship's log had been kept for thirty hours following their departure from Callisto. It's never been published, but you can see copies of it at any good planetary museum. It makes grisly reading, though."

"Grisly, sir?"

"Sort of. Sperry wrote that, nine hours out, somebody noticed that the walls of the ship were beginning to glow. It was a cold, bluish light, with a wide frequency range which analysis showed to extend into the Gamma radiations and farther. Two hours later they found their skins were glowing the same way.

"Sperry knew he was into something bad. He recorded all his own sensations—and they weren't nice. Well, to cut it short, they died. The diary just stops, but there's enough to show that it must have been hell—"

"Jeez!" said Wilkins.

"O' course, humans being as contrary as they are, nothing could keep them away from Callisto after that. One whacky chap landed there despite the official ban—he beat a patrol cruiser out by a couple of minutes, which was enough, for the cruiser captain wouldn't land. After living on Callisto for a year this fellow thought he'd licked the thing by using some sort of serum he'd synthesized. Ten hours after he started home he was going the way Sperry had. Then he about-faced and offered the theory that Callisto's radioactive core was back of the trouble—that its radiation altered the nuclear structure of matter to a new form, which remained stable in that form so long as it remained on Callisto. Something about enormous quantities of free positrons—only it turned out they weren't exactly positrons after all.

"Anyway, your atomic structure is changed as soon as you approach Callisto's surface. You're safe while you stay put. If you leave, your atoms become unstable, radioactive. The nucli simply disintegrate. You get what amount physiologically to an ultrarapid and incurable radium burn—only it isn't a radium burn. You die within thirty hours, but it doesn't stop there. Organic matter disintegrates entirely in about eighty hours. We learned that afterward, but this poor chap's work wasn't wasted. The next expedition prepared to stay permanently, and did. It turned out he was right—and you still can't leave Callisto."

"Jeez! But they told us at school that beta radium was shipped from there. How do you manage that?"

The senior officer carefully spat out his chew—not on the spotless control deck, but into a paper kerchief he had learned to carry for the purpose.

"The same automatic lifeships, son. They load them down there, and set the controls for an orbit

about four thousand miles from the surface. After the 9B has swung around out there for six months—it doesn't take any power once it's in position—it's safe to go aboard. Inanimate matter slowly radiates off the energy it has absorbed, and settles back to the familiar stable form we know. The beta radium, incidentally, turns into ordinary radium. So after six months' quarantine a liner pulls alongside and warps the automatic to a deck anchorage, and everything's fine. Sometimes, of course, we find some damn-fool stowaway has hid himself aboard. Not that there's anything left of *him*, but it's a squeamish thing to run across all the same."

Ensign Wilkins considered.

"Guess I wouldn't want to go there—not for a long time, anyway. Not unless the patrol were after me. Gee-sparks, what a place for crooks to hide out—"

"There's no extradition from Callisto," said the senior officer dryly. "And the government doesn't prosecute extraterritorial offenses. That's why, as I said, the Bureau of Correction isn't crazy to advertise the place—"

"CALLISTO, isn't it?" asked the girl. "It's beautiful—a little like Earth."

Her companion nodded, and with the movement his black silkene evening jacket gleamed dully in the Jupiter light that came through the observation port. They were alone on this deck—except for a secret-service man who knew how to keep himself out of the way. Brant had ordered it so. It was one of the rare occasions when he felt that he could talk freely and sincerely.

"Beautiful, but grim," he answered. "Especially to you, Sharon, it could be grim as death. To Sharon Tryst, Callisto would be a form of death."

She turned to him, startled. "Joseph! What are you saying?"

"Nothing to trouble you. Forgive me for thinking in metaphors." A smile lighted his dark face briefly. "I can think of nothing less compatible than Callisto and Sharon Tryst. The one is oblivion, a world of ghosts. And you—three worlds are at your feet. You are beautiful. Your talent has made you the idol of millions—"

"I've been lucky," the girl said, flushing a little. "An entertainer needs luck, and believes in it. We're all superstitious, especially those of us who play to the telescreens. And talking about one's talent is unlucky—"

"There is no bad fortune," he said softly, "for those whom Joseph Brant approves. No—Callisto."

"You think Callisto would be so terrible?" she asked lightly.

"Not terrible, but tragic." The man's face, in that keen light, was pale and stern. The same illumination which brought out the harsh asceticism of his features wrought for her an aura of silver loveliness, enhancing the soft curve of her white throat, tinting her oval face with light, working lustrous magic with her hair.

"Callisto—and Sharon Tryst. Strange to speak those names in the same breath. I should not, but the mood is on me. I think it is because the thought makes me afraid."

"Afraid?" she parried. "Overlord Joseph Brant afraid? Then I can be frank. I am afraid for the overlord. You are strong, Joseph—but very blind. Sometimes I feel I cannot love you for fear—or perhaps fear only confuses my love."

"Then you shall not fear. I forbid it, Sharon."

She smiled tremulously. "You forbid? Are you God, Joseph, that you can rule even a woman's heart? No, but you might lift the weight from it. Oh, Joseph, why will you risk all you have won—and your own life—in a war with Venus? Surely you have enough—absolute control of Earth and Mars. No man ever had such power before you. But you are still not content. You want Venus also. Your own Congress is turning against you—"

"The Congress is weak where I am strong," he retorted. "A pack of squabbling deputies. They can do nothing."

"A new war will unite them. Our worlds are tired of war, Joseph. Why must we have more of it?"

His thin lips were compressed to a pale, straight line. He waited a little before answering. "For ultimate peace, a lasting peace that is impossible while each world remains a sovereign state. I war for peace, Sharon. Ten years more—and worlds united under me. I ask ten years to end forever the senseless, bitter struggles of the past—those butcherings called the Fifty Years War, the Century of Plagues, the Mars-Earth War. I war to make a repetition of them impossible. My mother bore me during the Century of Plagues. She had already breathed the spotted death, and her body—I'll not tell you that. But I war to end war, Sharon. After me, peace."

"And with you," she said bitterly, "death and death!"

He flinched a little. "It is my decision. You will live to see me right, as I was nine years ago when I ended the Earth wars by uniting all governments under me—"

"And could have given them peace, Joseph, but you did not. Instead, we have had seven years of war with Mars. Now Mars is yours, and you demand war with Venus. There are rumors that the Congress

will ask a constitution, even the end of the overlordship. If you refuse, they may try to kill you. The people are desperate. I *am* afraid, Joseph—for you."

"How long have you known me?" he asked harshly.

"How long? I came on board only forty days ago. You had just ended your tour of the outer colonies—"

"And still you do not know me," he burst out in cold passion. "All I do is for their sakes—theirs, not mine. I must live, I must remain in power, I must crush any who oppose me—because without me they will return to the barbarism of ten years ago. You think I can forget what it has cost me—that I lack the small, common virtues of common men? They are luxuries I cannot afford. I dare not take account of gratitude, or honor, or human lives. I am an instrument, a scalpel to cut away the rottenness that has eaten so deeply, no matter what the cost."

"No matter what the cost," she echoed. "It is you who are tragic, Joseph. Because you are sincere—"

She turned away to look out of the port, where Callisto rolled majestically before the great white face of Jupiter. Brant's pale face was immobile, but one hand rustled in a pocket.

"You love me," he said abruptly. "It is only that you are afraid—"

She turned her head slowly. There were tears in her eyes, luminous in the planet glow. "It is why I am afraid. I love you, Joseph. God pity us both—"

A sob shook her slim body. She turned suddenly away and ran down the deck corridor. He did not follow.

"LIFESHIP 27 ready for Callisto landing, sir. No passengers, I understand."

"On the contrary, Mr. Holt. There is one—a last-minute decision, I believe. We hadn't any scheduled." Commander Orens' voice was officially phlegmatic, but his senior officer detected an emotional undertone. "You'll be as surprised as I was, I daresay. But you'd better get along to impart landing instructions. I can't help saying it's a pity—"

Which was, for Commander Orens, a very outburst of emotion. The senior officer coughed, saluted, and went his way. A communications officers caught the captain's eye.

"Helio, sir, from Mars. Urgent."

Orens took the green envelope and absently ripped it open. A grunt of annoyance escaped him. The junior officer waited with patient expectancy.

"Bureau of Correction," grumbled the commander. "Asking us to apprehend a Martian, name of Tharner, wanted for dope smuggling and murder. Wonderful how they always learn their man's aboard after we've been out four months. Chap could have skipped at a dozen places."

"But most likely to try at Callisto, sir," offered the junior officer with a wry grin.

"Eh? That's so, of course. Put a guard on the Callisto ship at once. Inform Mr. Holt. Look up the passenger list and see if you can spot an alias. He'd probably reverse his name to Renrath or something simple like that. These Martians haven't a damn bit of imagination."

"Aye, sir." The junior officer turned away, looking back as Orens coughed hesitantly.

"That girl, Sharon Tryst," said the commander. "Telescreen star and all that. Sits at the overlord's table. You'd think she had everything to live for, wouldn't you?"

The junior officer goggled.

"Well?" snapped Orens. "What

are you waiting for? Check up on that Tharner chap. Investigate every Martian aboard. He can't be disguised as an Earthman. Get going."

The junior officer thankfuly got going.

"ONCE you press the red starting button, Miss Tryst, everything is under automatic control until you're within fifty thousand feet of Callisto. The ship will hover at that altitude until you press the white landing key which sets it on the beam from the field. If you shouldn't want to land, you can return to the *White Star* simply by pressing the red key again. We'll remain right where we are until you either land or return. White key to land, red key to return; you'll find them marked, of course."

"I . . . I think I understand."

Her eyes were dry and clear and, the senior officer thought, very beautiful. He decided that Orens had understated things. It wasn't just a pity; it was a cursed shame for a girl like this to banish herself to Callisto with a lot of bald and doddering retired millionaires. Then the cynic in him came to the surface as he reflected that plenty of telescreen stars had found the one-way trip a good investment; a million credits could be a lot of consolation for renouncing the white lights of Terra. But this girl didn't look just that kind. Were he in the overlord's shoes, thought the senior officer, he wouldn't let her go out of his life like this.

"Well, I . . . that's about all, I guess," he floundered. "Your baggage is aboard. I'll leave now, and any time you're ready you can punch the red button. That will seal off the entrance port, release the magnetic anchors, and start you down, all in proper order. Any time you're ready. The . . . the best of luck, Miss Tryst."

"Thank you, Mr. Holt."

He rose awkwardly to his feet. At the door of the tiny port corridor he looked back.

"If you want to change your mind —I mean, lots of people do—it's perfectly all right. Just don't touch the white key. We'd . . . we'd be proud to have you back, Miss Tryst."

She smiled gratefully, and the senior officer retreated precipitately, very much afraid that she would break into tears or he would say something foolish.

For a little time after he left she sat perfectly still, staring at the red key.

COMMANDER ORENS, urged equally by a desire to be of service to the overlord and to save a young woman from what he felt to be an impetuous mistake, had at once sent out a call for Joseph Brant to communicate with him. The overlord could not be reached, and Orens was in a fine frenzy of apprehension.

The senior officer, whose duty it was to stand by until the lifeship bearing Sharon Tryst had taken off, was doing just that, but violently wishing something could be done about it.

The stewardess in charge of Sharon Tryst's cabin, possessed either of special information or that insight called feminine intuition, found Joseph Brant just where the girl had left him, staring out through the observation port. She promptly unburdened herself to him.

"And, of course, it's none of my business, sir, but I thought you might like to know that she's gone on board the Callisto ship. She must have made up her mind awfully sud-

den. I think she was crying when she came in to pack. Anyway—"

Brant hurled her aside and shot down the observation corridor. He was well enough acquainted with the *White Star* to find the lifeship deck without delay, and without a word to the astounded senior officer charged into *Lifeship 27* through the still unsealed port. The senior officer looked after him with a quizzical but broadening grim. The overlord wasn't so slow, after all!

A soft *sl-sh-sh* from the pneumatic port, the click of magnetic grapples letting go, froze the grin just as it was. The brief roar of rockets, drumming against the deck cradle, ceased almost instantly as the lifeship lifted away.

AT THE very moment Joseph Brant burst from the port corridor into the tiny cabin, his hasty footsteps well muffled by the resilient heat insulation which covered floor, walls and ceiling of the little craft, Sharon Tryst had pressed the red key. Although the girl's back was toward him, Brant saw the movement. An instant later the roar of rockets informed him that they had left the *White Star*. Knowing how Callisto landings were arranged, and that the departure was not as yet irrevocable, Brant felt no concern. He congratulated himself on having got aboard just in time.

"Sharon," he said gently.

She spun around, her eyes wide, her gaze fixed as though in fright. Her face might have been carved of white marble.

Anxious to mitigate the shock which his appearance had produced, Brant remained where he was, some ten feet from her. "Why did you leave me, Sharon? Did you think I

could let you go—that I loved you as feebly as that?"

She shook her head as though bewildered. "Don't talk of love between us, Joseph. You shouldn't have come. I prayed you would not."

"I thank my destiny I did—to ask you to come back with me, Sharon—to be my wife."

She shrank back against the control panel. Her voice was so low it scarcely reached him. "That can't be. That is impossible—now."

"Not impossible, Sharon. Whatever I may have done, in whatever way I have hurt you, to drive you to this tragic gesture, I'll live to make up for it. I know I love you. You have said you love me. Come back with me, Sharon. I do not command now. I implore it of the woman I love."

She might have answered, but looking past him, stiffened instead in sudden surprise.

"A handss-some sspeech," remarked a strange voice. "How ss-sad that sshe iss right. What you ask iss indeed impossible."

Brant whirled. In the corridor behind him stood a short, rotund figure. Green hair fronds bobbed characteristically on the bullet head. Tiny albino eyes, so pale as to appear pupilless, stared unwinkingly above a hand that held a magneto gun unwaveringly in line with Brant's abdomen.

"Put down that gun," ordered the overlord. "Who are you?"

The other leered, showing black teeth. "Tharner iss my name," he answered, with the slow, hissing enunciation common to Martians. "Your poliss, Overlord Brant, have called me very dangerouss. I have never been more dangerouss than I am now. I am esscaping to Calliss-to."

"Put down that gun," repeated Brant calmly.

"With gladness—after we have safely landed on Calliss-to. How curiouss that I should ss-serve my world a good turn at the very moment when itss government wishess to ss-send me to the lethal chamber. Yet it iss I, the despised and hated Tharner, who am about to free it from a tyrant. Iss it not a ss-splendid irony? I would not ss-sell this moment, Overlord Brant, for all the creditss in your treasury."

"No? But what if I guarantee you a free and full pardon?" asked Brant shrewdly. "Plus—a bonus."

The Martian again showed his teeth. "A tempting offer, Overlord Brant. But it doess not tempt me. It remindss me much of the treaty you made with my world shortly after you came to power on Earth. It wass a very fair treaty, as fair as the offer you have now made me. But you did not keep it. My government truss-ted you. Very foolish. I am not so foolish."

"Don't be insane, man," snapped Brant. "You've got me in a squeeze and you know it. Do you think the small matter of your punishment would weigh with me at a moment like this? I'll sign any sort of guarantee you like—and keep it."

Tharner stared at him thoughtfully, the gun sagging a little in his hand. But it snapped up again at once.

