APRIL 1953

HUGO GERNSBACK, *Edito*

Science-Fiction PLUS

preview of the future

Thousand-Year Space Ark

Science-Fiction Stories by

Richard Tooker
Hugo Gernsback
Clifford D. Simak
Raymond Z. Gallun
Frank Belknap Long
and others—

35¢

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World War III—In Retrospect

PSEUDO SCIENCE-FICTION

. . . What type of Science-Fiction do you read? . . .

By HUGO GERNSBACK

For reasons often difficult to comprehend, there is still a good deal of confusion about Science-Fiction and what it really is.

Let us therefore analyze the term. *Science*, the dictionary tells us, is: "Ordered and systematized knowledge of natural phenomena gained by observation, experimentation and induction." *Fiction* is: "Imaginative prose literature."

Science-Fiction therefore can be defined, in short, as: *Imaginative extrapolation of true natural phenomena, existing now, or likely to exist in the future.*

Good Science-Fiction must be based on true science—science as interpreted and understood by responsible scientists. In other words, the story should be within the realms of the possible.

Should an author tell us that we can hear the noise of an A-Bomb explosion taking place on the Moon, we would have to say that a story based on such a premise is impossible, because science tells us sound cannot traverse the vacuum between the moon and the Earth.

Such a story would properly be termed *Pseudo Science-Fiction.*

Unfortunately, nowadays, an increasing number of authors write a vast array of pseudo Science-Fiction, with the result that a multitude of readers have become confused and misinformed.

In our opinion, a reader has a reasonable right to expect that the *science* part of a Science-Fiction story should be true or possible. If the "science" is distorted or exaggerated—becoming pure fantasy or a fairy tale—then the reader is deliberately misled.

In due time he finds this out. Then he and Science-Fiction part company.

A further point, often overlooked, is the important fact that in our present scientific and technological age a large percentage of Science-Fiction readers deliberately choose Science-Fiction *because they want to be informed—not misinformed.* Hence the science content of the story or novel should be reasonably accurate. If it is not, Science-Fiction is not fulfilling its mission!

This condition is aggravated by a periodical crop of pseudo-scientists, charlatans, and out-and-out fakers, who try to cash in on the public's ignorance of science. Often authors, who should know better, fall prey to these perverted science-peddlers and base their Science-Fiction stories on such science-nonsense.

The modern science-charlatan usually takes a current scientific development, such as radio, radar or electronics, and "discovers" that a well-known array of electric or radio apparatus, or components, if hooked up in a special "secret" (?!) manner—presto, will cure every disease from Abscesses to Zoophobia—not to forget cancer!

Usually the wire circuits connecting the various components, instruments and meters make no sense whatsoever to a qualified technician. Nevertheless, the modern science-faker claims the most preposterous cures, simply by connecting a misguided patient to such a machine or apparatus.

These contraptions, often costing over $1,000, are sold to innocent practitioners who fall for the swindle of this shining array of pseudo science junk.

Sometimes the machines are used only to "diagnose" the patient's ills, as was that of the notorious Dr. Albert Abrams, A.M., L.L.D., M.D., of California, who was exposed many years ago. Abrams "invented" a new diagnostic instrument called *Sphygmobiometer,* which "tuned in" on every imaginable disease. Every point on the instrument's meter-scale indicated a different disease! Like so many present-day science-sharpers, Abrams concocted a highsounding term for his new abracadabra, ERA (Electronic Reactions Abrams).

Then there was the science-bunko charlatan, Dinshah P. Ghadiali, who over many years collected a fortune by using colored lights to cure almost every known disease by means of a contraption he called the *Spectro-Chrome.* The U.S. exposed him.

There are, of course, many others. One of the recent perpetrators is L. Ron Hubbard, author of the ludicrous book *Dianetics,* a hodgepodge of pseudo-medical pseudo science, which, believe it or not, fooled many thousands of innocents.

Recently he has branched out in "Scientology"—a term he invented—then promptly bestowed upon himself the title of "D.Scn."—Doctor of Scientology! Scientology, he tells us earnestly, is "knowing about knowing," or "The science of knowledge."

He also added an electric gadget to his line, an electropsychometer, somewhat like a lie detector. This his headquarters sell for $98.50.

Now, if you have prenatal or preconception pains—as who hasn't?!—the scientologist will stretch you out on a cot, connect you with electric wires to the electropsychometer, and gosh!—your MEST (a Hubbard term made from the first letters of matter, energy, space, time) can be read in reincarnated "spirals" on the "E-meter"! That's bad news—you may have cancer or maybe ingrown toe nails! But don't worry, the scientologist will cure you in no time—providing you will buy his new book for $5.00!

This does not by any means exhaust the whole extensive catalog of pseudo science. Spiritualism—disguised as religion, as well as astrology and dozens of cults, all have their misguided followers.

Hundreds of health fads and quasi-medicines, such as black-strap molasses, chlorophyll, dozens of cold "cures," all aphrodisiacs, and other nostrums, have been exposed as worthless, often only to flourish despite Government censure.

All of these trends, unfortunately, affect Science-Fiction adversely in many different ways, simply because a number of authors, who, being human, become confused by the prevailing pseudo science blight and thus can no longer separate the wheat from the chaff—pseudo Science-Fiction is the inevitable result.

Science-Fiction PLUS

preview of the future

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APRIL, 1953 **Vol. I, No. 2**

FEATURE ARTICLE

NOVELETTES

SHORT STORY

SHORT-SHORT +

COVER ARTICLE

NEXT MONTH

HARRY BATES,

author of the story on which the motion picture,

The Day the Earth Stood Still,

was based, has written, especially for SCIENCE-FICTION +, his first new story in more than ten years! Harry Bates has permitted only six stories to be printed under his name—each acclaimed a masterpiece! Next issue we bring you complete, a 15,000 word novelette by Harry Bates—beyond doubt his finest story to date.

EANDO BINDER, returns to our pages with a solid tale concerning a variable star that wouldn't behave.

HARRY WALTON, contributes a science-fiction shocker of inter-dimensional worlds that may find its way into an anthology.

ROBERT BLOCH, presents a grimly humorous yarn of observers from another world.

In addition to many other fine stories, articles, columns and illustrations.

SPECIAL ATTRACTION: front cover in full color, by FRANK R. PAUL.

FEATURES

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This design, symbolizing science-fiction, is displayed with all stories of a *serious scientific-technical* trend. Such stories contain new ideas which are certain to be realized in the future.

$100.00 *will be paid by this magazine for each Short-Short Science-Fiction Story printed in future issues. These stories must be real science-fiction, not fantasy, and should not run over 1000 words. The Short-Short+ will occupy one page of the magazine.*

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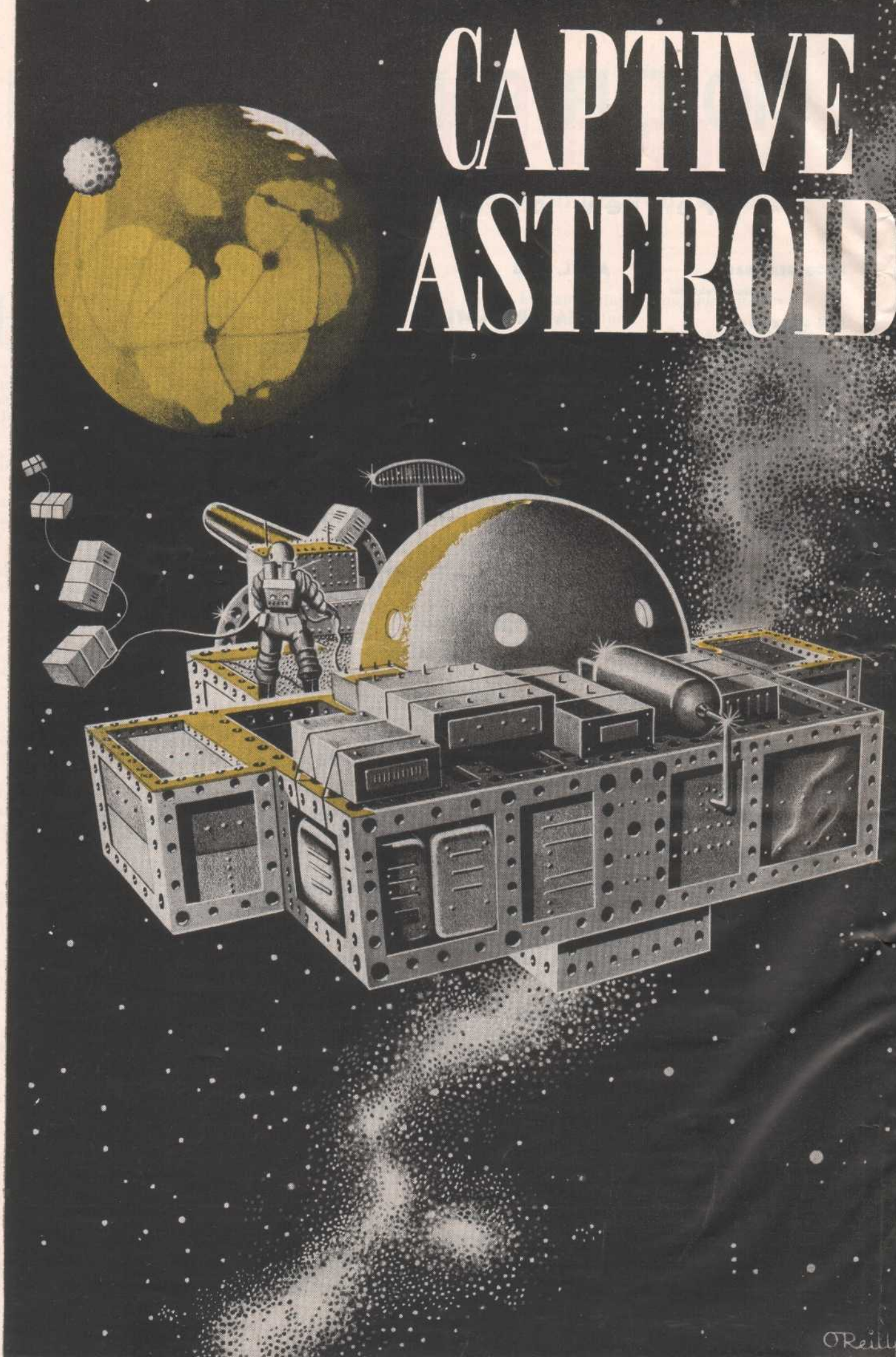
CAPTIVE ASTEROID



Only sheer curiosity impels the interest of the public today, in talk of stations in space and rocket trips to the moon and planets. They are interested more in a thrilling newspaper story than the real potentialities of space travel. But someday, the worlds beyond our atmospheric envelope will be the new frontier; new life, new opportunity, new advancement for mankind will be obtained by men and women with courage and scientific ability. This inspiring saga, which combines new scientific ideas with vivid human situations, foretells the hardships, romance, and achievements of future space pioneers.

Raymond Z. Gallun

Encouraged when Hugo Gernsback purchased his first science-fiction stories, Raymond Z. Gallun left the University of Wisconsin after one year to become a free-lance writer. He has sold stories to *The Family Circle* and *Collier's* and gained a reputation as a world traveler. Many of his stories are acknowledged classics in the field of science-fiction.

by RAYMOND Z. GALLUN

(Illustrations by Thomas O'Reilly)

BEYOND WHERE EARTH'S cities loom, crickets still chirp hauntingly at night in the open countryside. No one with a love of Nature would ever want that changed.

The far stars still look the same, too; though Man, encouraged by other triumphs, now dares to believe that he will reach even them, some day. Mars still seems the same red spark in the distance, and Venus, though no longer uninhabited, remains the silver speck that attends the sun at dusk or dawn, on Earth.

But the nearer sky is not quite as it was in the past. The space ships leave their blue-white trails of nuclear fury. The Moon is flecked with pale dots—the airdromes of mining and experiment stations, and of Cyclopean factories, where many of the craft for the conquest of the void are made.

And close around Earth itself the orbiters move swiftly, glowing. They are little, artificial satellites that were not there to be seen, before. They serve many purposes—television-relay, weather observation and control, the marking of the hour by their passage at zenith, the guarding of the world against the danger of warfare which once plagued the nations.

Each of these tiny satellites has a history, which can be simple and routine, or grandiose—full of the drama of soaring plan and chance-taking, death, tragedy, and the magnificence of something new and wonderful achieved, thus renewing faith in often errant human drive and vision, against the background of gigantic forces which Man has begun to wield.

Of all of these small moons, there is one that is a little larger than most, and of a strange, elongated shape. It has circled the Earth for more years than most, too. But at a two-thousand-mile distance, it is not the nearest nor the farthest away. It is not the brightest nor the gaudiest—the light it reflects from the sun is soft and pearly. It is not necessarily the most useful of the orbiters. But it is certainly the best known.

Its charm is many-sided. It was, for instance, the *original* of several things. On its surface was built what is still the greatest astronomical observatory to benefit from the clarity of observation of the far universe, afforded by a lack of atmosphere. But the thoughtful, quiet mood represented here—reaching hungrily for the utter limits of space—is in contrast with this orbiter's other departments.