"Now, that iss queer. I believe you, after all, Overlord Brant. I think you would keep thiss agreement, because any bargain we might make would be an excellent one for you. But I shall not make one. Although for yearss I have looted my world for my own benefit, I am a Martian, after all. I am ss-suddenly ss-sentimental. I wish to leave behind me a ss-single ss-splendid ges-

ture. I will set my world free by taking you to Calliss-to with me. Without you, the overlordship will collapsse."

Brant drew a deep breath of exasperation. "A million credits and full pardon, Tharner. Can you refuse that?"

Tharner shrugged. "Yess. I am a fool—but yess."

"You know that the landing beam will bring us down on the government field, that police will be on hand to receive us? I'll file charges against you immediately. You'll be clapped into the radium mines without trial—"

Tharner nodded cheerfully. "The mines would be terrible. I should not like to be sent to them. That iss why I would much rather not shoot you, Overlord Brant. For sso long as I do not murder in their territory, the poliss of Calliss-to will not charge me with my previouss crimess. If you charge me for threatening you with a weapon, I shall simply confess that I am wanted by your poliss and dared not return to the *White Star*. They will not ss-send me to the miness for that. They will not even ss-sentence me to please you, for when we have landed on Calliss-to you will no longer be Overlord Brant."

THERE WAS silence in the little cabin. This was crisis, as Brant knew perfectly well. A crisis in which an opponent held all the trumps. This egotistical little fool wanted, above all else, the satisfaction of besting Joseph Brant. Martians were always egotistical, beyond all reason and self-interest at times. It was a weakness of theirs. They had others. One was an absurd slowness of reaction compared to that of Earthmen. Tharner knew that, of course. It was why he kept the magneto gun constantly upon him, ignoring Sharon but for a watchful glance now and then. And he wasn't watching her now.

Brant suddenly tensed his whole body, his eyes sweeping from Tharner to the girl. "God, no, Sharon! Don't try—"

It had the effect he was counting on. The Martian's attention wavered, and in that instant Brant jumped him—despite the gun, which might as well have been in its holster. The overlord's fist crashed solidly against Tharner's fragile jaw, crunching bone before it. Tharner dropped like a felled tree. Brant kicked the gun far back into the corridor. He suddenly realized that the rockets were silent, that all motion had ceased. The lifeship must be hovering.

"Just in time, Sharon," he said with forced cheerfulness, for the situation had tried even his iron nerves. "I'm sorry I had to—"

The words stuck in his throat. Sharon Tryst was watching him, a paralysis pistol in her right hand. Her left was upon the white landing key.

"Keep back, Joseph. Not another step—"

"Sharon! Have you gone mad? What is this man to you? Is he—"

"Nothing, Joseph." Her lips scarcely moved, and were almost as bloodless as her cheeks. "But I could have worshiped him for what he did. I hoped that— Stand back, Joseph."

He stopped, irresolute.

"I hoped that he would spare me this," she went on, "but you won—as you always have, Joseph. So I must do this. We are going on to Callisto."

"Sharon, you—"

"Don't, Joseph. Nothing you

could say would change things now. I've thought this out, and the struggle is done with. No, don't talk. Let me confess, because then there will be nothing left to say. I was chosen to do this—the Congress wasn't sure of itself, dreaded your return. I was planted on the *White Star*. I was to make you love me, then pretend a quarrel and a silly, last-minute decision to go to Callisto. To make sure you would follow me on board I bribed my stewardess to tell you I was leaving. I waited for you to come before pressing the starting key—"

"But you couldn't have seen me. Your back was turned—"

"I was watching for you—in a mirror. A woman's trick. When this man appeared I had wild hopes of hiding my . . . my treachery from you. But you defeated him. Now you know everything, Joseph. I had to betray you, no matter what the cost. Your own words, Joseph. That is why I asked God to pity us both—"

"God himself could not forgive this," he said harshly. "Woman, do you realize what you are doing?"

Her answer was an agonized whisper. "I realize—everything."

Stiffly her fingers depressed the white key.

SHARON WAS STILL by the control panel when the lifeship whistled down through the upper reaches of Callisto's thin atmosphere. Nor had Brant moved. He felt that he was living a ghastly anticlimax. Tharner, the Martian, groaned and sat up, holding in manifest pain a broken jaw. A slight tingling of the skin signified to Brant that Callisto's radiation was taking effect upon them. Within two or three hours it would be unnoticeable.

The girl's face was still devoid of color. She seemed drained of vitality. The paralysis gun lay beside her where she had dropped it, and she did not look up even when Brant approached her.

"I have always done what I believed had to be done," he said in a cold, toneless voice, "without thought for myself, without counting the cost of anything but failure to do the thing. Anyone not a fool must realize that you have done the same. You've left your life behind you as I have mine—but of your own free will. You would have been a fit mate for—the overlord."

A faint flush touched the girl's white cheek.

"Now there is no overlord," he went on, relentlessly. "Even Joseph Brant cannot rule from exile. The overlordship is ended—I saw to it long ago that no other man could take my place. The Congress will organize a constitutional government. Venus will sue for peace, and Earth and Mars will grant it. You have done what you set out to do. Which of us was right only the future can tell. I hope that I was wrong."

Her slender body stiffened at the words.

"I pray that I was wrong," he repeated. "That is a strange thing for Joseph Brant to say. Perhaps it is possible because he is now only a man, because he can speak as a man, and not as the overlord."

With one hand under her chin he tilted her head so that their eyes met.

"I love you, Sharon Tryst. It is the one thing that remains to me—but you can take it away with a word. You told me that you were playing a part—but also you told me once you loved me. I believed you then."

"And I," she murmured, "have never lied to you, Joseph Brant—"

CRISIS IN UTOPIA

By Norman L. Knight

Second of Two Parts

A world political crisis is bad—but with a madman running the show—!

Illustrated by R. Isip

Synopsis of Part I

The Submarine Products Corp. so-called, but under the vastly different social-economic system of the Forty-second Century more nearly approaching a governmental body ruling all the seas of Earth —has, for two hundred years, been engaged in a vastly important, completely

secret experiment. By causing artificial, controlled mutations they have succeeded in producing a mutated type of man capable of living in and breathing water or air with equal success. These—the Tritons—have been developed on Triton Reef, a tiny group of islands in the deserted South Pacific. All other "corporations"—such as News Exchange, Planetary Transport, et cetera—have co-operated by diverting from this area for two centuries any traffic that might have discovered the experiment.

The secrecy was vital, lest the sudden discovery of this widely divergent humanoid species bring a violent, murderous reaction from unprepared people. A creature which is not human, but near human, tends to produce a greater revulsion than a wholly inhuman being. Until that instinctive revulsion could be done away with, secrecy was utterly necessary.

The time has nearly come for release of the news. The preparation of the world's peoples for the introduction of the idea has been going on for two centuries; the idea now seems acceptable.

And now trouble breaks on Triton Reef itself. One faction—the Triton elders—fears release, partly because the other faction, the younger Tritons, want to continue the experiment to its logical conclusion. Tritons are altered in body, but no mutation of mental powers has been experimented with; the younger Tritons want to apply the process—tectogenetics—to developing supermen. The elders, led by Cymorpagon, force the younger group into a single pool in Triton Reef. Two—Cragstar and Merling, a young Triton man and girl—escape, and attempt to swim the thousand and more miles to Easter Island, where they can reach communicators to notify Prime Center, the central government of Earth, of the situation. Underestimating sea distances, they are exhausted when they stumble on the submersible cruiser Kelonia, piloted by Raven and Topaz, two artists seeking material for submarine murals, who have disobeyed instructions by coming toward Triton Reef, curious as to what was in that supposedly blank area of sea.

Prime Center, warned, calls Pater Vervain, Drylander representative of the Center on Triton Reef. Vervain apparently has gone mad, for he reveals that he intends to rule Earth through ruling conquering Tritons—ideas credible only in a madman or a dictator of two thousand years before!

Vervain, seemingly, has reached this decision after being taken by Cymorpagon, the Triton leader, to a secret room and shown some sort of evidence Cymorpagon claims to have which proves that Prime Center intends to destroy all Tritons. Previously, Vervain had thought Cymorpagon himself was mad; his sudden reversal of behavior puzzles the Tritons; Prime Center cannot contact him after he makes his ultimatum and destroys the transmitting equipment on Triton Reef. Prime Center starts sending help to Triton Reef.

VIII.

ANOTHER vessel, much smaller than the *Capricorn* and flying from the northwest at a lower level, was also bearing down on Triton Reef. She was the News Exchange air cruiser *NE-6-137*, hurriedly diverted in mid-ocean from another assignment by the Communications Corp. Like the *Capricorn* she rode upon a mobile space warp, somewhat as a surfboard rides the crest of a roller: Her passage split the protesting air with a sustained and mournful wail. She drove high above a surging sea of fog, blinding white under the early afternoon sun. Her nimble shadow, edged with a rainbow band, pursued her across the fog floor like a racing porpoise.

The *NE-6-137* had established radio contact with the *Kelonia*—surface cruising somewhere under the fog—and was now reducing speed as she rapidly overhauled the submersible. Both captain and pilot were intent upon the direction finder.

"We'll be over her in a minute," said the pilot. "She reported that the fog is rising."

"So?" responded the captain. "Knock it down with the precipitator and we'll look for her."

The pilot pressed a foot treadle. The fog pavement under the air cruiser sagged as if undermined, and a circular pit extended downward until it revealed the gray-green, wave-

crinkled sea at the bottom, still foaming from the torrent of rain which had fallen into it. The pit advanced with the motion of the cruiser.

"I'm not quite clear as to what we're going after," remarked the pilot as the craft sank into the hole she had drilled. "Something about an uncharted reef—people under the sea. What's it all about?"

"It seems that Prime Center and S. P. C. have had some sort of biological experiment under way and kept it dark for an unbelievably long time," replied the captain. "Now they're ready to broadcast it. This seagoing soup tureen, the *Kelonia*, is mixed up in it and therefore she becomes news."

"There she is now!" exclaimed the pilot.

The fog swirled in and closed above the *NE-6-137* as she descended, and now she floated only two hundred feet above the heaving, slate-gray sea at the center of a charmed circle, holding the fog at bay with her precipitators. Beneath her was a wave-tossed object resembling a silver dish cover surmounted by a deformed thimble—the conning tower and upper hull of the *Kelonia*. The latter craft was already the target of three televisors trained upon her from observation hatches along the keel of the *NE-6-137*. The operators of these instruments, unlike the captain and pilot, had had more time for perusal and study of the preliminary Triton Reef data with which Narhajian and his staff were feverishly bombarding the world. Consequently they were more or less prepared for what they saw.

The observation hatches were shielded by inverted, retractible domes of silicoid wherein the operators and their instruments were suspended in gimbals. A narrator centered the cross hairs of her televisor field on the *Kelonia's* conning tower and addressed a far-flung audience:

"The splashes of foam around the *Kelonia* seem to be made by a numerous company of swimming creatures. At the moment we cannot identify them. We doubt that they are Tritons, since the *Kelonia* informed us—as you may have heard—that she has only two aboard. These may be porpoises or a herd of seals. No! They must be Tritons! Perhaps you caught the movement of a swimmer's arm, briefly lifted from the water. Mark the three clambering out upon the *Kelonia's* deck. They are definitely Tritons! We do not know what this may signify. Why have these other Tritons come out to meet the *Kelonia?* Her radio has become silent."

On the bridge of the *NE-6-137* the captain hurriedly leveled his binoculars at the *Kelonia* and stared tensely.

"What's this thing crawling out on deck?" he demanded. "It—he—no, it's a girl—she's black as the ace of spades—or is she purple? Here's two more coming! Are these Tritons? I expected some sort of scaly thing with fins. Why, they're practically human, and not bad-looking! Something queer about their hair—seems to be squirming all the time. And if I'm not delirious, they have feelers like confounded giant mosquitoes! They sprouted out suddenly on their foreheads!"

"Either you're not delirious, or both of us are," responded the pilot. "I see the same thing. Can they live out of water? Look at that!"

This concluding exclamation was inspired by the spectacular jets of water and vapor which the three Tritons expelled from their lateral gill orifices.

THE News Exchange vessel descended until the domes of the observation hatches barely cleared the wave crests. Heads were protruded from portholes and a robust voice cried, "What! No mermaids?" The captain stepped out on the narrow bridge deck just as the conning-tower hatch of the *Kelonia* was thrown open and Raven emerged therefrom, followed by Cragstar.

"Are these people Tritons?" inquired the captain, leaning over the rail and addressing Raven. His burning curiosity made mere radio contact seem inadequate.

"Yes," replied one of the three Triton maidens on the *Kelonia's* deck. "Are you disappointed?"

"They can talk!" exclaimed the robust voice.

"We understood that you had only two aboard," continued the captain. "Where did you pick up all these others?"

The *Kelonia* was completely encircled by a fringe of Tritons who had drawn near to listen and now clung to her sides.

"They shut themselves up somewhere in Triton Reef and then blasted a way out," replied Raven. "Prime Center told us to go on to the Reef; then they recalled their instructions and told us to wait. They say it isn't safe. Vervain, the man in charge, is out of his head and running around with some kind of weapon. Prime Center sent us a transcription of what Vervain said to the Reef Council, and we made a photographic retranscription. We've been circling around, five miles from the Reef, waiting for the *Capricorn* as per instructions. Then these others found us. It was then that we stopped sending. They hadn't eaten very much for a couple of days, and we fed them. Then we told them about Vervain and they wouldn't believe it. Five of them are down below now—came in through the air lock—watching our retranscription being run through the projector. Are you going on to Triton Reef? What are you going to do about Vervain?"

"We're going on to Triton Reef, but Vervain is not my problem," replied the captain. "I heard something about his blowing up the stereo plant. We took on some stereo experts from another ship who have orders to repair the damage. I hadn't heard about Vervain's weapon. That may put a crimp in our plans until the *Capricorn* arrives. In the meantime I would advise you to stay put and wait for the *Capricorn*."

"Vervain, or the elders, or both, may refuse to admit you to the Reef," remarked Cragstar.

"We'll consider that difficulty when it arises," responded the captain. "If your Triton friends are agreeable, we'll take them aboard and they can make their radio debut while we haul them back to their Reef."

As a result of this invitation the *NE-6-137* was invaded by a Triton boarding party which speedily disrupted the ship's discipline. She hove to in midair while the captain granted the crew temporary leave to abandon posts which they had already deserted. A tumultuous mob surged into the ship's broadcasting cabins bearing Tritons on their shoulders. On the dark side of the world, sleepers were roused by telephone chimes, listened to the somewhat incoherent words of friends, spent the remainder of the night before their stereoscopic telescreens. Commentators waxed lyrical and metaphysical, hailed the Tritons as "the vanguard of a new epoch," described them as "another eye through which the human mind may

see the Universe in a new light, another brain wherewith Man may appreciate and admire." So hectic a broadcast had not agitated the world since the return of the first warp-driven space cruisers, bearing a slab of Martian hieroglyphics.

"Here we are, left in the lurch," grumbled Topaz disgustedly as she listened in the control cabin of the *Kelonia* to the broadcast from the *NE-6-137*. "Merling and Cragstar and the others are going on to Triton Reef, while we potter around here and wait for the *Capricorn*. By the time she arrives, all the excitement will be over."

"Our instructions are to wait," admonished Raven.

"Prime Center didn't suppose that the News Exchange would have a ship down here this soon," Topaz asserted. "They just said, 'Wait,' and forgot about us. I'm taking the helm."

So WHILE the *NE-6-137* floated aloft and the images of affable but astonished young Tritons flashed across the telescreens of the world, the *Kelonia* traversed the short remaining distance to Triton Reef. The warning clang of an obstacle monitor on her port bow brought her to an abrupt halt. The booming concussions of surf were plainly audible. The navigators peered through the forward port.

Five hundred feet ahead a phalanx of ugly crags—jagged, sea-battered fangs of black granite—loomed through the thinning fog. Tumbling torrents of foam streamed from their fissures. One grotesque rock formation, pierced by an eyelike cavern, roughly simulated a colossal rhinoceros' head.

"This is the place; Cragstar laid a true course," remarked Raven, consulting scribbled pages of notes on the navigator's desk beside the calculator. "He says, 'Depth at Rhinoceros Rock, sixteen fathoms, increasing seaward. Tunnel under the Rock brings you to portal of submersible docks. Smooth bottom; crawl in; don't try to make it free-floating. Tunnel full of bad currents. Nautilus has short-range radio. Should respond if Vervain has not wrecked that also.'"

"Very well; we shall crawl," said Topaz, and the *Kelonia* slanted downward, spouting fountains of bubbles in the glare of her bow floodlight. She found a smooth, dark bottom which rang with metallic resonance under her caterpillar treads. Before her, the floodlight revealed the stark, angular buttresses of a black cliff, sparkling with prisms of silica. At its base yawned a huge semicircular tunnel mouth into which the *Kelonia* crept crunchingly, like a metal snail entering a culvert. This passage debouched onto the floor of an oblong lagoon from which no means of exit was apparent. The *Kelonia* halted before a sheer, unbroken wall of granite.

"Dead-looking place," commented Topaz. "Where's the portal? See what you can raise on the radio."

"Someone has spotted us, I think," responded Raven, looking upward through the forward port. Three dots of pale-green light had appeared halfway up the face of the granite wall. Even as Raven moved toward the radiophone panel, the telescreen glowed and the harassed countenance of Nautilus appeared.

"Ahoy there, you in the turtle boat! Who are you? What do you want?" inquired the Triton apprehensively.

Raven clicked the radio transmission switch.

"This is Raven, aboard the *Kelonia,*" he replied. "We hope to

make pictures of the Reef. There's a News Exchange air cruiser a few miles behind us, bringing repairs for your stereo plant which Vervain crippled."

"We are listening to her broadcast now," responded Nautilus. "It's the most confusing thing I ever heard! What are we to believe? Cymorpagon says that Prime Center has deceived us; Vervain denies it. Then Vervain agrees with him, acts like a man in a dream. Next, Cymorpagon vanishes. We have searched his quarters and every corner of the Reef, but he is nowhere. Now comes this NE cruiser, which picks up our young rebels, and they broadcast everything! If what Cymorpagon feared were true, the world should rise against them. But what happens? They are received in a whirlwind of acclaim! Vervain is angered by the broadcast—says this seeming good will is insincere—a trick to mislead us until we are scattered abroad and far from our haven in the Reef. And what is this talk of his destruction of the stereo plant? He claims that it was wrecked by Prime Center with some sort of long-range blast, in an attempt on his life."

"Nonsense!" retorted Raven. "He did it himself with a kind of gun. Was there no one with him when he spoke to Prime Center?"

"He insisted on being alone in the stereo plant. He locked himself in. It is true that he has a weapon and is patrolling the Reef with it. The NE broadcast called him insane. How can that be? He was ever the most rational of men, and yet—"

"Hang on a moment and we'll show you something," interrupted Raven. "We have a transcription of Vervain's interview with the Reef Council. Topaz, go below and bring the cartridge."

The "cartridge" was an optical by-product of the ever-expanding science of warp mechanics which had long since superseded the reel of film. When this manifesto of Triton dictatorship had been duly transmitted, Nautilus exclaimed:

"Incredible! We must discuss this with you in person! Stand by as you are while I open the portal. It lies dead ahead of you."

Raven and Topaz pressed their faces against the forward port and stared at the wall of granite.

"What's happening?" Raven ejaculated. "The ship's rising!"

"It isn't!" contradicted Topaz. "The cliff is moving. A piece of it is sliding down."

A great arched crevice had opened in the face of the cliff and the inclosed segment was descending smoothly, to the accompaniment of a powerful mechanical drone. A green-lighted space came into view beyond; the huge gate disappeared into its slot—a gaping chasm—which in turn disappeared with a *clank* as its cover slid into place.

"Now go ahead," called Nautilus.

THE DEPTHS beyond the portal were so brightly lit that Topaz extinguished the floodlight. Directed by the radio voice of Nautilus, the craft broke surface in a rectangular basin under an echoing, vaulted roof. The mellow submerged lighting painted the roof with writhing ripple shadows. Metal-bound packing cases were piled on granite quays which projected into the basin. Two submersible freighters rode at their moorings.

Nautilus' voice broke off in midsentence and his image vanished from the screen, which nevertheless continued to glow.

"What's happened? Now you see him, now you don't," complained

Topaz. "No one in sight to throw us a line, either."

Raven threw back the conning-tower hatch just as a door slid open halfway down the line of wharves, emitted a white glare, disgorged a highly vocal throng. The voices echoed clamorously under the vault of the roof. Various small-wheeled mechanisms were trundled out of the door. Raven was dazzled by a glaring round eye of light which was turned upon him. There were shouts of "Ahoy, *Kelonia!*" Several Tritons detached themselves from the crowd, dived into the pool and swam swiftly toward the submersible, churning up clouds of luminous foam. The stentorian tones of Nautilus issued from a group which had run out on one of the nearer wharves. Under his eye the *Kelonia* nosed into her berth and was made fast. The swimming Tritons, led by Merling and Cragstar, bounded onto the *Kelonia's* deck, splashing and spouting. They dragged Raven and Topaz from the conning tower, laughed at their amazement, deposited them on the wharf. A vociferous pack of News Exchange narrators and interlocutors immediately laid hands upon them, ringed them with mobile floodlights, televisors, microphones.

"How did you all get here?" marveled Raven.

"The NE ship landed up above; there's a way in from the topside," explained Merling.

"In Triton Reef you behold one of the engineering achievements of the age," declaimed a tall young man wearing the black-and-white cape of the News Exchange. "You must realize that all this huge chamber is the hollow interior of an artificial island."

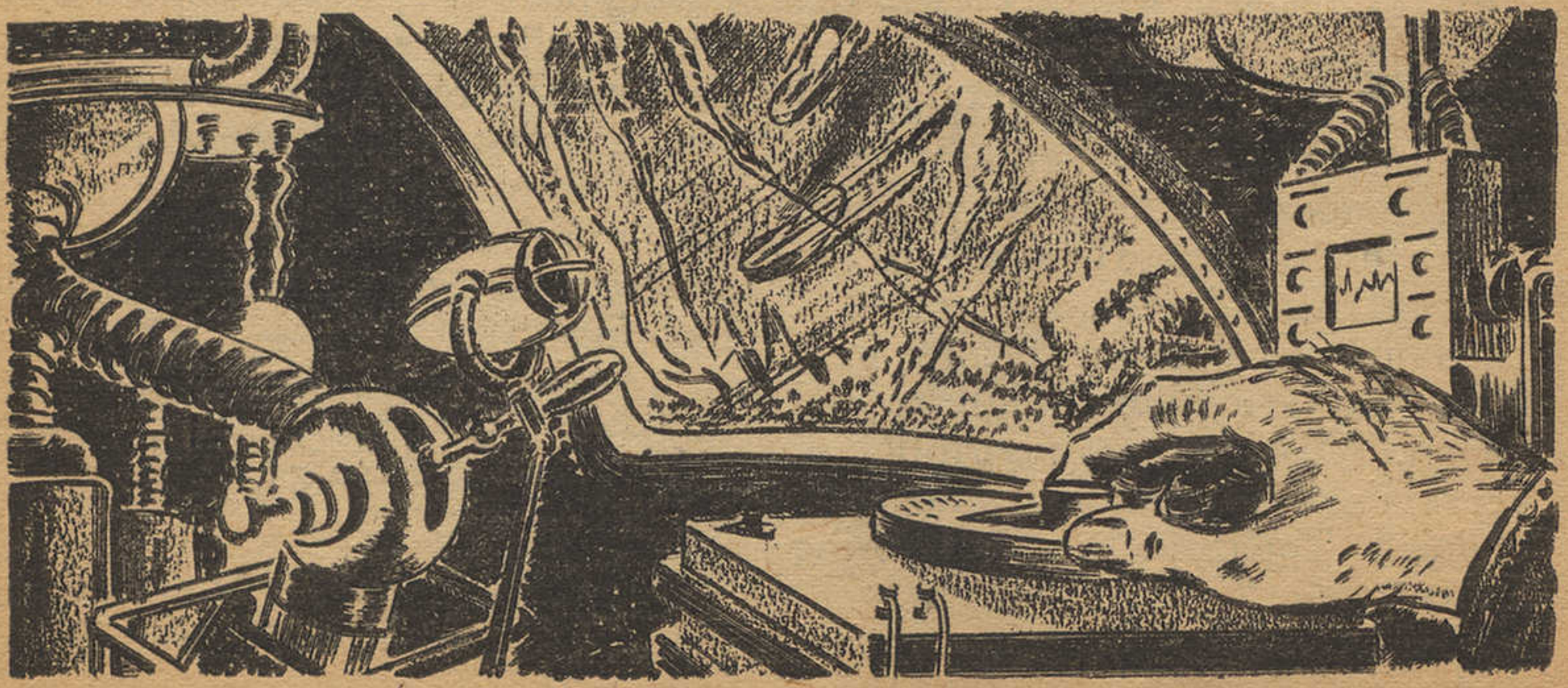
He gestured expansively, while obedient light beams and televisors followed his gesture.

"Externally it appears to be no more than a barren peak of naked granite," he continued. "Yet when we landed on its summit, Cragstar had only to touch the rocks with a little instrument which he carries and they opened up like Aladdin's cave, disclosing an elevator ready to take us down."

Penetrating feminine accents floated over the heads of the crowd.

"Show us this unfortunate transmitter which was so foolishly demolished," requested the voice. "We must see it in order to know what is needed."

"The transmitter! The one that



Vervain wrecked!" exclaimed Topaz. "We must see that. We might get pictures of Vervain."

"I fear that you must be advised not to approach the stereo plant," warned the tall young man. "A diatrode gun in irresponsible hands is not a hazard to which anyone should be needlessly exposed. For the present you are the subject, not the maker, of pictures. Let us first have your story."

"What story?" protested Raven. "We make animated murals, and we're looking for material."

The tall young man opened his mouth to reply, but was silenced by a crackling, rending din like the first crash of a summer thunderstorm. The wharf heaved underfoot, a floodlight toppled over, the lights in the pool went out, several people were thrown off their feet. A line of miniature whitecaps raced across the pool out of the sudden darkness into the zone of the floodlights. The rending noise faded into a prolonged, sullen grinding, and ceased.

"Another earthshock!" muttered Cragstar. "Any time, however short, that we remain on Triton Reef will be too long!"

IX.

Cragstar and the stereo maintenance crew were hurtled from the submersible docks to the anteroom of Vervain's quarters in an air-tight, bullet-shaped car through a hydraulic tube of mirror smoothness. At the end of its flight the car passed through an air lock. After releasing himself from his deep-cushioned seat, mounted on recoil plungers, Cragstar turned and addressed Aldarbrook, who was in charge of the maintenance crew.

"You haven't reconsidered?" he inquired dubiously. "You still think it advisable to make this direct request to Vervain?"

Aldarbrook opened the carrying case at her feet, removed and donned a headband bearing pivoted earphones and stroboscopic eyepieces.

"I shall approach him as if he were sane," declared Aldarbrook, "and ask his permission to repair the transmitter. Since we can't get into the stereo plant without passing through Vervain's rooms, and since he is said to be there now, we should be forced to use some subterfuge if we don't tell him our real intentions. Very probably he would see through any pretext; our equipment tells plainly enough why we're here. Then he would be angry, and an angry maniac with a weapon would be a real obstacle. This way, I may gain his consent. A blunt refusal is the worst I expect. In that case we shall await the *Capricorn*."

"I hope it works," remarked Cragstar as he opened the door of the car. He stooped and went out, followed by Aldarbrook and her crew.

"Great triple skew-torques! What's this?" cried Aldarbrook, stopping short on the threshold of Vervain's conference hall. The Dolphin Pool circuit had been restored and the place was now filled with light.

"This is Vervain's collection of anatomical models. Do you find them astonishing?" responded Cragstar. "You see, there are several ways of studying anatomy. Dissection is one way. The making of accurate structural duplicates is another. Some of these are orthodox human models, some are Tritons—students' work. The others represent creatures which do not yet exist—which may never exist."

"Marvelous! When the News Exchange narrators see this they'll all float away in a cloud of adjectives. Where's Vervain? I thought he was here."

At opposite ends of the chamber the green uniformity of the walls was broken by patterns like great targets —a ring of peacock blue, white ring, blue bull's-eye. The insignia of Submarine Products Corp.—the crown and trident—appeared in each bull's-eye, embossed in white metal. Cragstar indicated these twin objects. Short flights of steps led up to them.

"He may be in there, in the stereo room," said Cragstar, "or in the laboratory."

The outer ring of the door at which he pointed began to revolve as he spoke. The entire circular panel receded rapidly into the wall like the breech block of a huge gun, in reverse, exposing a burnished threaded casing and a lateral opening. A Triton hurried forth from this opening.

"Kalamar!" Cragstar called. "Where is Vervain?"

"In the culture room," replied Kalamar. "He is making a pretense of working. It is pitiful, like the make-believe of a child. He has forgotten almost everything. Already he has destroyed two gene cultures which cost him days of labor to isolate. Who are these people?"

"We're from Communications Central," replied Aldarbrook. "Can we get into the stereo room?"

"No; it is locked and Vervain has the key. He also has his weapon. I cannot persuade him to relinquish it."

"There you have it, Cragstar. We must see Vervain first."

So, ignoring the protests of the two Tritons, Aldarbrook invaded Vervain's laboratory and preceded them by way of double-insulated doors into the humid darkness of the culture room. A hooded crimson light cast a fiery glow on Vervain's impassive features, on his hands, and on the small apparatus with which he was busied—a Mephistophelean monochrome floating in blackness. Beyond him a shadowy multitude of glass ampules, tier above tier, threw back dusky-red gleams where the bloody radiance lay along their curved sides.

"What a hothouse! *Ugh!*" muttered Aldarbrook. "And the fumes! How can he stand it?"

All three began to cough and choke.

"What are you doing now, Pater Vervain?" inquired Kalamar between gasps.

"I am boiling some water," replied Vervain, slowly raising his head. Before him a little glass cup reposed upon a tripod, glowing like a ruby; it contained a clear, furiously bubbling liquid into which he had inserted a miniature immersion heater.

"But it is not water, Pater Vervain!" protested Kalamar in strangled tones. "It is chloroform!"

"Chloroform?" repeated Vervain with a rising inflection but a countenance of wood. "How do you know that? It looks like water."