For example, within its interior is a great chamber, given over to the carnival spirit, where weird amusement devices, made possible by the condition of minute gravity, entertain hordes of visitors with fantastic sensations of rising and falling and floating.

Fun and laughter are part of romance, of course. But romance often has a more serious, poetic face. And in romance lies this satellite's special fame.

For on its surface is the greatest and most talked-of and glamorized of the resort hotels that are off the Earth but still within easy reach. There is a regular service of passenger rockets. And here is where those who perhaps have never been in space before come for their first acquaintance with the larger playground of Man.

From the splendid Earthview Room, sealed and pressurized, honeymooners look for the first time upon their home-planet—huge, blue-green, murky, beautiful, though more than a little terrifying. They talk, they kiss, they laugh shakily. Their dreams soar. Maybe they will become part of great triumphs, too.

Even the old and the spent look around them in wonder, at strange carvings and flowers and plants, and at weird effects of beauty, impossible to achieve under terrestrial conditions. Here, then, is the gateway to the Universe, and the Outward Reaching.

Of course many of the experienced adventurers, the spacemen, stop on this tiny satellite, too. Some, of course, are hired as entertainers; but others have a real sentiment and memory for the place. All are set apart from the other visitors. For they are at home in their surroundings. Their pleasure is more subdued. They come, they go.

Usually they leave stories behind them—old and new, about how Earth's reach across the solar system has already gone as far as it has; about danger and opportunity, and the terrible madness of nostalgia that can afflict men in deep space. How the torrid, smothering atmosphere of Venus may one day be completely cleared of poisons by the great chemical machines, the oxygen freed from the carbon dioxide, making of this planet a true, verdant twin of Earth. How quiet is the dark face of Mercury, and how like a furnace its sunward side. How Jupiter's mighty gravity must still be avoided when visiting its cold moons, for ships have been lost there . . .

Yes, there are many tales told on this unique moonlet of Terra. They repel the timid, and urge the bold toward the future. But among these accounts—not all of them entirely true, of course—there are few better known than the story of Nils Tolburt, the rough, young spaceman, and his love for things unlike himself—and the strange workings of Chance. All of the important points of the story are authentic.

◀—*The Space Raft*

IT BEGAN ON MARS years ago, not long after the earliest interplanetary venturings. Nils Tolburt's father was one of the first people to arrive on the Red Planet. Some thought it cruel that he took his small son with him. But rugged and eager kids are often hard indeed to leave behind.

Mars was novel and wonderful for those first few hundred adventurers, then. It bore the marks of a dead culture and race—not human—that had perished in violence. With whom those beings had battled was not at once apparent. Then farther-winging spacecraft brought back the probable answer. The scattered asteroids had definitely been one planet, perhaps sixty million years ago. The lethal fruit of Martian technology—then advanced beyond anything we yet know—had apparently been the agent that had smashed it to fragments. Thus, two great peoples had destroyed each other, the Martians dying less spectacularly but no less surely.

Skip onward a number of years. Nils Tolburt was now a grown man. He had already been out to the asteroids, once. But now he'd been back on Mars for some time, following the profession that was best for one of his background and training. He was a relic hunter. He had two companions, older and rougher than himself, and typical of any frontier, anywhere—"Hellas" Joe Tomkins and Nick Scillieri.

One day they came up out of the excavations where, as usual, they had been sifting red dust for trinkets and ceramics eons old. Of course they followed the custom that is ancient among men who work long in their own company, and in a desolate scene. They loaded an atoplane as battered as their airhoods, and flew back across the blue-green thickets of Syrtis Major to the domed settlement called Vananis, to sell their loot and have themselves a time.

Again an antique habit among rough, carefree men was honored—with the usual bad result for young Tolburt. By sundown he fingered the unfortunate dice in his sidepocket, and laughed without regret. Chance was his matron saint, as it must be for those whose goal is only a blurred and rosy vagueness, of a substance that cannot be recognized until it is seen. For how, when you dig in the wreckage of civilizations that surpassed your own, can you ever tell what wonders you *may* find?

"I'm sick of you guys and your gambling luck!" Nils Tolburt grumbled genially. "Good thing I always keep a little money aside. I've had enough of Mars—I'm going out to try the belt—the asteroids—again."

"Sure, kid—we'll think about that tomorrow," said Hellas Joe Tomkins. . . . "Hey! . . . What's this? Encroaching culture spoiling a man's country? Can it be? . . . Could I treat you fellas to a show, maybe?"

They were face to face with an inevitable pattern of history—that wherever the masculine gender ventures, woman follows sooner or later. And, being human ourselves, can we not excuse this trio for banal reactions that are ageless? Perhaps we must.

Nick Scillieri grinned a frog grin. He read slowly from the crude and garishly lighted marquee, to emphasize relish and humor: "'Margaret Tubman's Dancing Troupe. Starring Vivien Marley . . .' Um-m—real girls! You spoke first—buy us those tickets, Joe!"

Vivien Marley was small and brunette, and very pretty. She danced on points, frilly ballet skirt bobbing. Sometimes she sang, too. And for young Nils Tolburt, she was not just a Name in Lights; she was all of the soft, lovely, whimsical things of Earth, that he scarcely remembered or had never known, and hardly knew he had missed in the life that was in his blood and bone.

What he felt was not desire, or even hope. One does not hope to possess an impish goddess from beyond one's ken . . . He did not see how the two-fifths-of-earth-norm gravity sometimes made her clumsy. He only gawked like a yokel in appreciation that went considerably sentimental, as he knew it did. His acquaintance with femininity was very slight.

Others gawked too, not all of them in the same way. Some leered and cheered, and she laughed, and blew them all kisses. The troupe to which she belonged had come to this trading town to sell them a little of the gentler life which they all lacked.

Hellas Joe Tomkins saw Nils' expression, and taunted in his ear, "Easy, son. Powder-puffs and hard space can't mix. You're going back to the asteroids, remember? This fluffy little devil would wilt out there in a minute. Now take Nancy Peters—homely, but more your type."

Tolburt was naïve in some respects, but no fool. He growled lightly, smiling. "Hell with you, Joe. Your mind is dim—I just want to look. And I'm coming back to see the show again tomorrow night."

So it was. And so, beyond all foresight, the miracle and tragedy happened. It was Chance, his saint or devil, working with Circumstance. Tolburt had a good head, but he didn't realize that in feminine eyes he was the most interesting young man around.

He was tall, the way they grow on Mars, where the slight gravity inhibits the lengthening of bones less than on Earth. His body and chin were strong. His cheeks were browned by the thin-veiled sun of Mars, rich in ultraviolet radiation, though far away small in the distance. His blond hair was bleached more blond. His eyes were far-seeing with a questing dream. He was unpolished and deep, with gentleness added. So, to a young girl fresh from the sheltered Earth, he was all the romance and enigma of an expanding space domain.

Near the end of her performance, Vivien Marley smiled honestly at Nils Tolburt. When she left the stage exit a little ahead of the others, of course he was there, the half-forgotten yearning in him to express tenderness, wondering—with some humor—why she would even notice him as a person. But surely it would only be a wonderful, harmless moment. It couldn't go far . . .

If he were shy, Vivien Marley was not. Yet she didn't greet him with an ordinary or crude manner. "I'm glad you waited, stranger," she said. "I think that you can tell me a lot about what it is like to be off the Earth."

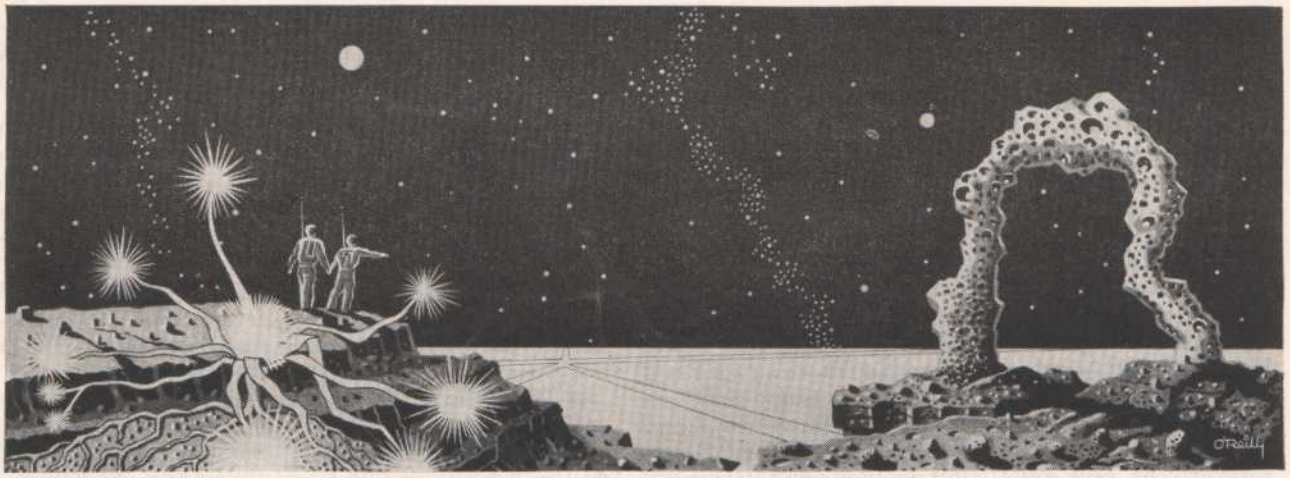
He felt as though he had two left feet. "Over beer?" he suggested, certain that the idea was coarse, though it was all that occurred to him.

"Can't we do better?" she asked. "Can't we go out there beyond the airdrome of the town—in airhoods and thick clothes? That would be more—more 'local'—wouldn't it? Oh, I learned that you can rent such equipment at the Gate . . . Please don't be startled. I think I can stand it, Mr. —?"

"Tolburt," he filled in for her. "Nils Tolburt. Okay, Miss Marley . . ."

So they walked out there together, miles beyond Vananis, named for some sounds left in fragments of a Martian recording machine found on the same site—sounds of a speech too ancient and dead and different from the Earthly ever to be reproduced by human throats.

The nocturnal cold alone would have killed them but for their electrically heated garments. The dry wind, thin as in the high stratosphere of Earth and holding only a trace of oxygen in this latter-day Mars,



"The huge heap of rust looming nearby—once an irrigation pump . . ."

would have smothered them except for the clear, plastic bubbles encasing their heads and the steady functioning of their air-purifiers. Yet they were kept snug and safe—at least from these elements.

THE DANGER was in the magic of the night. Above, Phobos, the nearer satellite, substituting for Earth's romantic moon with a weird effectiveness which Luna could never have equalled. The surrounding Martian hills, the color of dust and silver. The clumps of grotesque vegetation, paper-dry but alive, their faint rustle just audible through the airhoods. The dense shadows. The huge heap of rust looming nearby—once an irrigation pump, a building, or a climate-control machine—who knew what? The bas-reliefs, sand-scoured, so that their strange, hunched figures were all but obliterated. The sheared-off hillside, showing strata that went back—in small Mars' swift development—to an era comparable to Earth's Age of Reptiles, but far older. The heaps of rubble, crusted and glassy as with nuclear heat in a last great interworld conflict whose precise causes were unknown. Here in the night was history, layer on layer, showing growth, triumph, folly, beauty, death. History and enchantment.

Mars was almost Nils Tolburt's native region; but to her, Vivien Marley, it was utterly new. And the newness seemed to be reflected from her to him—newness as rich and strange as her unbelievable presence here with him. Her eager excitement made her even prettier. To him it was as if they—as unlike as a teeming city is unlike the depths of space—could find a contact-point for this little time, and be very close. There was triumph here, as of doing the impossible.

"Wonderful, wonderful—everything's wonderful!" she said at least a dozen times. See that thing—like a tree! See how that ridge reflects Phobos' light! . . . May I hold your arm? I've heard that voices carry better that way, than through two airhoods and the thin atmosphere . . . And you're part of it all, Nils Tolburt. You're part of the vanguard of our own civilization, spreading out and out! Tell me, Nils Tolburt. When did you come here?"

He could sense her young and guileless earnestness. She was like a kid, here, eager and off-guard right now, though at other times she could be smooth and cool. Perhaps she was twenty, but no older.

Nils' laconic tongue loosened. "Dad brought me here," he said, "when I was nine. He was lost out in the red deserts long ago. I'm twenty-three now."

"You're what they call a 'grubber', aren't you? A relic hunter for the antique trade back home. I've seen beautiful, costly, fantastic art objects!"

He laughed. "I think I'm an amateur archeologist at heart, though, Miss. I think differently, and love discovery . . ."

"I suspected as much, Nils Tolburt. And I like that. But you must have many plans."

There she was, getting down to his plans, digging into him as a woman always does. Even he, with his scant social experience, knew that. But her desire to know about him gave him a feeling of warmth and friendliness.

He crouched beside a carven rock and looked up at the sky. A big meteor blazed. "Lots of meteors hit Mars' atmosphere because it's so close to the Asteroid Belt," he said. "I'm going there again."

"Why?"