"By the odor, the fumes! You will asphyxiate yourself!"

"The odor? Of course. I am stupid."

Vervain removed the heater from the cup with his right hand and transferred it to his left while he reached for the switch. The hot metal sizzled in his grasp. The three onlookers cried out. Vervain deliberately hung the heater in its rack and nonchalantly examined his burned hand—which still exhaled tendrils of vapor. Then he realized tardily that he had heard an outcry from voices other than Kalamar's. He groped beneath the worktable, came up with the diatrode gun.

"There are others with you, Kalamar! Who are they?"

The voice was threatening, but

only his mouth moved—a mere parting of the lips. Aldarbrook experienced an eerie sensation of the scalp and spine. She moved forward into the ruddy light, followed by Cragstar.

"I am from Communications Central," Aldarbrook informed Vervain. "We felt that we should consult you before beginning work on the stereo transmitter."

"So you should," agreed Vervain, lowering the gun a trifle, "inasmuch as I have the key."

"Without the stereo you are voiceless, a prisoner in Triton Reef," continued Aldarbrook. "Is *that* your ideal for the future leader of a world empire?"

"The earthquake shall be my voice," declared Vervain, flourishing the gun. "When five hundred miles of South American coast founders in the sea, it will be time for me to speak."

"Prime Center will call it a natural catastrophe," argued Aldarbrook. "How will you deny it? We must begin now. And this little weapon of yours—is it exactly suitable for one who wields earthquakes?"

"There is something in what you say," conceded Vervain thoughtfully, resting the gun on the worktable.

"With the stereo, you might have a direct beam connection with Central," Aldarbrook went on. "The whole world could hear your commands, see your face. Of course, if you care to appear before it carrying a mere copy of a weapon two thousand years old, that's your affair."

Vervain laid the diatrode gun on the worktable, folded his arms, and appeared to meditate.

THE DOOR of the culture room opened a few inches, the silhouette of a head appeared in the opening, and a narrow beam of light played over the group at the worktable. The head and the beam withdrew quickly, and before the door closed again the owner of the head addressed some second person in a loud whisper:

"It's Vervain! In there! Get everyone out of here!"

"Who was that?" exclaimed Vervain, seizing the gun and wheeling toward the door. He collided with some object which toppled over with a crash of glassware, then strode into the laboratory with the others at his heels. He entered just in time to see the flutter of a black-and-white cape as it vanished into the passage leading to the conference hall. Treading with elephantine heaviness, he pursued it gun in hand.

One of Aldarbrook's crew came forth from a temporary retreat behind a reagent case, spoke tersely as they ran after Vervain:

"We tried to open the door of the stereo room. Squad of broadcasters came in another way—not by the tube. All over the place before we knew. Someone told them—Vervain—on the other side of the Reef. Doubted he was here. Two of them came in to look."

When Vervain appeared on the stairs leading to the laboratory, two mobile televisors were already retreating from the hall on noiseless wheels, in reverse, toward the portal whence they had come. Their operators continued to broadcast, undaunted, as they retreated. A third televisor in the other end of the chamber was still engaged in a sort of Cook's Tour of Vervain's anatomical exhibits; the two scouts who had discovered Vervain in the culture room were sprinting toward it. The remainder of Aldarbrook's crew were at the foot of the steps, which they had just commenced to ascend.

Vervain shouted "Halt!" in a voice

of tremendous volume. A shouting mask could have been little more startling. The operator of the third televisor glanced over his shoulder, deftly swerved into the convenient haven of the anteroom doorway. Here he did an about-face and trained the instrument on Vervain.

"In order to dispel any doubts which you may harbor as to my intended use of this weapon," boomed Vervain, "I shall give you a demonstration. After that, you may have thirty seconds for your departure. You may take the body with you."

He leveled the gun at the televisor operator in the anteroom door and discharged a globe of humming blue fire. If he had been more versed in historical knowledge, he would have known that the slow missiles of the diatrode gun were intended primarily for use against stationary electrical war machines, not human beings or other moving targets. Also he would have known that the trigger should have been depressed until the globe found its mark, since the ionizing guide-ray was thereby maintained. As it was, the globe drifted leisurely across the chamber, hesitated above an unfinished, one-armed manikin with closed eyes and the serene expression of a Buddha, and drifted down upon its head.

The globe pirouetted, enveloped the head with a ghostly nimbus, vanished as if absorbed. The figure was convulsed. It threw aloft its one arm, reeled over sideways, flung itself about the floor like a decapitated chicken, rolled to the foot of the laboratory stairs as Cragstar and the others appeared behind Vervain. There it threshed its limbs in a final spasm, its eyes and mouth flew open, and it lay motionless and staring.

"Revolting!" shuddered Aldarbrook.

"It was not alive," soothed Cragstar, "but very cunningly made, down to the minutest muscles."

Kalamar stepped to Vervain's side, laid a hand on his arm, spoke a few quiet words. Vervain peered closely at an indicator on the gun butt and announced:

"I have one shot left. I must recharge. I advise no one to stand in my way."

The operator of the third televisor —although poised for a leap—had not left the saddle of his machine. Consequently all three lenses followed Vervain's stiff march down the conference hall to the door of the stereo room. Half a billion watchers of the telescreens, on Earth and elsewhere, relaxed briefly. As Vervain mounted the steps he stumbled, struck one knee against the edge of a step with a sickening crack. It seemed a crippling blow, yet he rose awkwardly, mounted the remaining steps without difficulty.

"The man seems invulnerable!" breathed Aldarbrook.

Kalamar was regarding the hand which he had laid on Vervain's arm, his eyes wide with the dawn of a fantastic surmise.

"Invulnerable?" whispered Kalamar. "Is he even human?"

X.

A ROTARY PORTAL opened at the base of an obsidian bluff and Merling came forth, followed by Raven and Topaz.

"This is Sea Horse Pool," said Merling. "Here we are below sea level, under water, and above water at the same time."

They stood ankle-deep in a turf of dense green mossy growth bordering a beach of white coral sand and shell fragments. The beach sloped down to an irregular lagoon, half a mile across, still greater in length,

ringed by the obsidian bluffs. The waters were a placid sheet of light, illumined from below, disturbed only by the bubbling of aërating jets. And above—not sky, but a roof of steel and silicoid, arched and groined, supported by a rank of mighty pillars which rose from the green-lit depths. And surging above the glassy roof—surf and green water! A broad shelf around each pillar at lagoon-level gave root-hold to luxuriant thickets of broad-leaved plants and blue-flowered giant creepers which climbed the columns ivy-fashion.

"They must be growing in a salt-water soil," remarked Raven, eying these growths. "Did your biotechnicians make them also?"

"Yes. These, and many things which grow down under," Merling responded.

"Where are the children?" Topaz inquired.

"Somewhere below. It is strange that none of them are on the beach. It is their free time— They come now!"

A swarm of glistening black bodies rose rocketlike from the depths, broke surface noisily, drove toward the beach with the speed of otters, leaving wakes of foam.

"All these are between fifteen and eight years of age," explained Merling. "Those younger have a pool of their own, with closer supervision."

The Triton children leaped upon the beach in a shower of spray and hissing water jets, became vocal when they had emptied their gill chambers.

"Old Eight-Arms! Dacna saw him fall in last night, when the roof cracked in the quake and the sea leaked in!"

"We looked after they fixed the roof and we couldn't find him! We thought Dacna saw a bunch of kelp!"

"An octopus?" exclaimed Merling. "In the pool? Have you seen it?"

"Yes! At the deep end, among the tall cup sponges!"

"He was floating near the bottom. We thought he was dead."

"Murex pinched him and he squirmed!"

"He swims slowly. He is hurt."

"Is everyone out of the pool?" Merling asked.

"No. Some are asleep in the forest. Dacna went to tell them."

"You had best go to your homes until the pool is searched," advised Merling. "Who is pool warden?"

"Dacna is first; I'm second warden," announced Murex. "I'll telephone Pater Vervain from my home—" He checked himself, clearly distressed. "But I can't. I'll call Kalamar."

Raven and Topaz exchanged significant glances.

"It's a take!" declared Raven. "We can do this. How big is this octopus?"

"A monster! His arms are—so long."

Murex made two furrows in the sand with his toe, indicating a length of about five feet.

"That isn't very big," Topaz commented. "We've killed bigger ones than that around the Antilles. You may do it this time, Raven. I'll shoot the pictures."

"What are you intending?" demanded Merling.

"You needn't send for your official exterminators—which I suppose is what you're about to do," answered Raven. "We'd rather do the deed—and record it in pictures. Our warp armor is protection enough. Just show us the place."

The device traditionally known as armor was in fact a one-piece, hooded diving suit of flexible alloy mesh embedded in pliant, transparent ma-

terial. A zipper extended from the jointed metal belt to a locking attachment on the forehead, under the light disk. The suit was equipped with a voice stereophone and an aerophore—whose "gill pump" was driven by a vortex motor the size of a man's thumb—both mounted in a boxlike knapsack. Raven and Topaz had returned to the *Kelonia* and donned garments of this nature after finding that they could not accompany Aldarbrook. Up to the time of their descent into Sea Horse Pool the zippers of the suits were partially open and the hoods thrown back.

Curiosity as to the means whereby the obviously unarmed Raven proposed to dispatch an octopus, together with his equally obvious unconcern, led Merling to consent to the attempt.

"We have done it with a pair of pliers," Raven observed with intentional vagueness, "but I'd rather use my gloves."

WHEN the zippers of the suits were closed and locked, the locking activated a warp-generating apparatus in the belt. Both suits were instantly incased in a third-order space warp whose presence was not evident until the wearers were submerged, whereupon it could be seen that they were enveloped in a film of air—a bubble sheath whose surface maintained an invariable distance from the alloy mesh. It conformed faithfully to the movements and flexures of the latter, rigidly resisted pressure and impact from without, and was almost frictionless—a paradoxical combination of properties which only the mathematics of warp mechanics could reconcile. The vents of the aerophore and steel corrugations on the palms of the gloves and the soles of the boots projected through this super-slippery warp surface. A movie camera the size of a large watch was mounted crosswise on the left wrist of the garment; its cartridge had a capacity equivalent to eight hundred feet of film.

Merling led the way into the lagoon, wading a broad shallow which ended in a drop of four fathoms. Raven and Topaz joined hands and stepped off after Merling, who swam downward with the suppleness of a seal. There was more light beneath the surface than above; they seemed not to be sinking through water but through a luminous green atmosphere in a swirl of quicksilver. They alighted on a floor of white sand among the lavender domes of brain corals. Before them a meadow of fern-fronded algæ sloped into glowing green profundities. The fronds bowed with lazily rippling unanimity before a gentle current.

The two air-sheathed figures, veiled in gray metallic gauze, plodded into the lower reaches of the gorge which traversed the center of the pool, while Merling looped and circled before them. She led them into the verdant dimness of an algal forest—towering spires tufted with olive-green bristles. Giant fawn-colored sea horses, russet-flecked, drifted through the foliage.

In a clearing where flower-headed marine worms grew among man-high sponges—bulging goblets of maroon velvet—Merling held up eight fingers, pointed among the bases of a sponge cluster.

An inert brick-red tentacle, splotched with dull gray, lay across their path. Raven stooped, seized it, brought the feebly-writhing octopus from its retreat with a vigorous jerk, inspected the bulbous body.

"Bad wound," grunted Raven into his stereophone. "Must have been

In a whirl of abrupt fury, Vervain hurled the massive iconoscope camera, spun and fled.

injured when it fell in."

"That half-dead thing! I wouldn't waste any part of a cartridge on it," said Topaz scornfully.

Raven bestrode the mottled body, interlaced the fingers of his corrugated gloves, made a steel-ridged vise of his hands. He pinched up a fold of octopus skin in the jaws of that vise, between the creature's eyes, made sure of the presence of a hard kernellike body within the fold of skin, then squeezed his hands together. There was a sharp snap like the cracking of a nut, and the octopus gave a final twitch and was still.

"Cracked the big ganglion," concluded Raven. "That finishes it."

Merling swooped before them agitatedly, pointed into the algal for-

est, held up eight fingers.

"What! Another? Warden Dacna missed one," was Raven's comment. "Perhaps they fell in together."

This second cephalapod half floated, half walked from its leafy concealment, malevolently alive and in the full fury of its living colors. The word "fury" is used advisedly. Its arms—which subsequent measurement proved to be seven feet in length—flamed with a scarcely describable hue, an unearthly hybrid color between vivid salmon-pink and burning orange, with an overtone of blue. They were dappled with a black which somehow surpassed black—a blackness infused with an obscure vibration of color. The suction disks were cups of ivory. On the swollen body the color scheme was reversed—black dappled with flame. Its eyes were disks of moonstone.

Merling retired to a discreet distance.

"Beautiful!" breathed Topaz, intently squinting through her object finder. "I'm sorry we have to kill it. Wish we had a better light. My headlight—that will brighten things up a bit. Don't rush things, Raven. Creep up on it. Crouch. That's it! Wonderful! Two wrestlers—man and octopus—feinting for the first hold! You've got the idea. Bother! It won't wait!"

THE OCTOPUS was in no mood to embellish its performance with the artistic niceties of feint and parry as conceived by Topaz. Under the beam of her light disk it reared up on its arms, a death's-head on stilts, then hurled itself on Raven, enveloped him in a rippling fabric of tentacles. The squirming mass rolled to and fro, rose and sank, uprooted some of the smaller sponges.

"I can't see you, Raven," Topaz called. "This is nothing but octopus. Stick out a hand or something."

"Give me time," answered Raven. "I'm just getting myself oriented."

Although the octopus sought furiously to secure a grip upon the ultra-smoothness of the warp surface, Raven slid and twisted in its grasp like a lubricated roller bearing. His head and one arm were thrust deliberately from between the bases of two tentacles below the eyes of his antagonist. A puff of inky fluid darkened the water.

"It's throwing a screen," admonished Topaz. "Roll out of it, Raven. It spoils the definition."

"You might speak to this bit of shark bait about it," suggested Raven. "It's the one who's doing it."

He now had both arms free and was eye to eye with his opponent. Its beak gnawed madly at the warp covering his chest. They rolled over, Raven vanished, and the mollusk ejected another cloud while Topaz fumed. The roll carried them beyond the cloud and Raven came to view again. His hands were clasped together and in position to crack the vital ganglion.

In whatever crypt of dark ferocity that may serve as the mind of an octopus there now dawned a fearful realization that Raven was no ordinary victim to be rent apart and gulped down at leisure. It suddenly unwound its tentacles. The fold of skin was jerked from Raven's grasp.

"No you don't!" he cried, seized a stalked, moonstone eye with one hand, thrust the other hand between the jaws of its snapping beak. His arm disappeared to the shoulder while his steel-ridged glove tore through its vitals, sought and found and crushed its cold molluscan heart. Both contestants were swallowed up in a gushing cloud of octopus ink.

Raven emerged from the cloud, trailing inky streamers.

"I cracked the ganglion also, just to make sure," he remarked. "The Triton Reef octopus squad can take away the remains."

"The action was good, but it didn't last long enough," Topaz commented.

The pool was now briefly suffused with scarlet light, then returned to its normal state of green radiance.

"What was that for?" Raven wondered.

"A signal, perhaps."

The illumination now blinked rapidly.