"It's better there for a grubber, as you must know," Nils answered. "Things weathered away on Mars, even after its inhabitants were wiped out. But that original asteroid world went up all at once and completely, under Martian attack. A big torpedo, boring to its center, perhaps it was. The crust hurtled outward, and the blue sky vanished—all in an instant. The flame died out. And of the things that were left—more than you'd think, since the fury passed so quickly—many were preserved, completely new for those millions of years, in the cold vacuum of space. There was no weather at all to rust or damage them."

She smiled at him again, her eyes wide open with fascination. "Yes—I've heard, I've read," she told him. "And I've seen, too, at home. Parts of mummified bodies—ugly as those beings seemed to us . . ." She looked sad for a second, then brightened once more. "Cloth, jewelry, wonderful scientific instruments. Seeds, even, that can grow again, shielded deep in lumps of soil from the killing ultraviolet rays of the sun. Flowers, vegetables. Some of them have become common in Earthly gardens. Then there are, of course, natural metals and ores, from the rich insides of the planet . . . Yes . . . But what do *you* expect to find out there, Nils Tolburt?"

Her question was like a tease, that touched his own vague dreams and awoke a familiar thrill in him.

He shrugged. "How can I tell?" he said. "That's the fun of it. Those long-ago people were scientifically pretty smart. The secret of life, maybe? Photographs of dinosaurs, taken on Earth before there were men to see? It's all possible! I wish you could go out there—feel the presence of the Belt the way I do!"

"Why can't I? Oh, I know, Nils! I haven't got the stuff—you think!"

"Think? Know! . . . Please—it's not any insult to you! You just have to be born to space. Like dancing, I guess. Because it can get unholy rough on you out there—particularly after a long while! Still—I wish you could go!"

She laughed gleefully. "You're wonderful, Nils—maybe I will! Why not? Don't women always go where men go—in the end? And am I any different, fundamentally, from other women? Here, Nils—I can't kiss you—not really—not with both of us having to wear these bubbles over our heads. But this *is* a kiss." Her small, gloved hand squeezed his large one. "Honestly, Nils . . ."

He was a little dazed. She was as guileless and spontaneous as before. Could the diverse personalities of the crude, toughened grubber and the dancer of whimsical ballet from completely civilized Terra, blend after all—and especially Out There? Night and Day—Beauty and the Beast? Half in humor, half in fright, but with a complete thrill, Tolburt wondered.

"I wouldn't very much care to leave the space life forever," he said quietly. "You like your dancing—don't you?"

She bit her lip. "Of course . . . I've always loved it—at least till now, when something bigger comes . . . Look, Nils—can't we both sit down here under the stars and talk this out? What does a night like this mean, if it's wasted, sleeping? . . .

She was very earnest. Maybe in some ways women are forever reckless, and men cautious and traditional.

"Yes," he said. "I'd like to talk it out." He pressed her hand, too—a kiss.

Chance and Circumstance were working on them both. The chance of their meeting, their own separate drives, newness, glamour. And it was easy to say "I love you," and mean it. Then all problems and dangers seem easier to answer. If sometimes he frowned worriedly, she made little motor sounds or pup-dog growls as close to his ear as the airhoods let her come, and things were better.

When dawn streaked the east, and brought color back to the pastel-tinted landscape, their minds were in accord. They were happy, as they walked back toward Vananis.

Hellas Joe Tomkins and Nick Scillieri—grotesque, bundled figures against the sky—came out to meet them.

"What in hell!" Joe roared. "Where yuh been, you two? Miss Marley—your boss-lady, Tubman, is mad and scared enough to be tied!"

Vivien's mouth showed a hard pout—though her throat muscles worked—a loved career was lost, now. "Let Tubby be sore," she stormed. "I can't help it! And she's a tyrant, sometimes! . . ."

Later, in their hotel, Joe cornered Nils, and his brown face turned very paternal. "See here, fella," he said. "I size this Vivien up as a life-hungry little demon—now, suddenly space-struck. Tomorrow, it'll be another guy, and another idea. I'm glad. Because she's too fine drawn. Do you want to see her sort of shrivel out there—while you go nuts slowly, watching? Or do you want to have to keep at bay the woman-starved wolves that you meet out there?"

"I thought of all that, Joe," Tolburt said. "In a way it would be a relief to me if you were right about Vivien. But I don't think you are. So there you have it."

So Joe and Nick tried shanghai-tactics on Nils; but when he awoke from the doped liquor and found himself in Hellas, the big Martian oasis, long known to astronomers, where they'd been grubbing before, he simply borrowed their plane and escaped.

Margaret Tubman must have raved—oh, raved! —at Vivien. But they say that frontal opposition to love is very poor psychology.

So Nils Tolburt of the solitudes of Mars and the Belt, and Vivien Marley, artist of the theater—her thoughts once having gone to crowds and applause and the hope of fame—were married to each other, and to the Great Distance and the Scarcely Known.

When Hellas Joe and Nick found a lift back to Vananis, they tried to give Nils money. "Buy her at least a halfway decent passage on a freighter, out to Ceres City, kid," Joe said. "We know you haven't got enough dough, with all the stuff you'll need. And she won't have saved much either."

Nils said, "No," and grinned. Masculine pride. Then he added: "Vivien is better than you think—fine on the free-fall test that scares so many. And her health is perfect."

They shook his hand. "We'll always give you good luck anyway, Nils," Nick said.

And Hellas Joe added: "So long, fella. Maybe I'd do the same as you, if I had the chance. She's sure a sweet trick!"

NILS WAS LEFT alone with the grim business of a change of course—counting two out there in the Belt instead of one. For once he deeply regretted his wastrel habits. But he drew his savings and sold two beautiful blue Martian vases he'd kept—soon they would grace a fancy home on Earth. He had a tidy sum, which nevertheless melted away with purchases, even though many of them were second-hand. Two real space suits, more solid than the garments for Mars. Instruments. Guns for protection. A small propulsive jet. Then there was dehydrated food. Other things that—perhaps naïvely—he thought might help a woman to feel more comfortable out there in the void. And so forth.

Then he had just about enough money left to buy two tickets for the Hitch Out.

Yes—the Hitch Out. It was a common term among the asteroid wanderers. It meant the rough way to get into space—borrowing escape velocity from any major planet or moon from a spaceship. Once you've broken loose from the attraction of such larger bodies, you're free. A small nuclear jet with a heavy radiation shield can get you almost anywhere.

At the Vananis dock they stood together, among their mountainous supplies, to be weighed in. The men who did the weighing eyed them curiously, and with a pity that was like contempt for madness. This little girl, her face looking sweet and frightened and determined behind the vision plate of her helmet, going into the void by the hard route? Crazy! Then they shrugged.

Nils was scared, too. He'd never stopped being that—for her, and even for himself, now. But it was her choice, too. And everything was a gamble. But maybe love is always like that.

Inside the dark, none too clean hold of the freighter, he helped her strap down. "This buckle goes *so*," he said. "There. Ready? Just relax."

Doors were sealed, signal bells clanged. The rockets thundered. From the corner of his eye Nils saw his wife's small, dainty features twist, before his own vision blurred under the strain of the thrust. He heard her cry "Nils!" once.

Minutes later the terrific pull was replaced by its opposite—the weightlessness of the void, which feels exactly like falling.

He unfastened himself and moved toward her swiftly. For here was the thing which many a strong man with a slight fear of the heights could never take. For it did not end—not in free space where there is no hull-rotation—as in the great ring-shaped liners —to replace gravity with centrifugal force. It goes on and on, punishing the stomach and one's belief in the

rightness of things, fraying nerves and often bringing on hysteria.

But Vivien took it well, as the tests had said she would. Only her cheeks paled, and to his solicitations she answered almost sharply: "I'm okay, Nils! I'm okay!"

So one hurdle was passed safely. The doors of the hold opened, and alone and with ease he thrust out the great wire-lashed box of supplies—much of it water, frozen and tinned to avoid evaporation in the interplanetary regions.

"Now we jump together," he said, speaking by helmet-radio.

And she repeated it after him, like a baby learning a language: "Now we jump together, Nils . . ."

The rockets of the freighter flamed again, and it tangented on, away from Mars and toward Ceres. He didn't watch it go . . . He left his wife clinging to the lashings of the great cube, and went to work, quickly mounting the propulsive jet on the box, which was perfectly balanced for space flight. They and their supplies were already fixed on their course, taking motion from the first motion and direction of the ship. But he had to be ready to make slight corrections. Ahead, millions of miles away, was a little haze of light against the star-curtain—the scattered cluster of fragments he'd visited before and meant to reach, now.

He took his first measurements to check course, having learned to use the instruments pretty well from Hellas Joe during their previous trip. Then he turned toward Vivien to see how she was.

She tried to smile. "Magnificent, isn't it?" she said. "Fantastic grandeur! And we're pledged to it, Nils—for whatever happens!"

For courage she was now somewhat facetiously overdramatic. But the grandeur was there all right: Mars, a red, receding crescent near the corona-enveloped sun. And outward, the pinpoints of the stars against the blackness. Though he loved views like that, he respected them like cold death. He searched Vivien's face for strain—of the continued sense of falling, of the awareness of being buried alive in an infinity of unbreathable vacuum, of the distance from home increasing by miles per second. He found it clear in her eyes. Now was the time to spring what he hoped would be the antidote.

"We have days to spare, now," he said. "So let's set up housekeeping. Just watch . . . Wedding gift and surprise from your husband . . ."

She even helped him as he assembled the thing. Framework of rods, heavy, airtight fabric with windows of plastic—all to be fastened firmly to one side of the box of supplies. When this much was done, he motioned her inside, followed, and zipper-sealed the outer and inner pairs of flaps, between which was a little compartment—here was an air-lock arrangement for entering and leaving this fabric shelter. Now an air-tank hissed at his touch, and air filled the space tent.

"No need for armor in here," he said. "You're at home, Vivien."

Quickly he got out of his massive attire, and proceeded to arrange the interior of their quarters, while an air-purifier unit worked silently.

Miracles of compactness had been achieved in years past. But here was a house that could be rolled up and carried into the void! Just a regulation space-tent touched up by his own ideas. Of course there was a little ato-stove, fitted with clamps to secure the pressure kettles in the absence of all weight. There was a mirror for Vivien, and a plastic stand with tabs attached to hold down her toilet articles. There were even some small pictures to be taped to the walls. And there was a rose—artificial, but real as real, even to the odor, in a tiny vase with a suction-cup bottom.

No doubt her dreams of a place to live were more sophisticated than this. But pleased surprise made her laugh, and she kissed him.

"Nils, you idiot!" she exclaimed. "But it's sweet and whimsical. Only you didn't have to but it was for the best . . . Maybe you've won with me—or we've both won—already. And I'll be all right . . ."

He shook his head. "Not quite yet, Vivien," he said wisely. "Keep braced. But for now let's forget it . . ."

So, for a while they shut out the stars and the magnificent distance, which could become too rich and terrifying for one's soul. They were in love and together, and were comforted.

She didn't get space-sick—not in the usual sense. He did—a little—as always happened to him at first. That terrible, disoriented queaziness tickled the fringes of his awareness for an hour. Then it was gone. It depended on something in one's nature, perhaps.

Her trouble was different, coming slowly and steadily as the days passed, building a strain in her, a monotony, a hunger for all she missed. There was the silence that repeated recorded music couldn't cover. The music grew tiresome and mocking in itself. She looked a little haggard, but every time he asked if she were all right, she said, "Of course. I have to be, Nils . . ."

A MONTH PASSED, and half of another. Millions of miles they had crossed in that little tent, pitched on one side of their box of supplies. Then she broke down—just for a minute. A burnt finger while she was cooking set her off.

She began to cry, and wouldn't let him near her. He was all tenderness and poor technique.

"Damn—nothing stays put!" she stormed. "No up, no down, no sidewise! It has got so that you can't believe in anything. No change, no sunrise, no sunset, no people! No charm. Nothing! Just this damned spider's nest of a tent, and those stars, and you . . . Oh, Nils . . ."

He pulled her to him roughly and somewhat sternly, and she wept on his shoulder. "Sorry, Nils—my fault. I didn't look ahead right, did I? Now we're both in a mess . . . Oh, I'm sorry I said that! I love you, Nils. That much I've got. It was just for a moment that I felt so terrible. Now I'm all right. Honest ! . . ."

Then she was shelled in and the same as before except that—remembering what had often happened to men in space—he began to wonder if she wouldn't try to kill him sometime, or herself. She was a girl, and high-strung. He tried to compensate for her aches with his love. He even plotted courses back to Mars. But changing direction so radically was hard to do, and the journey would have taken longer than to go out to their destination. So what was there to do but go on, especially when he himself wanted to go on? She wouldn't hear of turning back anyway—proving at least her strength of will—perhaps for his sake, or perhaps to demonstrate something about herself to herself.

Another three weeks they journeyed. But they never reached the asteroid cluster Nils had aimed at, and had visited before. Various things interfered. First a mere, great boulder of hill size. It meant only that they had reached the Belt. They coursed with it for

a while, for its direction and speed were almost the same as theirs as it moved in its orbit.