"Emergency code. The lights are talking. It was a signal."

"*Capricorn now over the Reef,*" blinked the lights. "*All Tritons will go to their places. Prepare to embark.*"

The message was repeated twice.

XI.

THE HALF-BILLION telescreen audience, its numbers now augmented by an additional million or so as various less essential activities throughout the world slowed down or came to a temporary halt, shifted their cramped limbs and viewed the descent of the *Capricorn* from her all-but-airless height. They saw it presented from three viewpoints, artfully interwoven in changing sequence from continuous transcriptions relayed and fitted together by the narrative editor aboard the *NE-6-137*. There were News Exchange televisors aboard the *Capricorn* also. They looked down upon an expanse of fog like a pavement of blue-shadowed gilded wool; saw it ripped aside from the face of Triton Reef by the *Capricorn's* mighty precipitators as if by the impatient gesture of an invisible titanic hand. They saw the fog-bedewed shield deck of the *NE-6-137;* saw it vanish in a blinding deluge of rain; saw the blue heavens open and reveal the *Capricorn*—a floating, gold-plated projectile reflecting the westerly sun with molten brilliance. From a televisor mounted by the outer elevator portal of the submersible docks they saw the *Capricorn* slide disdainfully alongside the News Exchange cruiser—golden whale and silver minnow.

The navigation cabin of the *Capricorn* was in her forekeel. The commander of that vessel was now fully aware of the nature of his mission and had forgotten his initial grievance over the interrupted schedule. Craving the satisfaction of direct contact via the unaided human voice, he hailed the *NE-6-137* from an open air lock with pretended ignorance and a brusqueness which had become habitual.

"Ahoy, you dust-breathing hedgehogs!" he shouted. "What sort of a layout is this? I'm told that you have here five hundred odd refugee sea nymphs who want to be taken off their island without getting their feet wet. Can't they swim? And no stereo! Where are your Communications experts? Did they forget their tools?"

"Well, well! If it isn't the *Capricorn,* practically dragging her belly on the ground!" replied the News Exchange officer in like vein. "Don't ask me for information; I'm just a bystander. You have your orders, so get on with the business."

The dock chamber re-echoed with the clangor and bustle incident to the embarkation of the Tritons when Raven and Topaz, intent on being at the focus of activity, returned thereto with Merling—who excused herself to locate Cragstar. The two submersible freighters which they

had seen on their arrival were transferring the heaped-up cases on the docks to the *Capricorn* via the submarine portal and outer lagoon. The Tritons were being taken aboard by way of the elevator. On its downward trips the elevator disgorged successive loads of men and paraphernalia from the *Capricorn*.

The navigators of the *Kelonia*, still garbed in their warp suits, but with the hoods open, elbowed their way to the door of the elevator in time to see the emergence of a party similarly clad, save that the suits were not equipped with aerophores or cameras and were provided with oxygen tanks. Topaz clutched a sleeve.

"What goes on?" she inquired.

"Why, I saw you in the broadcast not long ago," exclaimed the one addressed. "This? It's an industrial warp suit. They use 'em in chemical works and such places. We're going after Vervain. He can bombard *us* as much as he likes."

"Stand aside, please," said a Triton at their elbow. "We're moving the loading conveyor to this pier."

They dodged the moving metal framework which whirred toward them, suspended from overhead rails, and the warp-suit detachment was lost in the crowd.

Another party of Tritons entered the elevator. Raven caught fragments of conversation.

"—temporary quarters at Great Barrier. I'm staying there when we've built the permanent . . . search party hunting Cymorpagon . . . Florida Keys are my choice—"

When the elevator returned, it discharged a small rotor-driven truck with a load of gas cylinders marked in glaring red letters:

LETHEGEN! CAUTION!

"Lethegen! That's an idea," observed Raven. "I suppose it's for Vervain. But if they're going to use lethegen, then why do they need warp suits?"

"They can't just turn it loose anywhere," Topaz pointed out. "They might meet Vervain where they wouldn't want to use lethegen. There might be other people around."

Another trip by the elevator brought down another load of cylinders, this time lettered in white:

ANTIVECTOR GAS

"I'm beginning to understand," said Raven. "First they get him cornered. Then one gas, then the other. Where are they taking it?"

"Follow it and see."

THE TRUCK led them to one of the termini of the Triton Reef hydraulic tube transit system. Three bullet cars lay in their cradles by the loading platform. Topaz stooped to enter the passenger conpartment of the nearest car, found her way blocked by a man in a warp suit.

"Oh, hello! I saw you in the broadcast," she was greeted by this individual. "No. You can't. I'm sorry. but those are orders. We don't know what else Vervain may have in addition to the diatrode gun, and we can't risk having superfluous spectators around. Yes, I see your warp suits, but I'm not running this undertaking. The answer is—No!"

The two retired for a hurried conference.

"The third car, down at the end—no one seems to be watching it," remarked Raven, pointing with a gloved finger.

They found the door of the passenger compartment locked.

"Try the freight door, and hurry!" hissed Topaz.

The metal panel slid back easily, revealed the dark interior of the chamber in the tail of the vehicle.

"Plenty of room," announced Raven. "We can cushion ourselves with this packing."

The chamber was half filled with fluffy, cottonlike material.

"I'll make a thick pad of it against the rear wall and lie with my back against it," decided Raven. "Then you build another pad in front of me and lie against that. That will take care of the acceleration."

They had scarcely disposed themselves in their nest of padding when a voice cried, "Who left this door open?"

Came a thud as the door closed on its water-tight casing, followed by a creaking of locks.

"How about the air in here?" inquired Topaz out of the thick darkness.

"We'll be in here for only a few minutes," Raven assured her. "There'll be enough."

Topaz squirmed restlessly.

"There's something hard underneath this stuff, something with ridges on it," she announced at length.

"Perhaps it's boxed parts for the stereo," guessed Raven.

As if in reply the door opened, something was tossed in with a thump, and Cragstar's voice was heard indistinctly.

"—Exchange has a relay system working, so they're not going to rebuild the stereo for the short time remaining."

The door closed again.

"That disposes of your theory," remarked Topaz. "What *are* these things under me?"

The compartment was illumined by the beam of her forehead disk. Followed a silken tearing and rustling as she dug into the packing, then a sudden stillness.

"Name of a green porpoise!"

"What's the matter?" Raven inquired curiously.

Topaz's light was extinguished.

"Lethegen cylinders! I hope the valves are all good."

"A little leak wouldn't hurt. We'd recover soon."

"But in the meantime— Everything might happen!"

The car began to move. It slid into the air lock with a *clang*. Water gurgled around it. Then—acceleration!

The valves of the lethegen cylinders were in perfect condition when the car started, but they had been stowed away hurriedly. An interspace between the valve of one cylinder and the base of the one ahead of it was not solidly packed. When the acceleration began the forward cylinder jerked back two inches—

An ear pressed close to the valve thereafter might have heard a minute sizzling.

Fifteen seconds later the car slid out of the air lock into Vervain's anteroom. A member of the warp-suit squad opened the freight compartment, detected a faint banana-like fragrance, hastily closed it again.

"Gas leak," he replied tersely to a companion's query as he closed the zipper of his suit and encapsulated himself in a warp sheath. The others did likewise.

"Test kit is in there with the cylinders," he continued, speaking into his radiophone. "I'll find the leaky one."

THE TWO STOWAWAYS had been unable to surround themselves with protecting warps of their own because of the acceleration of the car during the first half of its transit; their arms had been pinioned at their sides. In that brief time the highly diluted lethegen had paralyzed the higher brain centers and they were removed from the compartment in a state of smiling vacuity.

Raven uttered one word: "Octopush."

"I shooed them away once," grumbled their rescuer. "What'll we do with 'em now?"

"Stand 'em up against the wall until they come out of it. They're only in the blank stage."

"They may fall over. Better sit them together on this bench. You can put them in any position and they'll stay. That's it. Bend their legs. Someone should keep an eye on them. You're appointed."

"Now then, where's Vervain?" asked the individual in charge of operations. "Is he still in the stereo room?"

"Yes."

"Is there anyone with him?"

"Triton named Kalamar, a sort of understudy to Vervain. Vervain let him in. I'm told that he seemed excited—said he wanted to verify something."

"We'll have to gas both of them. Where can we get at the air duct to the stereo room?"

"In Vervain's museum of oddities—the next room. There's a manhole into a service tunnel."

"Let's begin, then. We'd better keep our suits on until he's thoroughly gassed. He may come out at the first whiff."

A broadcast narrator in the conference hall leveled his televisor at the manhole leading to the service tunnel and bent over his microphone.

"The cylinders which are now being passed into the manhole contain lethegen," said the narrator. "An opening has been drilled into the air duct serving the stereo room and a stream of lethegen is being poured into it. They are using ten cylinders of lethegen, since a high con-

centration of the gas is desired and the stereo room is of fairly large volume. There goes the last cylinder, and Vervain has made no attempt to escape. Now the gas squad are removing their suits and piling them on the floor. One moment, please, while I inquire about this."

Pause, while the narrator made inquiries.

"There is no further need of the suits, since Vervain is undoubtedly reduced to a state of profound coma. Moreover, the expansion of the compressed oxygen which the gas squad have been breathing renders the interior of the suits cool and clammy. Now they are bringing in cylinders of antivector gas. This will sweep through the ventilating system and precipitate the lethegen as a shower of minute, stable, and innocuous crystals. The crystals are volatile at several degrees below body temperature; therefore they do not form in the lungs and cause irritation. The antivector gas does not neutralize the narcotic effect of the lethegen already inhaled and absorbed by the blood stream; that may be allowed either to disappear naturally—the length of time required depending on the amount absorbed—or it may be treated by other and more quickly effective means."

Two men mounted the steps to the door of the stereo room. The narrator continued:

"In a few moments we shall show you Vervain and the stereo room. There was a little difficulty in finding the reserve of duplicate keys—a matter which was in Vervain's care. These massive portals, patterned after the air locks of interplanetary vessels, render it possible to isolate an accidentally flooded chamber. Ah! The door is opening."

The circular portal receded and a cloud of sparkling white crystals gushed from the lateral opening like an eddy of snow. A party of four entered the opening, reappeared lugging an inert figure.

"Is this Vervain?" queried the narrator. "No! It is Kalamar. And see! He is tightly bound with copper wire! What could have occurred in the stereo room?"

"There's a perfect fog in there," announced one of the men carrying Kalamar. "The crystals are still coming down. Kalamar was near the door. We couldn't see Vervain."

"Then behold him now!" boomed a huge voice.

Vervain was standing in the portal of the stereo room, dusted from head to foot with clinging white powder, the diatrode gun in his hands.

He descended the steps and stood astride the pile of discarded warp suits.

XII.

"RAVEN! It did!"

Topaz found it strangely difficult to express herself.

"What did?" responded Raven dully.

"It leaked! I mean the gas, and we've been put off somewhere!"

"I don't care," yawned Raven; then exclaimed: "What did you say?"

Topaz repeated her remarks in more coherent form.

"We're in a tube station; there's three cars lined up," said Raven, his alertness returning, "and there's a lot of loud talking and running around going on—in there."

He turned toward the door of the conference hall, where Vervain had just made his appearance. The individual who had been detailed to "keep an eye on them" had been called upon to assist in carrying cylinders of antivector gas when it

seemed certain that Vervain was *hors de combat.*

"This misguided one shall be an example," Vervain was saying; he gestured with the diatrode gun toward the bound and unconscious Kalamar. "I had not made up my mind what to do with him. He attacked me after I admitted him to the stereo room. Now I have decided. Watch and take heed. Thus shall I deal with opposition. You who are supporting him may stand aside or not, as you wish; it is of no importance to me."

When Vervain had appeared, unscathed, after what should have been an overwhelming flood of lethegen, there had been a general outcry and momentary confusion in the conference hall, then a sudden stillness while he spoke. At the end of his pronouncement, the four who had brought out Kalamar laid their burden on the floor, sidled away—but they moved toward Vervain. All the occupants of the hall commenced a slow, cautious encircling movement toward Vervain.

While watching, listening myriads bit their lips, clenched their hands, rose from their seats, the broadcast narrator continued in a husky voice:

"It seems inevitable that Vervain will not be subdued without tragedy, unless— It has occurred to me that I may drive this mobile unit at Vervain, then leap off! I shall leave the televisor in operation. The broadcast from this particular point will cease abruptly. You will observe that we are now rushing directly toward Vervain."

The narrator's voice rose.

"But wait! We have a new factor in the equation!"

Two figures had darted into the hall from the anteroom—two figures incased in the glistening fabric of warp armor. The detachable weighted uppers of the boots had been removed, leaving only the corrugated soles. These two also were speeding toward Vervain.

Vervain had aimed his weapon at the prostrate Kalamar; then he perceived the headlong rush of the mobile televisor. A fraction of a second later he discovered the charging figures of Raven and Topaz. He wavered, confused, by a multiplicity of targets.

The navigators of the *Kelonia* now executed a maneuver which had originated in a sport of the ancient world—a sport of indomitable vitality, surviving universal social collapse to rise again, curiously transformed in some details but still recognizably the same.

At a distance of fifty feet from Vervain, Raven panted into his stereophone:

"Now! Together!"

As one they cast themselves on the floor, hurtled toward Vervain feet-first, super-smooth warp skidding on smooth vitrolith pavement. Under other circumstances it would have been a spectacular double slide to the home plate.

Vervain's legs were rammed by two pairs of steel-ribbed boot soles just as the televisor arrived. Vervain and televisor were overthrown together with a resounding crash. The narrator—who had forgotten to leap off in his concentration on Raven and Topaz—was catapulted into the tangle, further complicated by the pile of warp suits. The diatrode gun skittered over the floor. Raven rose from the heaving pile and slid after it.

A general rush—including two auxiliary televisors—converged on the melee.

Vervain heaved to his feet, shedding warp suits. The narrator tried to grip Vervain's legs, was kicked

loose and sent rolling over the pavement. Topaz bounded up from her prone position, leaped upon Vervain's back, fastened herself there with a full nelson and a scissor grip around the waist. Raven rose on one knee with the gun in his hand. The narrator scrambled to his feet with a detached wheel of the televisor carriage in his grasp, threw it at Vervain. The wheel rebounded from Vervain's head, sailed through the air, struck the forehead of a gas-squad man, felled him in his tracks.

Vervain jerked his head backward with irresistible force, broke Topaz's grip with ease, bent forward suddenly, sent her somersaulting over his head. The smooth warp surface was ill-adapted for wrestling tactics. Topaz ended her flight on the narrator. Now Vervain snatched up the televisor, carriage and all, lifted it above his head, hurled it at Raven.

This fearful missile descended on Raven and burst over his warp as if it had fallen on a block of steel. The diatrode gun was discharged by the impact. A whirling blue globe sped toward Topaz, who was disentangling herself from the narrator. It collided with the warp sheath of her hood and thereupon disintegrated into a score of lesser globes which fled away from each other, mutually repelled, into all parts of the conference hall.

One of these secondary globules struck Vervain in the chest. It seemed to melt into him. His arms fell limply at his sides and he stood swaying lightly, face and body racked with muscular spasms. Then he became motionless, stiffly upright. The crowd approached him cautiously.

Raven struggled up from the wreckage of the televisor, shaking off fragments of glass and metal, and hastened toward the throng which had gathered about the rigidly erect body, unfastening his zipper as he ran.

A gas-squad man stood before Vervain, ear pressed against his chest.

"It would be understating it to say that he's out cold," said the gas-squad man. "He's cold as a fish's tail. It's a queer way for electrocution to affect a man. He's dead on his feet."

XIII.

THE BODY LAY on a wheeled table in the dockmaster's office, where it awaited transfer to the *Capricorn*. Kalamar, now fully recovered from the effects of the lethegen, stood beside it and spoke to the silent gathering which filled the room.

"There can be no doubt; there is not the slightest indication of life," declared Kalamar. "Does it not seem strange—this immediate bodily coldness, the initial rigidity followed by complete relaxation with no sign of rigor mortis? See—I can flex the arm, the fingers, without the slightest difficulty, yet they are entirely lacking in warmth. It seems that no one has the answer. Nautilus, where are our fingerprint files?"

"They are packed and on Pier 7, waiting to be taken aboard," was the surprised response.

"Have the case opened and bring me Vervain's fingerprints, together with the kit for taking prints, and the projector."

"Certainly. But why—"

"You shall see," replied Kalamar, a cryptic gleam in his eye.

When the requested articles had been brought, Kalamar took the prints of the flaccid fingers on a glass slide and inserted two slides in the projector. The images were thrown on the ceiling.

"On this side are Vervain's au-

thentic prints," Kalamar explained. "On the other are the ones which I have just taken."

An outburst of protests followed. The authentic prints showed the usual tracery of lines and whorls; the others were mere featureless smears, with no distinguishing characteristics save some irregularities in the prints of the left fingers.

"The authentic prints cannot be questioned," replied Kalamar to the objectors. "I reprinted everyone in the Reef when I took charge of the fingerprint file. No, Vervain has never suffered an injury since then which obliterated the markings. I am not contradicting myself when I say that the irregularities in the prints from the left hand of this body are due to burns which were inflicted today. These new prints are not those of anyone in Triton Reef; they do not match Vervain's because *they are not Vervain's fingerprints.*"

"What preposterous nonsense! Are you mad also?" sputtered Nautilus. "We just saw you take them!"

"You did not see me take Vervain's fingerprints; that is impossible at the moment," retorted Kalamar. He turned and pointed at the figure on the wheeled table. "It is impossible because *that is not Vervain's body!*"

"Then whose is it?"

"When did the substitution take place?"

"Where *is* the body of Vervain?"

"It would be more to the point to ask, 'Where is Cymorpagon?'" responded Kalamar. "As to the identity of these remains, that will not be difficult to establish."

He placed a small, flat case upon the table, opened it, and exposed a glittering array of dissecting instruments.

"When we have done that—and it will not require much time—we must proceed to the much more important task of finding Vervain. I am now positive that—"

The following words, if any, were washed away in a tidal wave of sound—from the cosmic standpoint, a mere creaking of Earth's framework; to the inhabitants of Triton Reef, the infernal bellowing of blind, elemental power on the loose. Cubic miles of rock stirred and moved upward half an inch. A section of the granitoid dome above the dock basin rumbled, split, plunged into the pool with a roaring impact, engulfed it in darkness, sent a great wave washing over the wharves and into the dockmaster's office. Through the ragged gap in the dome appeared the serene green-blue of the evening sky and the lucid brilliance of Venus.

The occupants of the office were left floundering on the floor like stranded fish. Nautilus struggled to his feet, unhooked the flashlight at his girdle, swept its beam around the room. The wheeled table had been relieved of its burden. Other beams pierced the darkness. There were shoutings and moving lights along the docks.

"The body is gone!" cried Kalamar. "Look on the floor!"

But it was not there.

"Perhaps it was carried out in the backwash," suggested Nautilus.

"No, it is here," replied a new voice.

Vervain's voice! Without doubt, Vervain's voice! The alien quality had vanished.

A dozen beams were turned toward the source of these words.

Vervain—or that which appeared to be Vervain, and which Kalamar had pronounced lifeless—was standing among them.

"Regardless of appearances, I am not Vervain," declared the enigmatic

one, tapping himself on the chest. "Kalamar, I believe, will understand. Follow me and I will show you where I am—I mean, where Vervain is. We must go to Cymorpagon's quarters. I see that the way is already open."

He indicated a panel of the wall; it had swung outward on hinges. A triangular notch had been cut in the vertical edge and the detached fragment lay on the floor. Both notch and fragment showed a bright edge of a newly-cut metal.

"But—that was not open ten minutes ago!" exclaimed Raven, who for a time had been stricken wordless by the whirl of events.

"Therefore it was opened during the quake," replied he who was not Vervain. "Cymorpagon opened it by cutting out the lock. I presume he dived from the dock, swam through the portal, and is now outside the Reef. Probably we shall find the cutting tool at the bottom of the shaft."

"What shaft?" inquired Cragstar.

"I can answer that," said Kalamar. "That panel was once a grid opening into a vertical air duct. It was part of the ventilating system of the living quarters for the Drylander staff which manned Triton Reef in its early days. The chambers have been empty and abandoned for years; most of the entrances are sealed."

"But we examined all those chambers when we searched for Cymorpagon," protested Nautilus.

"Not all," corrected Vervain's double. "There were some which you did not discover; they are carefully camouflaged. If you will refer to the old blueprints of the Reef you

will see them. Now, if you will follow me—"

They descended the shaft by a built-in ladder of metal. The air in the duct was dank and stagnant. As their guide had predicted, the cutting tool lay at the bottom of the shaft; he picked it up and took it with him. A horizontal tube led them to a seamless blue-metal door.

"Beyond this lies Cymorpagon's hidden workroom," announced he who seemed to be Vervain. "The door is water-tight and provided with multiple locks. It will be simplest to carve ourselves a passage with the implement so conveniently left behind by Cymorpagon."

The cutting tool was of the type known as a decoherence cutter, or decoherotome. It slid through the metal with a crackling sound, leaving a transient phosphorescent trail, cleanly excised a circular block. The Vervain who was not Vervain pushed on the block and it fell inward with a clang; light streamed from the space beyond. He spoke over his shoulder as he started to crawl through the opening.

"You will wait here a few moments until I call you."

After a short lapse of time Vervain's voice said, "Enter."

The others peered into the chamber and beheld—two Vervains, standing side by side. A framework of intersecting rings like a huge armillary sphere reared its frabric behind them.

For a few seconds the two figures stood motionless, then one of them smiled and stepped forward.

"Your faces are a study in astonishment," he remarked. "Meet my *alter ego*, Vervain the Robot. It is he who brought you here—and who now releases me. Let me show you how he works."

When the others had entered and assembled around the framework of rings, Vervain clambered into the midst of it and snapped a metal harness about his arms, his legs, his body; inserted his head in a suspended helmet.

"This is the pantograph control," Vervain's voice came hollowly from the helmet. "From my cell I have seen it operated by Cymorpagon. Now I throw it into operation."

Lights glowed; Vervain was lifted and hung floating at the center of the skeleton sphere; the various rings moved and shifted slightly but noiselessly on each other. The robot duplicated Vervain's posture and began to speak.

"This harness is now enveloped in a transmitting field similar to that used in stereotelephony," said the robot, gesturing toward Vervain, who gestured away from the robot. "The robot carries a transmitter of its own, drawing power from here. I see what it sees, hear what it hears; it transmits my voice, does what I do. To duplicate facial expressions would involve refinements which Cymorpagon did not attempt."

The robot walked around the stereo-pantograph while Vervain trod on air within the shifting rings.

"If any part of the robot encounters an obstacle," it continued, "a certain resistance is transmitted to me through the pantograph. This is its nearest approach to a sense of touch. Only through this, and vision, do I have any information as to the surface on which the robot happens to be walking. It has no sense of smell and—fortunately for the operator—no sense of pain. It is not overly difficult to operate; one has only to project oneself in imagination into the scene revealed in the televisor, within this helmet. See—I make it climb this grating,

the door of my cell from which I watched Cymorpagon, then climb down again. In passing, you may ask how I opened it. I didn't. The last quake did that."

Vervain switched off the pantograph, descended from the framework.

"I am curious to know how you vanquished the robot," he said. "Not long before the quake, something happened to Cymorpagon. There was an electrical discharge from the pantograph; Cymorpagon was surrounded by a faint bluish corona for a few seconds, and hung limply for quite a long time thereafter. I thought he was dead. Then he began to groan, and hurriedly climbed down from the pantograph, muttering about something he had seen in the televisor. After that he took the cutting tool and departed, leaving me in my cell."

Raven and others gave a brief description of the struggle in the stereo room.

"It seems, Raven, that yours is the first authentic instance of mechanicide," said Vervain.

"Is that also part of the stereo-pantograph?" inquired Cragstar, indicating a bewildering mechanism which occupied one whole wall of the room.

"No, that is Cymorpagon's earthquake machine," responded Vervain. "He gave me quite a discourse on it when the robot Vervain was supposed to be asleep. He claimed to exert a secret control over the geodyne converters by means of it. Actually it is no more than the imaginings of an insane mechanical genius, made visible. It moves, it seems to do things, but accomplishes nothing. Any tampering with the converters would obviously register on the indicator panels. Even if Cymorpagon's scheme of producing artificial Earth movements were theoretically possible, the little driblet of energy which our entire geodyne plant extracts from the Earth's core would be a microscopic portion of the required amount.

"His mind seemed divided into two compartments. With one, he discharged his duties in the geodyne plant with outstanding efficiency. With the other, he conceived things like this. And at the same time he was astute enough to provide his workroom with a self-contained source of energy, so that there would be no drain on the Reef power lines."

"How did he get in and out of this place ordinarily?"

"Through the tool closet. It has a sliding floor which communicates with his sleeping pool. That's how I came in. He must have spent years in building this hide-out, little by little."

"Which brings us to the 'evidence' he spoke of," remarked Kalamar. "What was it? And his opposition to the ambitions of our children—where does that fit in? He seemed plausible for a while—I regret to say."

"There was no 'evidence'," responded Vervain. "That was pure deception. I doubted its existence, but I had to know the facts, whatever they were, and walked into the trap. I did not expect to be forcibly imprisoned. I believe that his opposition was sincere in part. He was among the earlier synthetic Tritons—a laboratory infant, drawn squalling from a cylinder of sterile plasm. The technique was not so precise then, and as he grew older he brooded over his physical differences. Triton Reef was his fortress; he feared the other world. He became an obsession—psychopathic."

"But the robot, in your likeness! Cymorpagon couldn't have made

that," objected Nautilus. "He was no anatomist."

"True. But he was a warp engineer. He fitted it with pantograph control," responded Vervain. "I do not know when he obtained the body. The head—Kalamar will remember that."

"It was made as a jest," Kalamar informed them, "during my student days. We always made the heads in the likeness of someone. As I recall, yours was mounted on a pedestal and provided with a phonographic attachment."

"And presented to me," finished Vervain. "Eventually Cymorpagon admired it and I gave it to him. It may be that it was then he conceived his puerile dream of a Triton autocracy."

"Cymorpagon was about two thousand years late," said Cragstar reflectively. "If he had lived in the times of those skew-minded people who thought that they could rule the world single-handed—you know whom I mean. There was one called Butler, or Whistler—I can't think of the name at the moment."

"You're thinking of Hittelberg," Raven declared promptly. "There was a university town by the same name in this country."

"I am never very quick at remembering historical names," apologized Cragstar.

THE *Kelonia* had turned her prow northwestward toward Pitcairn Island, rose and fell on the pursuing rollers which broke over her stern with a rhythmic swashing. Overhead, a star-dusted sky in a rare interval of clarity. Raven and Topaz gazed toward Triton Reef through the aft port of the control cabin.

"The Reef hasn't been so lit up since the S. P. C. engineers finished it, I'll wager," remarked Raven.

Half a mile above it hovered the *Capricorn*, the Tritons and their belongings now safely aboard. She was bejeweled with lighted portholes, and played a ten-million-candlepower beam over the crags and spume geysers of Triton Reef. Another giant beam burned down upon the *NE-6-137*, afloat at a lower level, transmuting her into a spindle of silver flame. The NE cruiser in turn sprayed the *Capricorn*, the Reef, the sea with a fan of lesser beams, sent them twizzling to the horizon and back again, splashed golden coruscations from the sleek hull of the *Capricorn*.

At Communications Central Narhajian's transcription editors had already nearly completed building up a master cartridge into a progressive, coherent narrative, which presently would begin to unreel its tale of strange history made and stranger history in the making, by wire and radio and stereo beam. Around the world the duplicators in their millions waited to reproduce that cartridge, for study and repetition at the receiver's leisure:

THE SAGA OF THE TRITONS

The narrative began:

CHAPTER THE FIRST

Vervain and Kalamar, aboard the *Capricorn*, stood on a deck of silicoid and looked down upon the Reef through a half mile of vacancy.

"At first, I thought that you were under some form of mental control," said Kalamar, "although so far as I knew, Cymorpagon was no hypnotist. I began to suspect when I laid my hand on your—on the robot's—arm. It was cold, cold and rubbery. Then I thought of the line like a scar around the neck."

"Somewhere down there he still lives—I hope," mused Vervain, thinking of Cymorpagon as the illumination poured over Rhinoceros Rock. "The Reef is well provisioned. We may find him when we return to salvage the heavy equipment—What's that?"

A tiny, glistening, black figure was creeping antlike toward the summit of the peak on Rhinoceros Rock.

Hooded televisors were hastily uncovered. The weary telescreen audience, slowly dispersing or sprawled about their instrument among the litter of hastily prepared refreshments, were galvanized by a terse announcement.

"Cymorpagon has shown himself on one of the islets of the Reef. The *Capricorn* is launching a boat to take him off."

But the rescue party never reached Cymorpagon. A televisor with telescopic attachment, aboard the lifeboat, caught a brief picture of him atop the horn of Rhinoceros Rock. He was drenched in the vivid glare of the *Capricorn's* beam, a figure of blue-black and silver with luminescent eyes. He stood with feet widely planted, hands clasped behind him. He seemed to be trembling, but he was not. Rhinoceros Rock itself was quivering.

Cymorpagon regarded the descending lifeboat—not with the imploring, terrified eyes of a proper castaway—but with contempt, defiance, even triumph. He swayed with the swaying of the rock, struck himself on the chest with one hand, made a sweeping gesture with the other, as if to say, "This is my handiwork!"