A day beyond it, Vivien came out of her silence enough to say, "Nils! Look!"

From a window of their tent he saw a larger fragment—about a mile long, shaped like an arrow-head. He was almost beside himself with excitement as he fixed the glass on it.

"A surface chip of the old planet!" he cried. "And that's not all! Lady Luck, be with us now! It looks like what I always hoped to find—an isolated piece with the remains of—what would you call it, considering that they weren't men?—a town or a colony, on its back? Here—take the glass—see for yourself!"

For a while Vivien seemed as eager as he was. "Oh, Nils—it's beautiful!" she said. "It's like—like ruined castles on a crag, floating among the stars! Let's go—let's get there quickly! . . ."

He fought for calm as he checked speed with the jet. They landed, light as a bubble, near one end of this tiny asteroid. In space-suits they crept forward, as the ruins frowned over them.

"Just a quick look," he promised. "A few hours, and a picking up of what we can find that seems most worth while. Then back to Mars, back to Earth. You need it, Vivien . . ."

Excitement always buoyed her up, so that now, though thin and a little haggard, her face looked almost that of the bright pixy that he had first known.

"No, Nils!" she protested. "You'll stay as long as you like! That's what we came out for, isn't it? I'm all right! And I love this little asteroid!"

So he yielded to her insistence and his own temptations.

Walls were around them, twisted and toppled and fused in spots by the blast that had ended the world that had been the enemy of Mars perhaps sixty million years ago. Metal lay broken in bright newness that could last here forever. Fragments of eerie bodies, clawed and strange, and blackened and dried out by the dryness of space, were jammed into the warped steel, and the soft-colored or transparent building materials. It was as though part of that awful split second had come to a pastoral scene, congealed for eternity as the harsh preserving silence of the void closed in. This surface fragment must have shot straight out into space.

Nils knew that other surface shards had been found before—not as good as this one, perhaps, but much the same. He'd been on one before—seen the clear building blocks, the tiles, the tunnels, the courtyards, the crumpled machines, the queer cells and chambers, the gardens with fallen flexible roofs of glassy material, the space-blackened vegetation.

Gripped by his old passions—the treasure hunt and the archeological impulse, he went furiously to work. He found nothing obviously or clearly new. But did it matter? Digging, blasting, and grubbing, he was in his glory. Shuffling her feet cautiously, Vivien helped him. But very soon her first eagerness faded, and the danger signs came back—mostly indicating, no doubt, an awful yet to-be-expected nostalgia.

Once she said, almost calmly: "You can't stare down those stars, can you, Nils? They just keep staring back, the way they'll keep staring after we're dead. Eons after. This is a graveyard, Nils. And the skeletons in it aren't even human."

Then she began to cry.

"Just a little more time," he said as he cuddled her. "At least we've got enough trinkets to make us rich."

That night—yes there was a day and night on his asteroid—it turned like a spindle once every twenty-nine hours—he stretched out to sleep, tired from his strenuous work. While she lay asleep near him, he heard coarse voices over his radio. He caught only a few faint words: "You think . . . just a rock? . . . Wanna bet your . . . ? . . . Hell! . . . Ceres City . . . Dames. Ha-ha!"

It was asteroid hoppers talking by helmet phone, only a few thousand miles away. Ordinary guys changed and poisoned by space, by living too long bottled in their armor, smelling the stench of their own unwashed flesh, constantly worried about this or that—the shortness of supplies, or that their air-purifiers might break down. They were woman-starved, homesick, civilization-starved. No one could say what they might do, given the chance . . .

Nils Tolburt waited with a nuclear rifle, sweating and praying. They must not come here! But even then, a stray thought that he could not help crossed his mind. It was bitter and sour, yet it had something of a wish for the best in it . . . Vivien needed company, sound, laughter, change. Ceres City might not be good for her—but better than this life! Or so it seemed to him. She might even have wound up in Ceres City, if she had failed to find triumph as a dancer and had chosen another path . . .

The hoppers passed his asteroid by, but he could have called them easily enough by radio.

HIS GREATEST MISTAKE had been over-using the propulsion jet-tube to blast through shattered masonry. Damn all trust of second-hand equipment! The next morning it blew out from the side, and narrowly missed killing him. It was ruined beyond all repair. He stared at it, and at the dead things and the dead grandeur of the sky, scarcely realizing that the twinge in his chest meant that his sick wife and he were stranded. Their desert island of space was moving in its orbit farther and farther from a region where there was any chance of their being picked up.

After that, he set up his small radio to keep out a continuous signal of distress, hiding it from Vivien's eyes. His first and only thought was survival, and protection for his wife. He had the usual survival equipment—even seeds and hydroponic jars for growing green vegetables that would give a little variety to diet. He had a large store of dehydrated food, and there was considerable water left. He knew that deep in most asteroids, particularly the "surface" ones, there is much water in the form of ice. These pieces of a living world, hurled suddenly into the cold of space, didn't dry out slowly, like the Moon or Mars. The water-table, deep down, merely froze swiftly, and was sealed against loss through sublimation, by the surrounding rock and soil.

And water, being oxide of hydrogen, was also a source of oxygen to breathe. A simple electric current could set it free.

Other castaways had lived for months, before, on asteroids.

The whole character of Tolburt's work changed, though the fury of his toil was even greater. He put the transparent jars of his hydroponic garden out in the sun.

It was a small sun, here, shrunken because it was more than two-hundred-million miles away, and provided only a scant fifth of the radiant energy per unit area that is delivered at an Earthly distance—yet it was still brilliant, as it must be in space where there is no atmosphere to absorb a considerable portion of its intensity. Sealed inside the hydroponic jars, each fitted with a tiny atomic heat-unit, and whose walls

cut out only the damaging portion of the solar radiations, plants would still grow rapidly. Other vegetation had certainly grown on the original asteroid world, whose distance from the sun seemed to have been compensated for by an intrinsic warmth in the planet itself—hot springs, and a higher internal heat, maintained by radioactive materials at its core.* The existence of radioactive materials in quantity was evident from the explorations of the asteroid miners.

The double thermos walls of the jars would slow the escape of warmth at night.

Among the many things that Tolburt had searched for in the ruins, were machines and devices that still worked. He discovered a pump—all soft and rubbery material like a heart—except for the hidden electromagnets and wires, which were the "muscles" within its texture. He found batteries that had been known before. They were sealed in black cases. Atomic they certainly were in basis, for the current of one the size of his hand could have killed an elephant. He collected much flexible glass, twisted but unbroken. A little heat welded it. He found tools which his human fingers did not quite fit.

Of course Vivien knew what had happened almost at once. His change of activity was a plain sign. She was keen in her judgments. He could not hide anything. It was to the credit of her fundamental grit and courage that she kept silent and tried to help him during all of two long days of new effort.

But the facts had to come out of her mind. Will power could not bottle them up. She said the first words quite calmly:

"I know what's happened, Nils. You've hidden the radio, or are using it for something else. And I don't see the jet-tube anymore. It's broken, and we're stuck, here. Isn't that it? We're not just sorting our loot. I wish it *were* funny, and not so serious."

Then, like many a space man who feels himself buried alive in millions of miles of vacuum, she went all to pieces in a kind of claustrophobic panic. She could not stop her wild laughing.

Nils forced her inside the space-tent, and got the helmet off of her armor. Then in some mixture of fear and exasperation and hope that it would help—as it would help a male companion in a similar seizure—he slapped her repeatedly.

"Vivien!" he shouted. "Steady up!"

Perhaps he had just made his worst mistake of all—after a long run of mistakes. Chance didn't seem to be on his side right now at all.

Saving tears came to her eyes, again. They lasted for minutes while he held her close. Finally she smiled up at him as if in gratitude.

"Nils—it was something fierce. I thought I had spoiled everything for you in some terrible, wonderful place that could never be. I must have been dreaming for a long time. But we were always at home, weren't we? Just now we were making a nice garden . . ."

Her thin, pixy face was screwed up and earnest. Her dark curls were damp . . .

Whatever Tolburt did not grasp at once by evidence, he sensed by intuition. Vivien's mind had armored itself with *unreality*. People are not built for the interplanetary regions. Her weakness was a common one. Nils knew that what had happened to his wife might, and perhaps still would, happen to him. Or even to someone like Hellas Joe Tomkins—for all he knew.

Nils Tolburt's first panic-stricken impulse was to try to call Vivien back to facts. But some flash of wisdom stopped that. Maybe it was wrong, but he said:

"So let's make a bigger and better garden."

After that, one day of toil followed another in a grim, purposeful grind. Vivien worked with him and seemed happy at it, but quite unaware of her real surroundings, her gaze always on the ground, her feet shuffling cautiously, in some reflex action to the tiny gravity.

But Nils Tolburt lived in hope that she would awaken. In any case, the unbreathable, airless magnificence and harshness of the void must not batter at her again. It must be veiled and masked by a living beauty that a girl from Earth could understand.

Almost as soon as the first green showed in the hydroponic jars, the walls of another airtight garden were restored, the edges of the building blocks were welded together and sealed.

Then its clear roof went up—anciently it had had a roof, too; now the flexible glass had to be straightened and repaired. Water from ice, melted by heating units deep under ground, was pumped up to wet dessicated red soil which Nils knew would bloom again—the seeds and spores in it preserved forever in deep freeze.

When one garden was finished, and given a sealed-in and electrically warmed atmosphere, the Tolburts started restoring another. Vivien meekly took Nils' simple orders to bring him this or that. The two gardens they now possessed were separated only by a wall.

Toil went on and on, for Tolburt's vision was extravagant—drawing from what was lacking of life in the void all the fierce yearning for the opposite—seeming impossible out here. There were rich old tiles to cement back into place, and strange stone monsters to re-erect, paths to make, and in the ruins of adjoining buildings, sealed quarters to provide and furnish. Furniture from warped metal had to be devised. Gorgeous old tapestries of glass fabric had to be hung.

Nils' self-reliant life had made him a fair mechanic; and he did his best and kept trying—for Vivien. It was love; it was paying back for a sense of guilt. It was a lonely man's way with a wife who was his only companion, as he was hers. Whatever else they'd lost, they had kept the sweetness between them. And now maybe there was shelter for her, and for him, too, during whatever time there was left. She looked better, now—happier, and better filled out. Though he felt that she'd die sometime, in her fogged condition. Her perpetual gaze let her do simple things valiantly but never let her see the truth. She would die, and he'd be alone, and sometime he'd die, too—here. His signaling radio had burned itself out. They were far in space, where no one would come perhaps for decades.

Their first tiny garden—the hydroponic jars—was stripped of its first produce and forgotten. In the second, amid curling, hairy shoots of a fantastic order, the zinnias bloomed first. Funny that he'd thought to bring zinnia seeds in a survival kit. He'd done it by the same kind of impulse that had made him bring that artificial rose for their first "house." A thought of Vivien, it was. And a vagrant sentiment.

Zinnias shouldn't have been here in the Belt at

*Light intensity is inversely proportional to the square of the distance from its source. Using the earth's distance from the sun, 93 million miles, as a unit, and the intensity of solar light on earth as another unit, comparative approximations of the sunlight received by other planets can easily be calculated.

For instance, Mars' distance from the sun—140-odd million miles on the average, for a rather eccentric orbit—can be represented roughly as $1\frac{1}{2}$.

$1\frac{1}{2}$ or $\frac{3}{2}$ squared is $\frac{9}{4}$, which, inversely, becomes $\frac{4}{9}$, that is, Mars receives $\frac{4}{9}$ of the solar radiant energy per unit area that earth does.

Tolburt's asteroid is clearly one of the more sunward ones—it is almost the first he meets while journeying outward into the belt. Its distance, then, from the sun, can be considered as somewhat more than 200 million miles, or about $2\frac{1}{4}$ times as far as the earth.

$2\frac{1}{4}$, or $\frac{9}{4}$ squared is $\frac{81}{16}$, which, inversely, becomes $\frac{16}{81}$. $\frac{16}{81}$ is just slightly less than one-fifth.—*Author.*

all. But they were zinnias impossible on Earth. With so low a gravity to inhibit their growth, they became as tall as corn. Call this a new development or extravagance—an offshoot of the science that enables men to travel in space!

The months passed. Strange flowers opened. Fruit hung green and then ripened. Some were sweet, some acid, some doubtful for human use. Some were starchy, others were rich in protein and fat. Some of them, their seeds found elsewhere in the Belt, were already being cultivated on Earth.

"Vegetables for the kitchen are getting stranger all the time," Vivien commented with some puzzlement. "Some taste almost like meat." But when she tackled the cooking, the results were usually good.

Furry little creatures, half like insects, hatched out from ancient eggs left in the ground, and scampered in the foliage, twittering and mewling.

BETTER THAN THREE Earth-years passed. Very little changed except that Tolburt went on building and building, extending his quarters and gardens, and making them as different from raw space as he possibly could. The leaves of plants touched the clear roofs. More and more habitable rooms were wrested from the ruins. He could never have accomplished so much on Earth in that time, but, since materials had so little weight here work was quite easy.

Sometimes Tolburt felt almost happy, as a sense of possession and peace and permanence came over him. He had a way of accepting and making the best of what Chance and Circumstance brought him, and that helped.

But often he was bitter, feeling that both he and Vivien had been cheated. Love? Compromise? When people were not too different, yes. But some lovers should not marry. He'd labored for years, making up to her only a little for a great mistake. And where would she be without him? Famous, for all he knew. Not mad, at least—not a sweet shell of her former self, smiling and shuffling cautiously . . . Where was Hellas Joe, now? And the others? Damn Choice and Chance! He, Nils Tolburt, had been carefree and eager . . .

"Don't work so much. Stay inside more with me, Nils," Vivien often urged him. But he had his answer:

"No—not yet. There's still one more thing I've got to do."

It was another extravagance that fascinated him. It began with the way water behaved out here—a great mass of it not lying flat in a pool, as it would have done on a world with any reasonable gravity. Instead it formed itself into a gigantic, slightly flattened dewdrops, which, like lenses, inverted the images of things beyond them.

It was beauty, impossibly unlike the aspect of the bleak asteroids and space, yet impossible anywhere else. It was a newness which might be developed.

So, keeping his wife away, he built a circular room, lined it with varicolored tiles and fanciful old carvings, and roofed it with the usual flexible transparent material. He transplanted vegetation into it, the fuzzy green fronds reaching the ceiling, freshening the air as green plants always do. Flowers bloomed. The little furry creatures appeared there. So far the room was like the other gardens, but richer.

But into the old pool basin at its center he pumped hoarded water—always he'd hoarded and stored water in underground cisterns. The water bellied up from the rim of the pool, held by cohesion and surface-tension which far outmatched its feeble weight. It extended upward like a crystalline balloon being inflated, until it was almost a sphere. So far, so good.

One more touch he added—a square box made of tooled gold. Inside was a mechanism which he had managed to put into working order. It played weird, sing-song, yearning melodies, millions of years old.

He already had an idea of what *might* happen. But his main thought was still to give Vivien, as best he could, the soft, gentle things that might keep her safe. For a long time he had suspected that, almost imperceptibly, her mind was sinking deeper and deeper into the fog. But now he felt quite proud of himself—as if, in this room, he had created something advanced and charming and impossible before, that kept pace with the era of Man's venturing beyond the Earth.

He brought his wife through a passage to the room, and said: "Here it is, Vivien. Now our home is finished."

She looked around her for a long time, and seemed to listen to the sounds that were there, her gaze remaining dull and yet puzzled. At last she smiled and said mildly, "It's nice, Nils. It's gorgeous. All for me? Thank you." And she kissed him.

He had hoped for more response than that. "Isn't it a dozen times better than anything we've had before?" he demanded in a kind of tired bitterness. "Don't you see? Don't you feel?" By a mighty effort he kept his voice gentle.

She seemed half to study him, as if trying to find out what he wanted her to say. "Of course, Nils," she answered. "It's beautiful and it's different. And I love you, and thanks forever."

He missed the strange, groping glitter in her eyes because he thought it best, then, to leave her alone, before his frazzled nerves betrayed him into shouting at her. She was his Vivien, and she had always tried valiantly. She could not help it that she failed.

He went away to fuss with his various machines. And so it was for more than a week—he left her to herself more than usual.

But suddenly, near one noonday on the asteroid, something like a premonition hit him. It was partly guilt, again. It was partly the unclear memory of something unusual about his wife, now—a kind of darkly secret animation. And now, all at once he was smitten by a nameless sense of silence in his rooms and gardens, though music still played. It was as if now he were left alone for good.

In panic he hurried from chamber to chamber, searching. And so he arrived at the entrance of the circular room which was his masterpiece. Sunshine streamed through the roof, water rustled and tinkled. And his premonition proved utterly wrong. For he heard Vivien's voice humming—trying to follow the notes of a tune not conceived by a human mind. Then he stopped, flabbergasted, hiding in the shadow of a great leaf.

She was not on the ground, shuffling cautiously; she was high in the air, floating down, her body making a graceful arabesque. Some soft, blue, mineral fabric, as old as the rocks of Earth, was around her—that was all. She landed lightly, and as the eerie music soared, giving back a lost art-form, she leaped again, lightly, creating something new, and possible only where gravity was almost zero—something to match in dancing what the spaceship represented in science. This, too, must be part of a new age.

The movement of the music changed, and she glided down, straight for the gigantic dewdrop in the pool-basin. With the impact of her body, it broke into

a thousand lesser drops, inches in diameter, that shot toward the roof and then drifted gently back, coalescing again, brilliant in the sun, while she swam among them, a dainty nymph figure, not dull-eyed any more, nor bound to a timid shuffle, but laughing, nimble, and joyous.

He ached with gladness and appreciation for the new beauty that was here. But the best was knowing that the results of his work had been good—that it had sheltered Vivien from the too-blunt magnificence of space, until restored peace and the suggestion of her surroundings, and her old love of dancing, combined to open for her the way to recovery . . . Yes, that must have been how it was. And her keen mind had regained its ingenuity, using what the once fearsome asteroids could give her, to produce something never seen on Earth.

Tolburt clapped at last, and shouted "Bravo!"

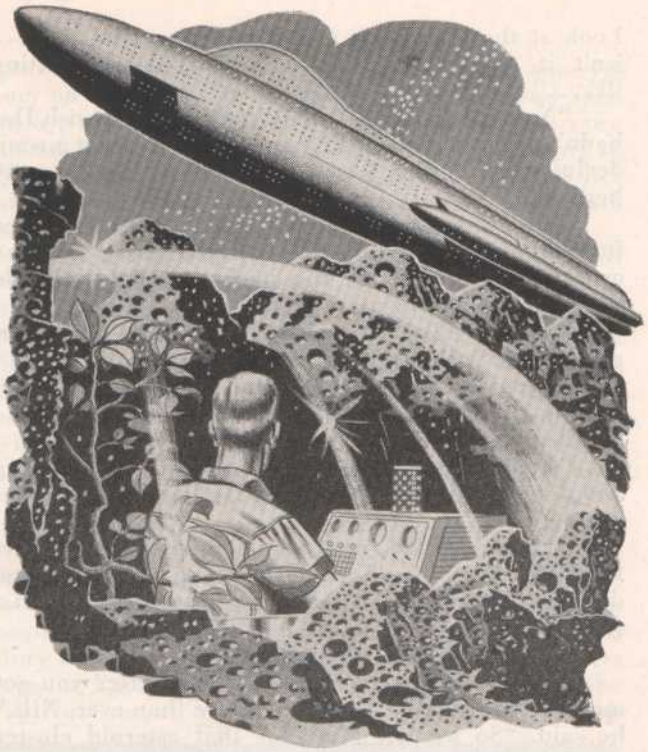
She grinned, and floated toward him, and then, as if just in fun, but not quite fun either, she kissed his rough hand solemnly. "That's thanks—thanks for everything, darling," she said. "Yes—I know now. I've come back to facts. We're on a beautiful little world that you made. Here, ballet and space aren't utterly incompatible things any more; they come together, and make each other better. And you're here. So I'm happy, and all in one piece again . . . and now, shouldn't I be cooking dinner, instead of fooling around? . . ."

NILS TOLBURT had a deadly scare, an Earth-month later. As he moved alone among still unrestored ruins, a shadow darkened the parched rock and ground around him. Looking up, he saw a great, ring-like hulk blocking the sunlight. He had almost forgotten that his asteroid, moving in its orbit, had nearly circled the sun in the more than three years since Vivien and he had come here, and now again was not too far from Mars and the traveled traffic lanes.

Memory of how men sometimes become in space made Tolburt wish mightily to go for his gun—before he saw that this was hopeless. Dozens of forms in armor were already dropping toward him from the great ship.

Soon they were around him in a horde, their voices—both masculine and feminine—filling his helmet-phones:

"With . . . impact . . . broke into a thousand lesser drops."



"A great . . . hulk blocked the sunlight."

"Hello—Mister! An asteroid with gardens on it? How come? . . ."

"Yes—we saw it from space, through the 'scopes. And of course we wanted to visit the ruins, too . . ."

"Uhunh—we asked the Captain to come close, and he seemed to have the same idea, so . . ."

"Hey—Friend—you don't have to look so surprised. We're just tourists. Don't you know tourists when you see them? . . ."

All this chatter from so many people quite threw Nils Tolburt off balance.

But then one girl—obviously scared of her near weightlessness, but knowing that she would soon be back in the liner with the comforting centrifugal "gravity" of its slow rotation, gained momentary command.

"Quiet, Dad," she ordered. "Quiet, all of you! Can't you see the poor man's a castaway—not used to so much noise? . . . Yes—probably you've been here for years. Sir—you wouldn't know what progress has been made. You ought to see . . . Yes—right now we are bound for Ceres City, which we hear has become quite civilized and luxurious . . . But—right now—Sir—may we see the wonderful things you have here? Please! We can pay you. . . ."

Tolburt had to be polite; more than that, he was glad for the presence of others after so long—for himself, and certainly for his wife. He grinned proudly. "Come along to the main air-lock, folks," he said. "This trip is on the house." And then, after all were inside his domain: "Hey, Vivien—company! . . ."

Vivien's eyes shone. She remained gracious and poised. "This way to the principal garden," she said. "Perhaps while Mr. Tolburt explains things to you, I could make you drinks—something typical and special . . ." Yes, Vivien had the makings of a great hostess.

Later, they sipped the juices of tangy, exotic fruit through slender tubes from bottles—left by the ancients—and very useful now in controlling liquids, which are elusive where gravity is very low. Many oh's and ah's and delighted comments about the charm of the strange surroundings were still to be heard:

"What gorgeous flowers. What fantastic music!

Look at those carvings and that drape. Oh—Alice—isn't it stupendous! Oh—I hope I'm not getting ill! . . ."

"Nonsense, Clara—it's all in the mind. I wish Dot hadn't been too unsure to leave the ship. What a wonderful place! You know, I'd almost like to *stay* here . . ."

Nils Tolburt heard no more of this, for two large individuals, who had purposely lost themselves in the crowd and lingered in the background, now made their presence known:

"Pss-sst! Nils!" A stage whisper, then a pair of grins from two ugly brown faces.

In joyful unbelief, Tolburt slipped quietly away, leaving the company in Vivien's capable hands. He led his two old buddies to his private workshop.

"Your lady—I see she's fine—we were wrong about her, kid. We apologize," Hellas Joe Tomkins said.

"Thanks. Glad you admit a point," Tolburt laughed. "But now—how, in the name of all miracles, did you two happen to turn up here, and in a *tourist* crowd?"

"Tell him, Nick," Joe ordered, sheepishly.

Nick Scillieri cleared his throat. "After you got married, we worried about you more than ever, Nils," he said. "So we left Mars for that asteroid cluster where we'd all been before, and where we knew you meant to go again. We hunted everywhere, and asked everybody we met, but there wasn't a sign of you any place. On the grubbing side, we didn't do any better than usual, either. No 'secret of life' that you used to josh about, has yet turned up. Yeah—somebody *did* find some real dinosaur pictures—only not us. And somebody else found some ideas for improving spaceship jets, making better liners possible. So we figured—on looking around us, and feeling the holes in our empty pockets after we'd spent our dough—that space is moving on, getting almost civilized in spots, and that we'd better blend in."

Tolburt grinned. "Is that the reason for the ship stewards' uniforms you're wearing?" he chuckled.

"Yeah," Nick admitted defensively. "We figured that the best of the Belt—the mineral deposits and all—had already been claimed, and marked 'No Trespassing.' So here we are, and—damn you—it ain't so bad, with the tips you get! . . . But that's not the point, now . . . We remembered yuh, Nils. And Joe said that if you weren't in that cluster, you must have got some place else first, because you could hardly have missed it. We remembered that until just a few months ago on Mars, when we already had our ship jobs. In Vananis we found an astronomer with a new set of telescope photographs of the Belt, and we talked to him, giving dates and everything. So he pointed to a little speck in a photograph, and said that it must have been right in your path when you headed for that cluster. He said it was on the way back, now. So we pow-wowed with our Captain. 'A good trick to spring on the rubbernecks, Sir,' Joe said. 'A little detour to give them a sense of real exploration.' So we got here, Nils, and found you . . ."

"Sure," Hellas Joe Tomkins joined in. "Of course we wanted to locate you and defend you from danger; but to tell the truth, kid, we had a hunch that if we did find you, our rotten luck would change . . ."

Joe sounded so lugubriously hopeful that Tolburt couldn't help laughing silently inside. In fact his merriment couldn't be kept hidden; it broke to the surface.

"I don't see nothing funny," Joe grumbled, hurt. "What's wrong with thinking of making a buck—some way, maybe—with all the stuff you've got here?"

"Nothing, Joe," Tolburt chuckled, sobering a little. "The fact is, when I look back, it surely seems as if luck *has* changed! At least by comparison. So I feel damned good. And I owe you two plenty of credit. Thanks! Nothing can seem very difficult, now."

"Sure, Nils," Nick broke in. "The tourists—the rubbernecks—you heard them getting all steamed up about everything here. And if they want things, they'll pay . . . Maybe this *could* be a place for rubbernecks, kid . . . Only—dammit—bunches of them will still be few and far between, way out here . . ."