The televisor on the lifeboat ab-

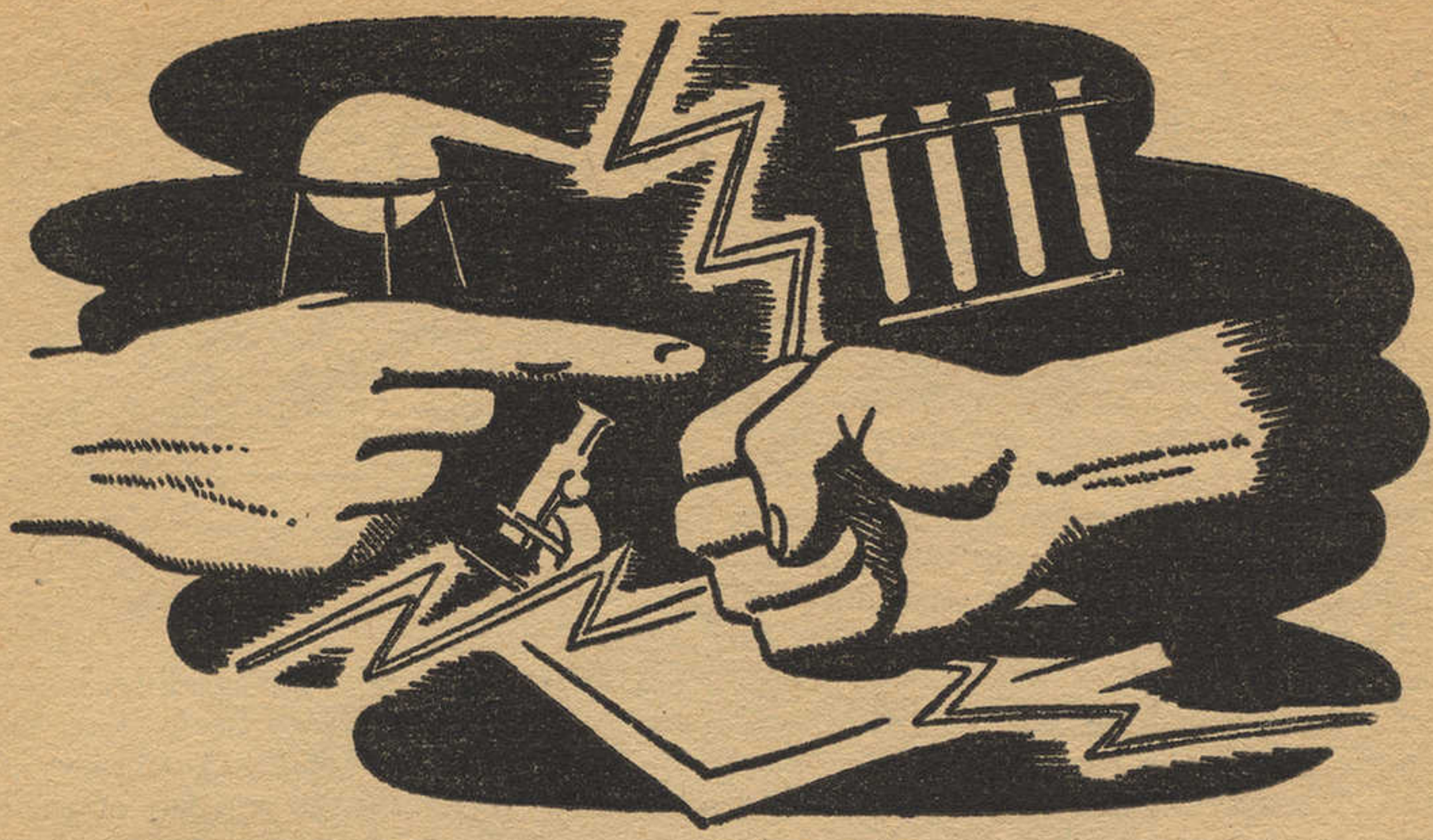
ruptly lost Cymorpagon's image. Rhinoceros Rock was crumpling, sliding, disintegrating in cascades of flying granite. The sea was laced with interweaving lines of foam like the sand patterns on a vibrating plate. Sea and sky shook with the thunder of invisible artillery. The ruins of Rhinoceros Rock, the crumbling dome which covered the submersible docks, a dozen neighboring pinnacles sank and vanished like foundering ships. A great circular wave, white-crested, spread outward from the debacle.

The wave overtook the *Kelonia*. She soared upward to the stars while Raven and Topaz staggered on the leaping deck, clawed madly for handholds. Then she plunged downward until it seemed for a few frantic moments that she must surely dash herself against the ocean bottom.

"Even madness may serve a purpose," whispered Kalamar. "If Cymorpagon had been sane, the submersible fleet would be three days' away and we should be down there with him."

The sunken wreck of Triton Reef lay far astern. Astern of the *Capricorn*, skirting the fringes of the outer void. Astern of the *Kelonia*, unhurriedly cleaving the sea at five fathoms. But aboard both craft the dreams were the same—dreams of shallow seas under kindlier skies, and sun-gilded groves of sponge and coral.

THE END.



BRASS TACKS

These "Final Blackout" letters are but a few of many. They vastly interested me, because the readers dispute the actions of the character with the author —which means the author made that character live!

Dear Mr. Campbell:

If L. Ron Hubbard never writes another story, he will still have his place in the Hall of Fame, not only of science-fiction, but, in my opinion, of literature as well. I've read quite a bit in my short life, but I will be surprised if I ever again read a story as powerful as "Final Blackout." All the points were brought forth with great force, and when I finished the last sentence tears were at my eyes, and I'm not ashamed to admit it. "Final Blackout" rated the "nova" and any other award you have to offer.

Before reading the last installment, I had a few minor criticisms in mind to write to you about, but I wouldn't think of it now. The excellence of the novel swept all thought of cheap gibes away. You may be sure I'll not let those three issues of your book leave my hands.

The rest of the stories in the June publication were good enough to have rated excellent if they hadn't been in competition with L. Ron Hubbard's masterpiece. "The Roads Must Roll" and "The Testament of Akubii" were the outstanding among these. Your cover, by Rogers, shows that gaudiness is not necessary to attract trade.

Stating again that "Final Blackout" was a terrific novel and will probably rate among the top three this year, even above "Gray Lensman," I leave you.—Albert Manley, 1628 N. Abingdon St., Arlington, Va.

I'm led to believe that "Final Blackout" must have been liked!

Dear Sirs:

Before starting this letter let me say that I have never before written to any magazine for any reason whatsoever, but in this case I believe it can be broken.

I am writing to congratulate you on printing a story of such high caliber as L. Ron Hubbard's "Final Blackout." For sheer excitement, suspense and interest it certainly was the tops. The setting of the story was well-chosen and it was carried through to the end with a tension only a very good writer could keep up. It is true, I am somewhat disappointed with the end which did not seem at all fitting for a man like the Lieutenant, but I suppose the story had to stop somewhere. All in all it was the best story I've read for years —and I've read many. It certainly puts Astounding in the lead of all other magazines, if it wasn't already there! I'd like to see more serial stories of the same type in the near future especially by L. Ron Hubbard.

I might add I've read Astounding since March, 1937, and have found it the best. In fact Astounding is the only magazine of its type I read. I think I have now had my say so again congratulations to L. Ron

Hubbard and Astounding.—Harry Snyder, 44 Rusholme Road, Kitchener, Ont., Canada.

Hubbard evidently made the Lieutenant real!

Dear Mr. Campbell:

Having received the final installment of Hubbard's serial and read the story as one whole novel I can now come to two conclusions: this is going to be one of the most controversial novels ever printed, and I should have read it over the two months' period because it is much too dynamic to take in one sitting.

The style is the kind I most enjoy, not too much science and no trite Rover Boy actions. The Lieutenant, despite Hubbard's obvious sympathetic feelings for his character, was, to me, one of the most despicable I ever encountered. The ordinary citizen, no matter how broadminded he may be, cannot honestly accept a person into his realm that is so shockingly different from himself. I do not know if the author realizes it, but in this strange character he has endowed the perfect makings for the recently popular "human mutant" or "superman" in science-fiction stories. And I believe that only the second generation of war-cultured beings could reasonably become the mutants that will exterminate the present order of homo sapien, their own parents.

The many ideaologies that the author seems to sponsor do not conform with mine. I do not think a militaristic form of government, as was the future England's, could bring anything but a return of medieval transformations. As one of the "rabble"—politicians and peasants—I would certainly dislike being classed as such, and from observations of the past, the ruling aristocracies seem more to be the rabble by living from the efforts of the people they so despise. Antiquated and naïve as the present run of governments must seem to such as the Lieutenant and his "mechanical" human followers, I prefer the happy, though jumbled, freedom I now enjoy. I can't wait to hear what the more pink-tinged of your readers will have to say on the subject.

I've often read that science-fiction is escape literature. Far from it, I should say, with such socially significant stories as "If This Goes On—", "Final Blackout," "The Roads Must Roll" and others. Ten years ago the general run of fantasy tales provided fun and an entertaining few hours. Today the science story is an all-time job to read, and not an easy one to solve, at that. My head feels queer after finishing an issue of Astounding, as if it were working after a long period of in activity. But those articles! They leave my brain but a throbbing agony. Surprise: the Isip boys did the best illustrations for June.—Charles Hidley, New York, New York.

"Surrealism" does what realism can't sometimes.

Dear Editor:

Congratulations! Astounding is out of the hole at last! The March issue showed the upward trend, but the April issue is outstanding after almost a year of mediocre stories. The cover was very good and stood out among the other magazines on the newsstand as it should. I hesitate to give Part One of "Final Blackout" a rating because of the two parts yet to come. However, I enjoyed it very much and indications are that it will develop into a near-nova.

In my estimation, "Reincarnate," by Lester del Rey was the best novelette. The plot and ending combined with Kolliker's two illustrations give it an A-plus rating. The picture of the atomic explosion was so expressive that it made me wonder if surrealist art didn't have something on the ball after all. Let's have more of Del Rey and Kolliker.

"Repetition," by Van Vogt, was in second place with a rating of A. It was a good example of some of the problems which will confront planetary adventurers and possible ways of solving them.

"Admiral's Inspection" rates an A minus. It was a good story with a humorous touch and offered interesting entertainment.

"The Treasure of Ptakuth" was a better-than-average tale and gets a B rating. Mars is going to have a hard time living up to the expectations of science-fiction fans.

"Unguh Made a Fire" was fairly good and rates a B minus. It was so improbable that I had a hard time enjoying it though.

"The Magic Bullet," science article supreme by Ley, I found very interesting and informative. I am very interested in gas and explosives myself and have done some experimenting along this line, so Ley's articles always "hit the spot" as far as I'm concerned.

A superb issue indeed! Let's not slump again, and how about another astronomical

cover soon?—D. L. Dobbs, 1011—17 Avenue, South East, Minneapolis, Minnesota.

"Heinlein" is really (Shh!) Robert Heinlein, and not a moving picture, pen name, or imitation!

Dear Mr. Campbell:

Best story in the May issue is Simak's "Rim of the Deep." Give the man credit for writing a really new kind of undersea yarn. The plot didn't matter, thank goodness—the warm, familiar atmosphere of "coral city" and the deeps, and depth-dippy Old Gus were among the most refreshing things Simak has done. Maybe he did treat pressure and things a little lightly—but give him an *A* on this one.

Outside of that it was a good issue, with ratings going something like this:

"The Last of the Asterites"—B-plus. Atmosphere again, and an interesting situation. Your blurb about flotsam on the waves of civilization struck the right note, made the story twice as much worth reading.

"Space Guards"—B.

"Hindsight"—B. Not bad.

"The Long Winter"—C. Drawn out. Same idea could have been written more effectively in two thousand words. Gallun has done many, many better—and darn few worse.

"Space Double"—C. Robots; phony villains with an unnatural brogue, and a weak-kneed hero too darn dense to see the obvious, combine to make this a dud. It was readable, but no more.

Who is Robert Heinlein? He knocked me off my feet last year by writing the third best story of '39—"Life Line"—and now he goes ahead and writes the best of 1940—"If This Goes On—" of course. A really honest-to-goodness-new author? Ever since my second favorite s-f author turned out to be a pseudonym for the first, I've been on the lookout for pen names. But if Heinlein's really new, he's a find.

My list of the best yarns of 1939:

1. "The Gray Lensman."
2. "Cloak of Aesir."
3. "Life Line." (Swell idea, swell story.)
4. "Cosmic Engineers."
5. "Shadow of the Veil." This bit by Gallun raised scarcely a ripple. Yet I liked it enough to read it three times.—Oliver Saari, 943 Dupont Avenue North, Minneapolis, Minnesota.

Is that a reason or an excuse?

My dear Sir:

In your June issue, you wonder what is wrong with the army. Let me be one of the "million men who will spring to arms"

(237,000 off.) to answer this challenge. There is nothing "wrong" with the army, we don't write science-fiction, we read it.

And having read it we silently pass judgment, either approving or disapproving. But because we say nothing you wonder what is "wrong" with the army. It has long been known to the army that the ultimate function of the navy was to entertain the army. Would you have us write science-fiction, and thereby with our superior talents, force the navy out of their last sphere of influence?

No, let the navy write its science-fiction, and the army continue to read it and be entertained.—James Post Meyer, Corporal, Hq. Btry., 1st Bn., 9th F A, Fort Lewis, Washington.

SCIENCE DISCUSSIONS

New angle on "Technological unemployment"—for cyclotrons!

Dear Mr. Campbell:

I took advantage of this visit to Boston to get some information and views on atomic power. The items in the accompanying article are a sort of secondhand reaction; I talked to some of the nuclear research men in town. Their reaction to the atomic power story was about as I suggest in the article; "aren't these newspapers a little slow? They'll be getting excited about the discovery that radium and X rays cure cancer next."

Also the physicists vs. physicians feud around the cyclotrons is one of those good-natured mutual struggles. Each side actually recognizes the importance of the other side's work—but each side still wants more

from the cyclotron than would be possible if they could get it full time. The physicists really get it in the neck worse than the biochemists; they not only can't do their own work, but have to run the cyclotron and do the biochemists' bombardment work.

Finally, I take full blame—or credit; we'll know later!—for all predictions. The items on shielding difficulties are the result of talking to many men, plus my own ideas, checked where possible against data tables.

One question that occurred to me while talking to the cyclotroners and—oh, call that van de Graff apparatus a "statotron"—statotroners was the delicate question of technological unemployment. What to do with cyclotrons and statotrons when the U-235 is available in quantity? Who wants a cyclotron that makes radioactives in millimicrograms when U-235 is available?

Answer seems to be about the same as in chemistry. Who wants test tubes when commercial chemical plants can make sulphuric acid, et cetera, by the ton? Answer: all research must be done in test tubes first. It would have been unhealthy to invent nitroglycerin in ten-ton lots, for that matter. Cyclotrons and statotrons are test tubes for nuclear physics—and for atomic engineering. (Wonder what school will be the first to grant an A.E. degree, meaning Atomic Engineer?)

Another thing—the forgoing may be of no particular interest, but since several people seemed interested in that letter about the actual set-up of a cyclotron, they may be interested in a statotron. You can run this in Science Discussions if you like, but knowing you, I think you'll be interested anyway.