Tolburt's high spirits, produced by the contrast of past black misfortune with present pleasure in good company, didn't decline with the regret in Nick Scillieri's final words. He wasn't discouraged that easily—not now! After so much trouble and hopelessness, it seemed that problems were being answered in his busy and freshly enthusiastic mind by suggestion alone, although those effortless answers to the future were completely alien to anything that he, the relic grubber, could ever have thought of before. It was as if his matron saint, Chance, had combined with Circumstance to ease up on him, and to laugh at him benignantly, now. Just then *he* felt benignant toward the whole human race.

"Listen, you two," he growled, grinning. "Stop saying 'rubbernecks.' They're people, eager to see what they never saw before, and that's fine! Now, just let me think . . ."

Nils Tolburt's mind was reviewing everything: His strange, rugged youth. His marriage to a dancer. Vivien's sickness. The beauty he had repaired and built. Vivien's wonderful recovery in the adaptation of her pleasurable art to go hand in hand with the void . . . And these people coming. Their interest in everything. Civilization reaching deep into space. So—was distance now still to be an obstacle, when a course of action was almost obvious, particularly when, in his leap outward from Mars—years ago—with a young wife and a great box of supplies, he had employed the actual solution on a small scale?

Or was he only dreaming—making things seem all too simple in his optimism? But science provided atomic power, cheap and plentiful, didn't it? While the vacuum of space was frictionless. . . . And the interest of people in wonder and romance could be sold, couldn't it? Was that thought a cynicism? Or was it—more—the clear-seeing of a means to provide a gift—a thing of progress and education? Tolburt's thoughts soared on . . .

"All right, what's on your mind, Nils?" Hellas Joe Tomkins demanded at last, impatiently.

"Orbiters," Tolburt answered. "Little moons of Earth. They've all been built in space, up to now, haven't they? From materials rocketed up from the ground. But this one is ready-made, and *could* be different. It could be brought close, into a path around the Earth, where everyone could see and visit it easily. What I've already put together could be the start of a tourist hotel, where folks could get acquainted with space—feel the wonder of it—even see what big civilizations once existed in the solar system, and how they came to an end—especially if that lesson becomes important again, in our own culture . . . What we could do is take some of the relics I've found here to Earth, and sell them for working capital. On Earth we could look for further backing . . . Is the whole idea crazy? What do you guys think?"

Hellas Joe and Nick Scillieri suddenly looked alert—almost wolfish.

"You mean," Nick gasped, "jet this whole, mile-

long hunk of rock millions of miles across space, and into an orbit around Terra?"

"What do you think he means, Slowbrain?" Joe snapped. "Yeah—I'm for trying the idea, Nils. A mile of rock ain't so much to push around—not in a vacuum, and away from restraining gravity. You just build up speed and then coast, as with a ship. As for the rest, we'll see . . ."

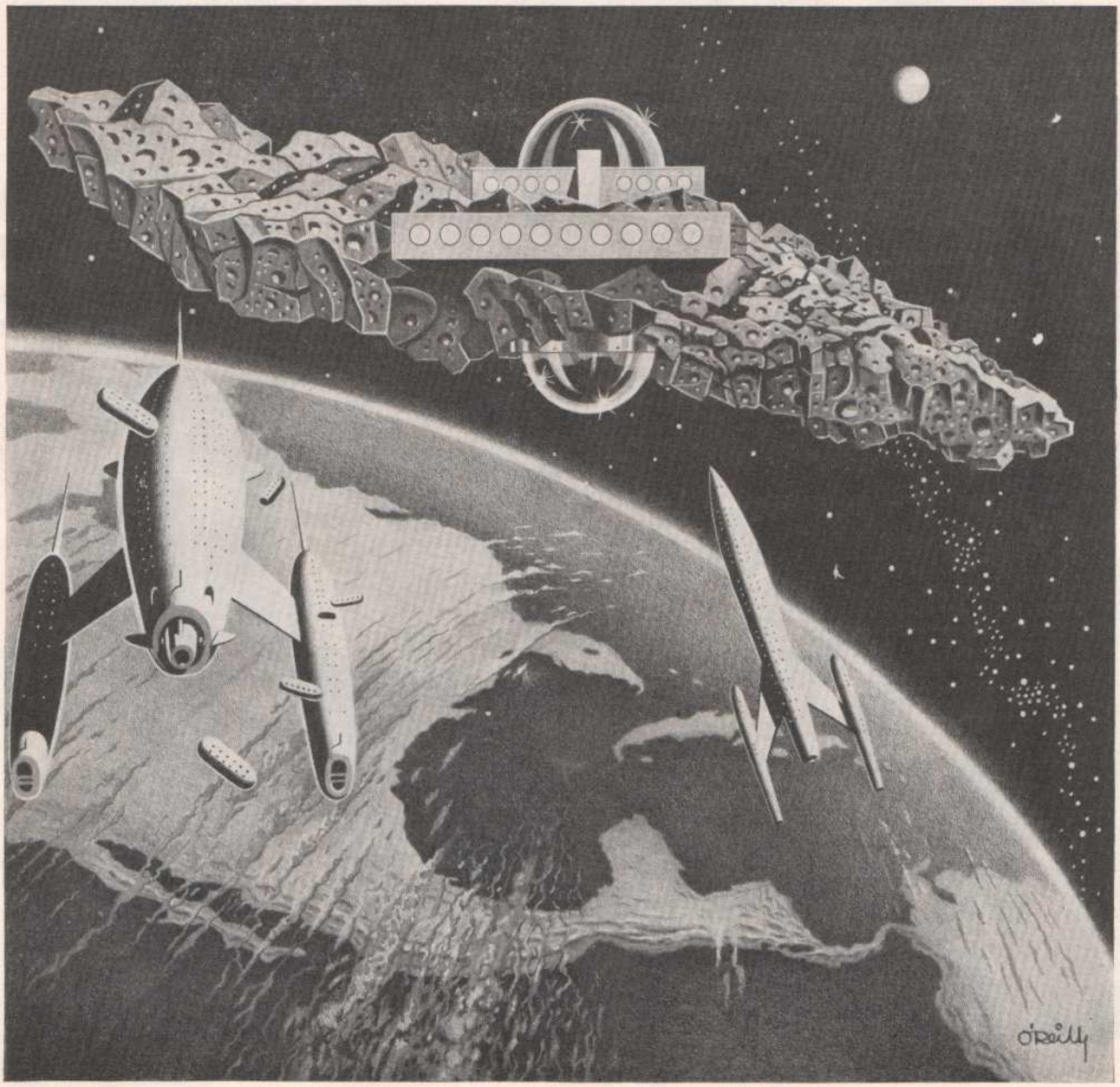
So THE SCHEME was put into action. During the months that followed, back on Earth, and then in the deep void once more, there were moments of discouragement. But after much time and work—mostly done by the three men themselves, the great rocket-tubes were welded into place on Tolburt's asteroid—now appropriately named *Inspiration*—and set aflame. Grandly a little world began to move, pushed by nuclear fire, from its age-old path.

After it was established in its new orbit around the Earth, its possibilities were smoothly realized. Novelty of achievement always arouses interest. Here, close at hand, was a chip of a vanished world—beautiful, fantastic, an advertisement of the solar system, the stars far beyond, and the whole future of the restless human race. Famous universities took up the appeal for funds for the construction of a great observatory on the surface of the satellite that had once been an asteroid. And Tolburt's gardens and rooms, once meant for another purpose, became the beginning of *Hotel Inspiration*, glamorized far and wide. Other ideas were realized, falling naturally and easily into place. Thus, things are as they are today.

Tolburt himself is not quite as he was. He is still big, and somewhat rough; but there is a charm to him. He looks opulent, as the head of a great enterprise perhaps should. Hellas Joe Tomkins and Nick Scillieri, his partners, have become more glossed than one would believe. Of course, all three have things to regret, sometimes. For their earlier years had been wild and free.

Vivien? For a while, for the benefit of people fresh from Earth, she performed dances similar to the one which space first allowed her to invent—though less frantic. Now she gives that wonderful exhibition only occasionally. She has a small son and a daughter.

So here is the story of Nils Tolburt, his strange beginnings, and their unforseeable outcome. It is a story of one of the little moons that were not always seen in Earthly skies—the story of *Inspiration*, the captive asteroid. +



". . . the satellite that had once been an asteroid . . . Hotel Inspiration."

retrograde

Although the problems of interstellar flight appear almost insurmountable, still, man gazes with far-sighted eyes to the mysteries that beckon from the twinkling lights of the far galaxies. It is certainly not inconceivable that on some of those myriad worlds that circle distant stars there may exist a race similar in appearance to humans. Such a race, in its climb upward from savagery, might encounter problems like those that plague us. There, similarity must of necessity end, for so distant an alien a race would certainly approach their problems in a manner incomprehensible to earth men. A master craftsman, the author tells an absorbing story highlighted by sound sociology and psychology, which are his forté.

by CLIFFORD D. SIMAK

(Illustrations by Jay Landau)

"With the help you gave us, we can't help but win."

evolution

Clifford D. Simak

Mr. Simak is a graduate of the University of Wisconsin and is at present news editor of the *Minneapolis Star*. The publication of his book, *City*, has won the nation-wide acclaim of critics. He is among the most popular science-fiction writers in the field today.

THE TRADER HAD SAVED some space in the cargo hold for the *babu* root which, ounce for ounce, represented a better profit than all the other stuff he carried from the dozen planets the ship had visited.

But something had happened to the *Kzyzz** villages on the planet Zan. There was no *babu* root waiting for the ship and the trader had raged up and down, calling forth upon all *Kyzz* dire maledictions combed from a score of languages and cultures.

High in his cubbyhole, one level down from the control room and the captain's quarters, Steve Sheldon, the space ship's assigned co-ordinator, went through reel after reel of records pertaining to the planet and studied once again the bible of his trade, Dennison's *Key to Sentient Races*. He searched for a hidden clue, clawing through his close-packed memory for some forgotten fact which might apply.

But the records were not much help.

Zan, one of the planets by-passed on the first wave of exploration, had been discovered five centuries before. Since that time traders had made regular visits there to pick up *babu* root. In due time the traders had reported it to Culture. But Culture, being busy with more important things than a backwoods planet, had done no more than file the report for future action, and then, of course, had forgotten all about it.

No survey, therefore, ever had been made of Zan, and the record reels held little more than copies of trading contracts, trading licenses, applications for monopolies and hundreds of sales invoices covering the 500 years of trade. Interspersed here and there were letters and reports on the culture of the *Kzyzz* and descriptions of the planet, but since the reports were by obscure planet-hoppers and not by trained observers they were of little value.

Sheldon found one fairly learned dissertation upon the *babu* root. From that paper he learned that the plant grew nowhere else but Zan and was valuable as the only known cure for a certain disease peculiar to a certain sector of the galaxy. At first the plant had grown wild and had been gathered by the *Kzyzz* as an article of commerce, but in more recent years, the article said, some attempts had been made to cultivate it since the wild supply was waning.

Sheldon could pronounce neither the root's drug derivative nor the disease it cured, but he shrugged that off as of no consequence.

Dennison devoted less than a dozen lines to Zan and from them Sheldon learned no more than he already knew: *Kzyzz* were humanoid, after a fashion, and with type 10 culture, varying from type 10-A to type 10-H; they were a peaceful race and led a pastoral existence; there were 37 known tribal villages, one of which exercised benevolent dictatorship over the other 36. The top-dog village, however, changed from time to time, apparently according to some peaceful rotational system based upon a weird brand of politics. *Kzyzz* were gentle people and did not resort to war.

And that was all the information there was. It wasn't much to go on.

But, for that matter, Sheldon comforted himself, *no co-ordinator ever had much to go on when his ship ran into a snag.* A co-ordinator actually did not begin to function constructively until everyone, including himself, was firmly behind the eight-ball.

Figuring the way out from behind the eight-ball was a co-ordinator's job. Until he faced dilemma, a yard wide and of purest fleece, he was hardly needed. There was, of course, the matter of riding herd on traders to see that they didn't cheat, beyond a reasonable limit, the aliens with whom they traded, that they violated no alien tabus and outraged no alien ethics, that they abided by certain restraints and observed minimum protocol, but that was routine policing—just ordinary chores.

Now, after an uneventful cruise, something had finally happened—there was no *babu* root and Master Dan Hart of the starship *Emma* was storming around and raising hell and getting nowhere fast.

Sheldon heard him now, charging up the stairs to the co-ordinator's cubbyhole. Judging the man's temper by the tumult of his progress, Sheldon swept the reels to one side of the desk and sat back in his chair, settling his mind into that unruffled calm which went with his calling.

"Good day to you, Master Hart," said Sheldon when the irate skipper finally entered.

"Good day to you, Co-ordinator," said Hart, although obviously it pained him to be civil.

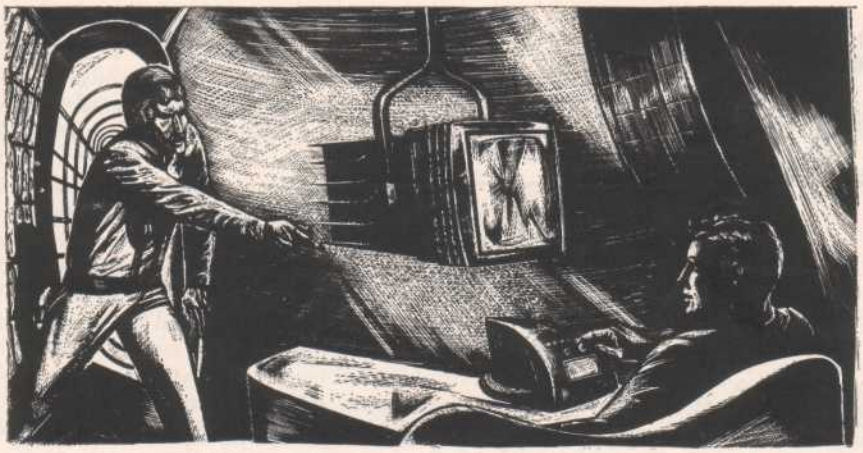
"I've been looking through the records," Sheldon told him. "There's not much to go on."

"You mean," said Hart, with rage seething near the surface, "that you've no idea of what is going on."

"Not the slightest," said Sheldon cheerfully.

"It's got to be better than that," Hart told him. "It's got to be a good deal better than that, Mister Co-ordinator. This is one time you're going to earn your pay. I carry you for years at a good stiff salary, not because I want to, but because Culture says I have to, and during all that time there's nothing, or almost nothing, for you to do. But now there *is* something for you to do. Finally there *is* something to make you earn your pay. I've put up with you . . . had you in my hair . . . stumbled over you, and I've held my

* Earthmen dubbed the Zan inhabitants *Kzyzz* on account of the strange sibilant sound they make while eating.



"He thrust out his head like an angry turtle."

tongue and temper, but now that there's a job to do, I'm going to see you do it."

He thrust out his head like an angry turtle. "You understand that, don't you, Mister Co-ordinator?"

"I understand," said Sheldon.

"You're going to get to work on it," said Hart. "You'll get on it right away."

"I'm working on it now."

"Indeed," said Master Hart.

"I've satisfied myself," said Sheldon, "that there's nothing in the records."

"And what do you do now?"

"Observe and think," said Sheldon.

"Observe and think!" yelped Hart, stricken to the core.

"Maybe try a hunch or two," said Sheldon. "Eventually we'll find out what's the trouble."

"How long?" asked Hart. "How long will all this mummery take?"

"That's something I can't tell you."

"So you can't tell me that. I must remind you, Mister Co-ordinator, that time spells money in the trading business."

"You're ahead of schedule," Sheldon told him calmly. "You've shaved everything on the entire cruise. You were brusque in your trading almost to the point of rudeness despite the standards of protocol that Culture has set up. I was forced time after time to impress upon you the importance of that protocol. There were other times when I let you get away with murder. You've driven the crew in violation of Labor's program of fair employment. You've acted as if the devil were only a lap behind you. Your crew will get a needed rest while we untangle this affair. The loss of time won't harm you."

Hart took it because he didn't know quite how far he could push the quiet man who sat behind the desk. He shifted his tactics.

"I have a contract for the *babu*," he said, "and the license for this trade route. I don't mind telling you I'd counted on the *babu*. If you don't shake loose that *babu*, I'll sue . . ."

"Don't be silly," Sheldon said.

"They were all right five years ago," said Hart, "the last trip we were here. A culture just can't go to pot in that length of time."

"What we have here," said Sheldon, "is something more complicated than mere going to pot. Here we have some scheme, some plan, something deliberate.

"The type 10 culture village stands there to the west of us, just a mile or two away, deserted, with its houses carefully locked and boarded up. Everything all tidy, as if its inhabitants had moved away for a short time and meant to come back in the not too distant future. And a mile or two outside that type 10 village we have instead another village and a people that average type 14."

"It's crazy," Hart declared. "How could a people lose four full culture points? And even if they did, why would they move from a type 10 village to a collection of reed huts? Even barbarian conquerors who capture a great city squat down and camp in the palaces and temples—no more reed huts for them."

"I don't know," said Sheldon. "It's my job to find out."

"And how to correct it?"

"I don't know that, either. It may take centuries to correct."

"What gets me," said Hart, "is that god-house. And the greenhouse behind it. There's *babu* growing in that greenhouse."

"How do you know it's *babu?*" Sheldon demanded. "All you've ever seen of *babu* was the root."

"Years ago," said Hart, "one of the natives took me out and showed me. I'll never forget it. There was a patch of it that seemed to cover acres. There was a fortune there. But I couldn't pull up a single plant. They were saving it, they said, until the root grew bigger."

"I've told the men," said Sheldon, "to keep clear of that god-house and now, Hart, I'm telling you. And that means the greenhouse, too. If I catch anyone trying to get at *babu* root or anything else growing in that greenhouse, there'll be hell to pay."

A SHORT TIME after Hart left, the chief of the *Kzyzz* village climbed the stairs to call on the co-ordinator.

He was a filthy character, generously inhabited by vermin. He didn't know what chairs were for, and squatted on the floor. So Sheldon left his chair and squatted down to face him, but immediately shuffled back a step or two, for the chief was rather high.

Sheldon spoke in *Kzyzz* lingo haltingly, for it was the first time he had used it since co-ordinator college days. *There is,* he supposed, *not a man on the ship that could not speak it better than I, for each of the crew was on Zan before and this is my first trip.*

"The chief is welcome," Sheldon said.

"Favor?" asked the chief.

"Sure, a favor," Sheldon said.

"Dirty stories," said the chief. "You know some dirty stories?"

"One or two," said Sheldon. "But I'm afraid they're not too good."

"Tell 'em," said the chief, busily scratching himself with one hand. With the other he just as busily picked mud from between his toes.

So Sheldon told him the one about the woman and the twelve men marooned on an asteroid.

"Huh?" said the chief.

So Sheldon told him another one, much simpler and more directly obscene.

"That one all right," said the chief, not laughing. "You know another one?"

"That's all I know," said Sheldon, seeing no point in going on. "Now you tell me one," he added, for he figured that one should do whatever possible to get along with aliens, especially when it was his job to find what made them tick.

"I not know any," said the chief. "Maybe someone else?"

"Greasy Ferris," Sheldon told him. "He's the cook, and he's got some that will curl your hair."

"So good," said the chief, getting up to go.

At the door he turned. "You remember another one," he said, "you be sure to tell me."

Sheldon could see, without half trying, that the chief was serious about his sex stories.

Sheldon went back to his desk, listening to the soft padding of the chief's feet going down the catwalk. The communicator chirped. It was Hart.

"The first of the scout boats are in," he said. "They reported on five other villages and they are just the same as this. The *Kzyzz* have deserted their old villages and are living in filthy huts just a mile or two away. And every one of those reed-hut villages has a god-house and a greenhouse."

"Let me know as soon as the other boats come in," said Sheldon, "although I don't suppose we can hope for much. The reports probably will be the same."

"Another thing," said Hart. "The chief asked us to come down to the village for a pow-wow tonight. I told him that we'd come."

"That's some improvement," Sheldon said. "For the first few days they didn't notice us. Either didn't notice us or ran away."

"Any ideas yet, Mister Co-ordinator?"

"One or two."

"Doing anything about them?"

"Not yet," said Sheldon. "We have lots of time."

He clicked off the squawk box and sat back. *Ideas? Well, one maybe. And not a very good one.*

A purification rite? An alien equivalent of a return to nature?

It didn't click too well. For, with a type 10 culture, the Kzyzz *never strayed far enough from nature to want to return to it.*

Take a type 10 culture. Very simple, of course, but fairly comfortable. Not quite on the verge of the machine age, but almost—yes, just short of the machine age. A sort of golden age of barbarism. Good substantial villages with a simple commerce and sound basic economics. Peaceful dictatorship and pastoral existence. Not too many laws to stumble over. A watered-down religion without an excess of tabus. One big happy family with no sharp class distinction.

And they deserted that idyllic life.

Crazy? Of course it was crazy.

As it stands now the Kzyzz *seem barely to get along. Their vocabulary is limited; why, I speak the language even better than the chief,* Sheldon told himself.

Their livelihood was barely above the survival level. They hunted and fished, picked some fruit and dug some roots, and went a little hungry—and all the time the garden patches outside the deserted village lay fallow, waiting for the plow and hoe, waiting for the seed, but with evidence of having been worked only a year or so before. And in those patches undoubtedly they had grown the *babu* plants as well as vegetables. But the *Kzyzz* now apparently knew nothing of plow or hoe or seed. Their huts were ill-made and dirty. There was family life, but on a moral scale that almost turned one's stomach. Their weapons were of stone and they had no agricultural implements.

Retrogression? No, not just simple retrogression. For even in the retrogression, there was paradox.

For in the center of the type 14 village to which the *Kzyzz* had retreated stood the god-house, and back of the god-house stood the greenhouse with *babu* growing in it. The greenhouse was built of glass and nowhere else in the type 14 village was there any sign of glass. No type 14 alien could have built that greenhouse, nor the god-house, either. No mere hut, that god-house, but a building made of quarried stone and squared timbers and with its door locked tight by some ingenious means that no one yet had figured out. Although, to tell the truth, no one had spent much time on it. On an alien planet, visitors don't monkey with a god-house.

"I swear," said Sheldon, talking aloud to himself, "that the god-house was never built by that gang out there. It was built, if I don't miss my guess, before the retrogression. And the greenhouse, too."

On Earth when we go away for a vacation and have potted flowers or plants that we wish to keep alive, we take them to a neighbor or a friend to care for them, or make arrangements for someone to come in and water them.

And when we go on vacation from a type 10 culture back to type 14, and we have some babu *plants that are valuable as seed stock, what do we do with them? We can't take them to a neighbor, for our neighbor, too, is going on vacation. So we do the best we can. We build a greenhouse and rig it up with a lot of automatic gadgets that will take care of the plants until we come back to care for them ourselves.*

And that meant, that almost proved, that the retrogression was no accident.

THE CREW SLICKED themselves up for the pow-wow, putting on clean clothes, taking baths and shaving. Greasy hauled out his squeeze box and tried a tune or two by way of warming up. A gang of would-be singers in the engine room practiced close harmony, filling the ship with their caterwauling. Master Hart caught one of the tube-men with a bottle that had been smuggled aboard. He broke the man's jaw with one well-directed lick, a display of enthusiastic discipline which Sheldon told Hart was just a little extreme.

Sheldon put on a semi-dress outfit, feeling slightly silly at dressing up for a tribe of savages, but he salved his conscience with the feeling that, after all, he was not going all the way with a full-dress uniform.

He was putting on his coat when he heard Hart come down from his quarters and turn toward his cubbyhole.

"The rest of the scouts came in," said Hart from the door.

"Well?"

"They are all the same. Every single tribe has moved out of its old village and set up a bunch of hovels built around a higher culture god-house and a greenhouse. They're dirty and half starving, just like this bunch out here."

"I suspected it," said Sheldon.

Hart squinted at him, as if he might be calculating where he best could hang one.

"It's logical," said Sheldon. "Certainly you see it. If one village went native for a certain reason, so would all the rest."

"The reason, Mister Co-ordinator, is what I want to know."

Sheldon said calmly, "I intend to discover it."

And he thought: *It was for a reason, then. If all of them went native, it was for some purpose,* according to some plan! *And to work out and coordinate such a plan among 37 villages would call for smooth-working communication, far better than one would look for in a type 10 culture.*

Feet pounded on the catwalk, thundering up. Hart swung around to face the door, and Greasy, charging into it, almost collided with him.

The cook's eyes were round with excitement and he was puffing with his run.

"They're opening the god-house," he gasped. "They just got the—"

"I'll have their hides for this," Hart bellowed. "I issued orders not to fool around with it."

"It isn't the men, sir," said Greasy. "It's the *Kzyzz.* They've opened up their god-house."

Hart swung around to Sheldon.

"We can't go," he said.

"We have to go," Sheldon said. "They've invited us. At this particular moment, we can't offend them."

"Side-arms, then," said Hart.

"With orders not to use them except as a last resort."

Hart nodded. "And some men stationed up here with rifles to cover us if we have to run for it."

"That sounds sensible," said Sheldon.

Hart left at the double.

Greasy turned to go.

"Just a moment, Greasy. You saw the god-house standing open?"

"That I did, sir."

"And what were you doing down there?"

"Why, sir . . ." From his face, Sheldon could see that Greasy was fixing up a lie.

"I'm not the skipper," Sheldon said. "You can talk to me."

The cook grinned. "Well, you see, it was like this. Some of them *Kzyzz* were cooking up some brew and I gave them some pointers, just to help along a bit. They were doing it all wrong, sir, and it seemed a pity to have their drinking spoiled by ignorance. So . . ."

"So, tonight you went down to get your cut."

"That, sir, was about the way it was."

"I see," said Sheldon. "Tell me, Greasy, have you been giving them some pointers on other things as well?"