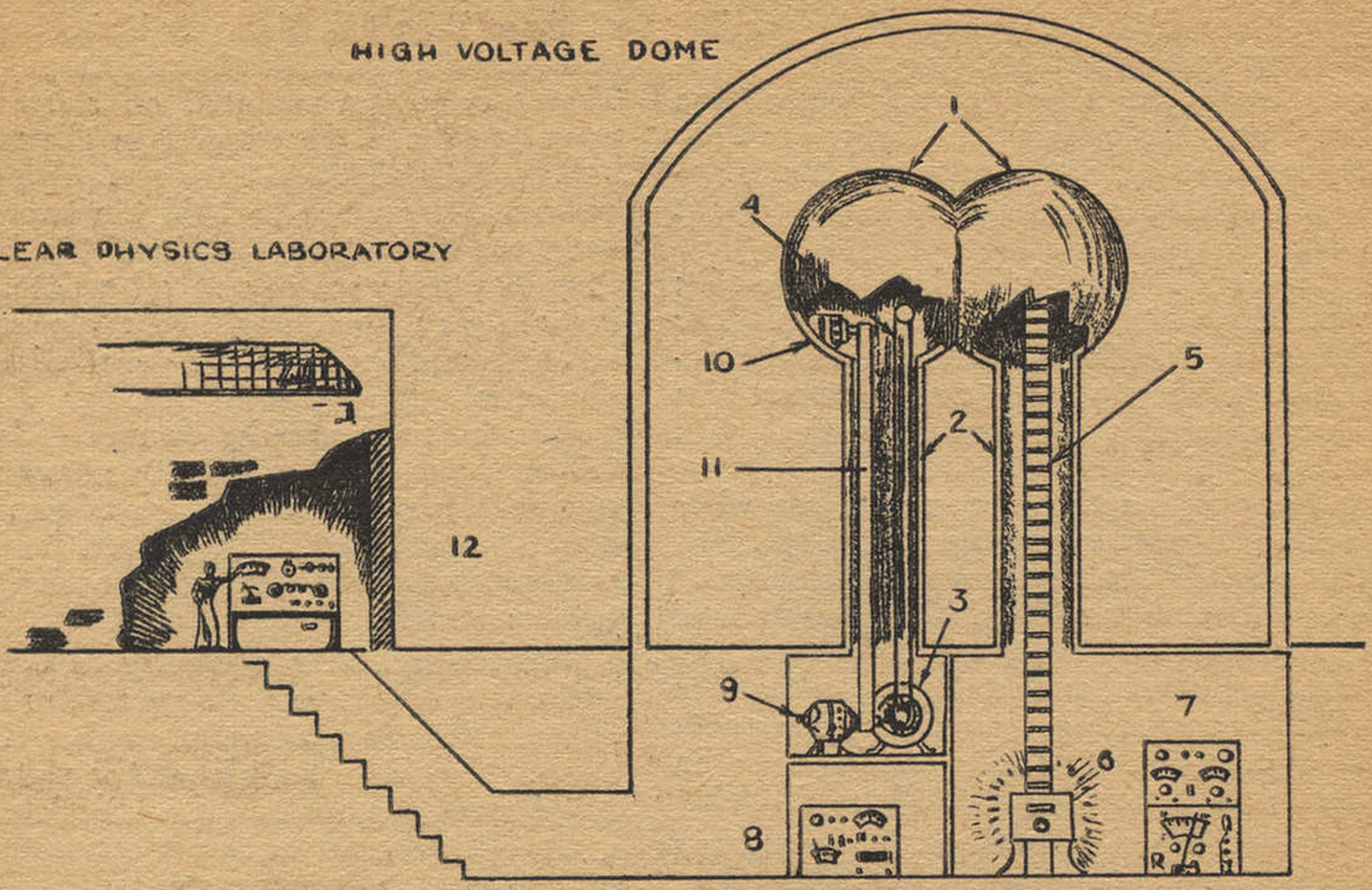
I've copped your abbreviation "statotron." It seems to be highly unofficial, because the men out at M.I.T. who were working on it, called it either "high voltage generator" or "van de Graff outfit" Inclosed find a sketch of what I will herewith commence to discuss.

As with the cyclotron, the statotron's main gadget is impressive, necessary, but of no particular interest to the men working on it. At M.I.T., they have the potential balls on two twenty-three-foot towers of textilite—cotton fabric and a synthetic resin bonded under heat and pressure—in a huge dome. The place is startlingly empty—just the two great brownish towers topped with two immense metal balls touching and slightly interpenetrating each other, like one of those Edgerton high-speed photographs of a pair of tennis balls in violent collision. There's a ladder mounted on a swiveled mount to reach the opening in the nearer ball. That's all there is to see. Since the dome is big enough to hold the two huge balls and their towers and still be better than fifteen feet away at all points, and it's all gray aluminum lined, the echoes and the emptiness give it a queerly impressive effect. To the men that run it, this part is of no particular interest—it's the tail on the dog. They've got to have it, of course; that's where the high-voltage currents are generated. But the real business, to them, is the complex and beautiful control panel and apparatus downstairs.

Everything that is necessary to the control and operation is underground, or in an adjacent building, a goodly number of feet away. They're not afraid of the voltage—a few good grounds and a couple layers of cyclone fencing would be perfect protection against that. But two-and-a-half-million-volt X rays take a lot of stopping.

That's why the apparatus is constructed as it is, now. Originally, the two great balls, and two towers, were used as separate, opposite generators. One was charged 2.5 million volts minus and the other 2.5 million plus, giving a total of 5 million volts available. But to operate and control the thing, to get readings on its work, someone had to stay in one of the two spheres. He was perfectly safe from voltage there—but they were getting 5-million-volt X rays which could not be adequately shielded out. They couldn't operate by remote control, because the control wires couldn't be insulated against 2.5 megavolts very handily. Hence the two were combined into one generator, and the control-and-reading end of the voltage is at ground potential, making remote control possible, but reducing the voltage to 2.5 megavolts.

In one of the two towers, now, is the charging apparatus—which see below. The other contains the tube. This is a built-up series of comparatively short but wide porcelain tube sections cemented to copper rings and made vacuum-tight. This construction was adopted to make the potential spread itself evenly down the tube. If there were a slightly lower resistance on one side of the tube than on the other, and it were all porcelain, there would be local differences of potential that would distort the beam of particles shot down it by the high voltage. The copper rings smooth out the potential.



1. Joined high-voltage sphere.

2. Tall insulating towers on which spheres rest.

3. Electric motors driving charging belts—one of three shown.

4. Main charging belts.

5. High-voltage tube through which particles to be investigated fall.

6. Target bombarded by particles—what all the massive apparatus is built for!

7. Local control board—used only in preliminary tuning up; dangerous due to X rays when apparatus is in operation.

8. Control board for charging motors and belts, and for apparatus which sprays charge on the belts.

9. Small motor which

10. Drives this generator

11. By this belt to supply power for filament heating, ion source, et cetera, in the sphere.

12. Main control board. Nearly all experiments are performed by remote control from here, where the operators can be safe from X ray and other bombardment.

The tube is constantly pumped by vacuum apparatus to maintain the necessary high vacuum. This is at the lower, ground-potential end, near the target and reading apparatus. One advantage the statotron enjoys over the cyclotron is that there is nothing but X-radiation to disturb instruments mounted right at the target. It's all grounded, and there are no magnetic fields. Furthermore, they can use lots of rooms, having to avoid only the slender tube coming through the ceiling of the underground room.

In a separate room, immediately under the second of the two sphere support towers is the charging apparatus. The van de Graff high-voltage generator employs the principle that made old-time mill hands swear bloody murder every now and then—that a running belt on machinery rapidly acquires an unhealthy electric charge, so that if you get near it, you get bit. The statotron apparatus helps this along—it's what they're after. Below the hollow tower, there is a framework bearing three 10-horsepower electric motors, three long steel spindles driven by them, all mounted on a heavy steel framework, and a smaller 5-horsepower electric motor—purpose explained below.

The three large motors drive the three charger belts—three yard-wide rubber-and-

fabric things of impressive size. They run up the tower and over spindles at the upper end. Along each spindle at the bottom are hundreds of little sharp metal points, almost but not quite touching the belts, and all pointing at them. These are carried on insulated rods, connected to a fifty-thousand-volt kenotron rectifier outfit. When the apparatus is running, they spray the belts with electrical charges, the belts carry them up to the sphere, where fingers wipe off the charges.

The fact that 30-horsepower was used to drive the belts rather startled me at first. But it's needed; those belts *move*. They are driven at the full speed of the electric motors, and they're big. There's windage loss, since they naturally stir up considerable breeze and stiffness to overcome. And, finally, it really takes horsepower to carry electric charges up to that blamed sphere. There are 2.5 megavolts repelling those charges, trying to force them away. It takes a full 4-horsepower to force those charges up there against the repulsion of the voltage up topside.

Finally, the small motor. The 5-horsepower item is connected by another long belt to a dynamo mounted in the sphere. They need power up there to run a cooling refrigerator for the apparatus mounted in the tube. More is needed for the actual creation of the ions accelerated by the 2.5 megavolts. There are a number of small items needing power. And you can't wire in power to a sphere carrying 2.5 megavolts very handily. The answer is to belt in mechanical power.

This entire apparatus—big motors, framework, spindles, small motor—is all practically suspended from the three belts. To keep them from flapping, a strain of some fifteen hundred pounds apiece is needed, so the weight of the motors and framework supplies it.

Finally, this entire room is air conditioned to about 100° F., and a chemical air dryer is in action. Static leaks off if there's moisture around, so they keep it out.

The main control is in an adjacent building about one hundred feet away, reached by a tunnel. The lay-out is such that X rays wishing to visit the operators cannot get up the tunnel. It looks like something designed by a Chinese with the understanding that devils always travel only in straight lines. This type of devil does.

The motors, ion-source, everything can be controlled from this room. The beam coming down the tube is located by means of four of those glow tubes used in modern radios to tell you when you've got the set tuned right. If the beam's off center to

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the north, the tube marked N starts glowing, and suitable corrections are made.

The apparatus can be operated also from the room at the base of the tube. When X rays aren't expected, it sometimes is.

I was naturally curious as to the relative headaches and blessings of cyclotrons and statotrons. Each must have something on the ball; what was it?

Primary advantage for the statotron; it can handle electrons, and the cyclotron can't. Reason: The statotron simply has a damned high voltage, and electrons will fall across it readily—and with much *whoomph* when they land at the other end. The cyclotron, on the other hand, actually employs only about fifty thousand volts, but contrives to use it over and over, multiplying it to many millions. However, to do it, the particles swinging around in the magnetic merry-go-round must be in step with the reversals of potential on the D-electrodes—where the fifty thousand volts are applied and re-applied. With something heavy like protons, deuterons, or alpha particles, this works out. But electrons are so light they'll jump across and make the swing before the voltage can reverse. It's like trying to play tennis with bullets—they get there before you can move the racket.

All electron work has to be done with the statotron.

Again, the statotron can be raised to a potential of 2.5 megavolts. That, then, is the voltage applied to particles falling down the tube. They can read that voltage to half a percent. In the cyclotron, the voltage actually applied to a particle depends on how many times it has been subjected to that reversing fifty thousand or so volts. They can read the voltage very accurately—but they can only calculate and make an educated guess as to how many times the particles are bouncing around before they finally come out. They can read their effective voltage on the cyclotron only to about two or three percent.

In much work today, accurate voltages are important. Score for the statotron.

Finally, the cyclotron has the odds in two important ways—nearly the most important. It has much heavier currents than the statotron—about ten times the power. It produces much greater quantities of radioactives. Second, it produces much higher voltages, and the bigger you make it, the higher the voltages attained. Hundred-million-volt cyclotrons are under construction; ten million seems to be the practicable limit for the statotron.

Each has its use—but they differ.—Arthur McCann, Hotel Westminster, Boston, Mass.

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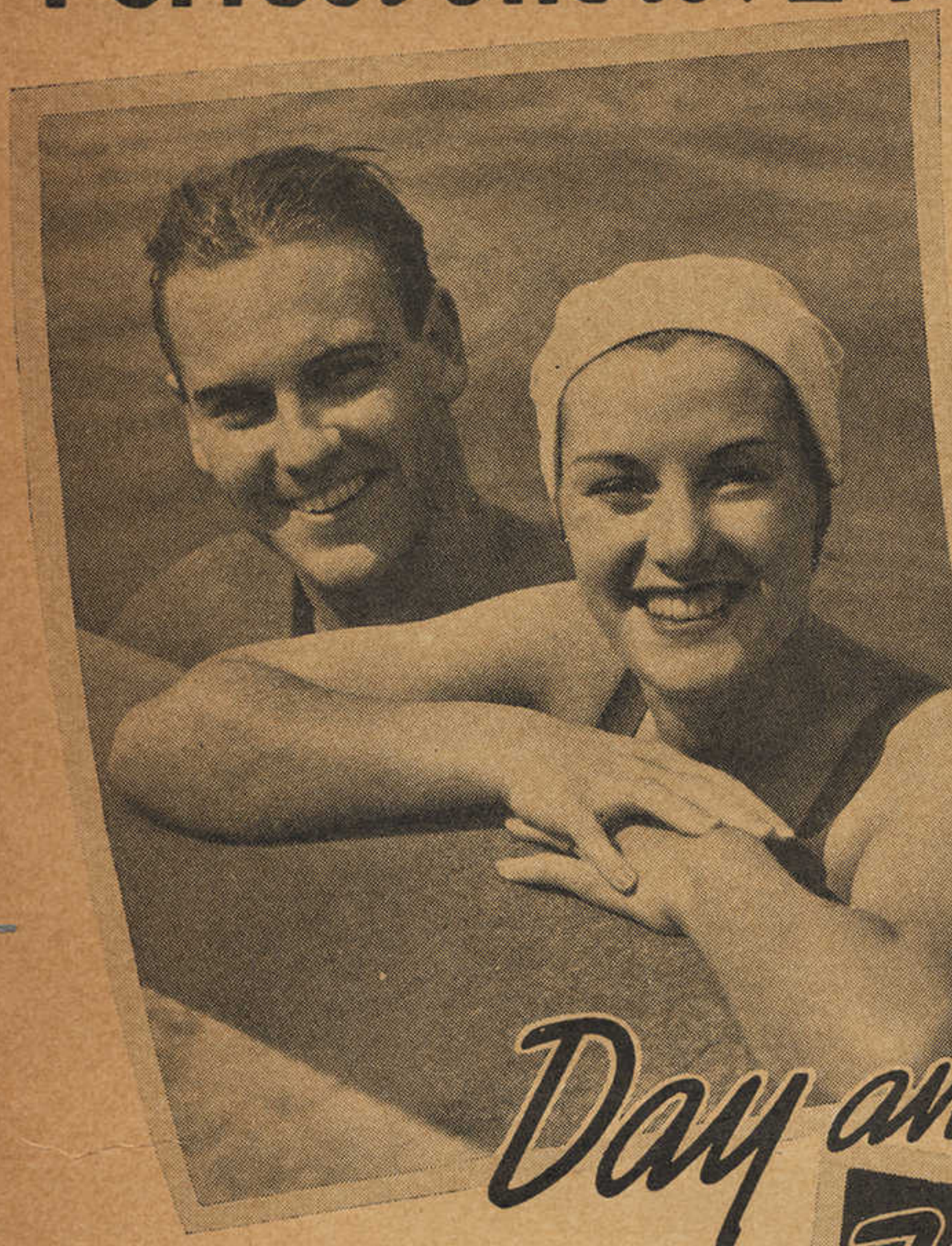

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A THRILL in every wave—a breath-taking bounce that says, *hang on or take your ducking!* Florence Holliss, above, likes the fast pace in sports. But in cigarettes, she prefers the slower-burning brand . . . Camels.

"THE FASTER THE PACE, the more the fun," says Florence Holliss, above. That goes for all her favorite sports...aquaplaning, tennis, riding. But she likes her smoking *slow*. "I always smoke Camels," Florence says. "They burn slower and make smoking so much more enjoyable. Camels are extra mild and extra cool—and they have such a welcome flavor." Make Camels your cigarette and enjoy *extra pleasure* and *extra smoking* (see right).

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