"Well, I told the chief some stories."

"Did he like them?"

"I don't know," said Greasy. "He didn't laugh, but he seemed to like them all right."

"I told him one," said Sheldon. "He didn't seem to get it."

"That might be the case," said Greasy. "If you'll pardon me, sir, a lot of your stories are a bit too subtle."

"That's what I thought," said Sheldon. "Anything else?"

"Anything—oh, I see. Well, there was one fixing up a reed to make a flute and he was doing it all wrong . . ."

"So you showed him how to make a better flute?"

"That I did," said Greasy.

"I am sure," said Sheldon, "that you feel you've put in some powerful licks for progress, helping along a very backward race."

"Huh," said Greasy.

"That's all right," said Sheldon. "If I were you, I'd go easy on that brew."

"That's all you want of me?" asked Greasy, already halfway out the door.

"That's all I want," said Sheldon. "Thanks, Greasy."

A better brew, thought Sheldon. *A better brew and a better flute and a string of dirty stories.*

He shook his head. None of it, as yet, added up to anything.

SHELDON SQUATTED ON ONE side of the chief and Hart squatted on the other. Something about the chief had changed. For one thing, he was clean. He no longer scratched and he was no longer high. There was no mud between his toes. He had trimmed both his beard and hair, scraggly as they were, and had combed them out. A vast improvement over the burrs and twigs and maybe even birds' nests once lodged in them.

But there was something more than cleanliness. Sheldon puzzled over it even as he tried to force himself to attack the dish of food that had been placed in front of him. It was a terrible looking mess and the whiff he had of it wasn't too encouraging, and to make matters worse, there were no forks.

Beside him, the chief slurped and gurgled, shoveling food into his mouth with a swift, two-handed technique. Listening to his slurping, Sheldon realized what else was different about him. *The chief speaks better now. Just that afternoon he talked a pidgin version of his own tongue, and now he talks with a command of the language that amounts almost to fluency!*

Sheldon shot a glance around the circle of men squatted on the ground. Each Earthman was seated with a *Kzyzz* to each side of him, and between the slurping and the slopping, the natives made a point of talking to the Earthmen. *Just like the Chamber of Commerce boys do when they have guests,* thought Sheldon—*doing their best to make their guests content and happy and very much at home.* And that was a considerable contrast with the situation when the ship first had landed, when the natives had peeked out of doorways or had merely grunted, if they'd not actually run away.

The chief polished his bowl with circling fingers, then sucked his fingers clean with little moans of delight. Then he turned to Hart and said, "I observe that in the ship you eat off an elevated structure. I have puzzled over that."

"A table," mumbled Hart, having hard going with his fingers.

"I do not understand," said the chief, and Hart went on to tell him what a table was, and its advantages over squatting on the ground.

Sheldon, seeing that everyone else was eating, although with something less than relish, dipped his fingers in the bowl. *Mustn't gag,* he told himself. *No matter how bad it is, I mustn't gag.*

But it was even worse than he had imagined and he did gag. But no one seemed to notice.

After what seemed interminable hours of gastronomical torture, the meal was done, and during that time Sheldon told the chief about knives and forks and spoons, about cups, about chairs, pockets in trousers and coats, clocks and watches, the theory of medicine, the basics of astronomy, and the quaint Earthian custom of hanging paintings on a wall. Hart told him about the principles of the wheel and the lever, the rotation of crops, sawmills, the postal system, bottles for the containment of liquid and the dressing of building stone.

Just encyclopedias, thought Sheldon. *My God, the questions that he asks. Just encyclopedias for a squatting, slurping savage of a type 14 culture. Although, wait a minute now—was it still 14? Might it not, with-*

in the last half day, have risen to a type 13? Washed, combed, trimmed, with better social graces and a better language—it's crazy, he told himself. *Utterly and absolutely insane to think that such a change could take place in the span of half a day.*

From where he sat he could look across the circle directly at the god-house with its open door. And staring at the black maw of the doorway, in which there was no hint of life or light, he wondered what was there and what might come out of it—or go into it. For he was certain that within the doorway lay the key to the enigma of the *Kzyzz* and their retrogression, since it seemed that the god-house itself must have been erected in preparation for the retrogression. *No type 14 culture,* he decided, *could have erected it.*

After the meal was over, the chief rose and made a short speech, telling them that he was glad the visitors could eat with the tribe that night, and that now they would have some entertainment. Then Hart stood up and made a speech, saying they were glad to be on Zan and that his men had come prepared to offer a small matter of entertainment in return, if the chief would care to see it. The chief said he and his people would. Then he clapped his hands as a signal, and about a dozen *Kzyzz* girls came out and marched around in the center of the circle, going through a ritual figure, weaving and dancing without benefit of music. Sheldon saw that the *Kzyzz* watched intently, but none of it made much sense to him, well-grounded as he was on alien ritual habits.

Finally it was over. One or two misguided Earthmen clapped, but quickly subsided into embarrassed silence when everyone else sat in deathly quiet.

Then a *Kzyzz* with a reed pipe—*perhaps the very one,* Sheldon thought, *upon which Greasy had done his consultative engineering*—squatted in the center of the circle and piped away with a weird inconsistency that would have put to shame even the squeakiest of Earthly bagpipers. It lasted for a long time and seemed to get nowhere, but this time the ship's crew, perhaps in relief at the number finally ending, whooped and clapped and yelled and whistled as if for an encore, although Sheldon was fairly sure they meant quite the opposite.

The chief turned to Sheldon and asked what the men were doing. Sheldon had a reasonably hard time explaining to him the custom of applause.

The two numbers, it turned out, were the sum total of the entertainment program whomped up by the *Kzyzz,* and Sheldon would have liked to ask the chief if that was all the village could muster, a fact which he suspected, but he refrained from inquiring.

The ship's crew took over, then.

The engine-room gang gathered together, with their arms around each other's shoulders, in the best barbershop tradition, and sang half a dozen songs, with Greasy laboring away on the squeeze box to accompany them. They sang old songs of Earth, the songs all spacemen sing, with unshed tears brightening their eyes.

It wasn't long before others of the crew joined in, and in less than half an hour the ship's entire complement was howling out the songs, beating the ground with the flats of their hands to keep time and flinging back their heads to yelp the Earth words into the alien sky.

Then someone suggested they should dance. One of the tube-men called the sets while Greasy humped lower over his squeeze box, pumping out "Old Dan Tucker" and "Little Brown Jug" and "The Old Gray Mare" and others of their kind.

Just how it happened Sheldon didn't see, but all

". . . their Earthman teachers guided them . . ."

at once there were more sets. The *Kzyzz* were dancing, too, making a few mistakes, but their Earthman teachers guided them through their paces until they got the hang of it.

More and more of them joined in, and finally the entire village was dancing, even the chief, while Greasy pumped away, with the sweat streaming down his face. The *Kzyzz* with the reed pipe came over after a while and sat down beside Greasy. He seemed to have got the technique of how to make the music too, for his piping notes came out loud and clear, and he and Greasy hunkered there, playing away like mad while all the others danced. The dancers yelled and hollered and stamped the ground and turned cartwheels, which were totally uncalled for and strictly out of place. But no one seemed to care.

Sheldon found himself beside the god-house. He and Hart were alone, pushed outward by the expanding dance space.

Said Hart: "Mister Co-ordinator, isn't that the damnedest thing that you have ever seen."

Sheldon agreed. "One thing you have to say about it: The party is a whingding."

GREASY BROUGHT the news in the morning when Sheldon was having breakfast in his cubbyhole.

"They've dragged something out of that there god-house," Greasy said.

"What is it, Greasy?"

"I wouldn't know," said Greasy. "And I didn't want to ask."

"No," said Sheldon, gravely. "No, I can appreciate you wouldn't."

"It's a cube," said Greasy. "A sort of latticework affair and it's got shelves, like, in it, and it don't make no sense at all. It looks something like them pictures you showed me in the book one time."

"Diagrams of atomic structure?"

"That's exactly it," said Greasy. "Except more complicated."

"What are they doing with it?"

"Just putting it together. And puttering around with it. I couldn't tell exactly *what* they were doing with it."

Sheldon mopped up his plate and shoved it to one side. He got up and shrugged into his coat. "Let's go down and see," he said.

There was quite a crowd of natives around the contraption when they arrived, and Sheldon and

Greasy stood on the outskirts of the crowd, keeping quiet and saying nothing, being careful not to get in the way.

The cube was made of rods of some sort and was about 12 feet on each side, and the rods were joined together with a peculiar disc arrangement. The whole contraption looked like something a kid with a full-blown imagination might dream up with a super-tinker-toy set.

Within the cube itself were planes of glasslike material, and these, Sheldon noticed, were set with almost mathematical precision, great attention having been paid to the exact relationship between the planes.

As they watched, a heavy box was brought out of the god-house by a gang of *Kzyzz*, who puffed and panted as they lugged it to the cube. They opened the box and took out several objects, carved of different materials, some wood, some stone, others of unfamiliar stuff. These they set in what appeared to be prescribed positions upon the various planes.

"Chess," said Greasy.

"What?"

"Chess," said Greasy. "It looks like they're setting up a game of chess."

"Could be," said Sheldon, thinking, *if it is a chess game, it is the wildest, most fantastic, toughest game I have ever seen.*

"They got some screwy chess games, now," said Greasy. "Fairy chess, they call it, with more squares to the board and more pieces, different than the ones you use just regular. Me, I never could rightly get the hang of even normal chess."

The chief saw them and came over.

"We are very confident," he said. "With the help you gave us, we can't help but win."

"That is gratifying," Sheldon said.

"These other villages," said the chief, "haven't got a ghost. We have them pegged dead center. This will be three times, hand-running."

"You are to be congratulated," said Sheldon, wondering what it was all about.

"It's been a long time," said the chief.

"So it has," said Sheldon, still very much at sea.

"I must go now," said the chief. "We start now."

"Wait a second," Sheldon asked him. "You are playing a game?"

"You might call it that," the chief admitted.

"With these other villages—all the other villages?"

"That's right," said the chief.

"How long does it take? With all those villages, you and the other 36 . . ."

"This one won't take long," the chief declared, with a knowing leer.

"Good luck, chief," said Sheldon and watched him walk away.

"What's going on?" asked Greasy.

"Let's get out of here," said Sheldon. "I have work to do."

Hart hit the ceiling when he learned the kind of work that Sheldon had to do.

"You can't third-degree my men!" he shouted. "I won't have it. They haven't done a thing."

"Master Hart," said Sheldon, "you will have the men line up. I'll see them in my quarters, one at a time, and I won't third-degree them. I just want to talk to them."

"Mister Co-ordinator," said Hart, "I'll do the talking for them."

"You and I, Master Hart," said Sheldon, "did our talking last night. Much too much of it."

For hours on end, Sheldon sat in his cubbyhole while the men filed in one at a time and answered the questions that he shot at them:

"What questions did the *Kzyzz* ask you?"

"How did you you answer them?"

"Did they seem to understand?"

Man by man the notes piled up, and at last the job was done.

Sheldon locked the door, took a bottle from his desk and had a liberal snort; then he put the bottle back again and settled down to work, going through the notes.

The communicator beeped at him.

"The scouts are in," said Hart's voice, "and every single village has one of those cubes set up in front of their god-house. They're sitting around it in a circle and they seem to be playing some sort of game. Every once in a while someone gets up from the circle and makes a move on one of the planes in the cube and then goes back and sits down again."

"Anything else?"

"Nothing else," said Hart. "That was what you wanted, wasn't it?"

"Yes," said Sheldon, "I guess that was what I wanted."

"Tell me one thing," asked Hart. "Who are they playing?"

"They're playing one another."

"One another what?"

"The villages," said Sheldon. "The villages are playing against one another."

"You mean 37 villages!"

"That's what I mean."

"Would you tell me just how in hell 37 villages can play one single game?"

"No, I can't," said Sheldon. But he had the terrible feeling that he could. That he could make a guess at least.

When it had become apparent that the retrogression was a planned affair, he remembered, *I wondered about the problem of communications which would have been necessary to have 37 villages simultaneously retrogress. It would have taken,* he had told himself, *a higher order of communications that one would expect to find in a type 10 culture.*

And here it is again—an even tougher communications job, an odd, round-robin game in which those same 37 villages play a game upon a complicated board.

There is one answer for it, he told himself. *It simply couldn't be, but there is no other answer for it*—telepathy, *and that is almost unthinkable in a type 10 culture, let alone a type 14.*

He clicked off the squawk box and went back to work. He took a large sheet of paper to serve as a master chart and thumbtacked it to the desk, then started on the notes, beginning with the top one and going through to the very last. And when he had finished the chart, he sat back and looked at it, then put in a call for Hart.

Five minutes later Hart climbed the stairs and knocked at the door. Sheldon unlocked it and let him in. "Sit down, Hart," he said.

"You have something?"

"I think I have," said Sheldon. He gestured at the sheet thumbtacked on the desk. "It's all there."

Hart stared at the chart. "I don't see a thing."

"Last night," said Sheldon, "we went to the *Kzyzz* pow-wow, and in the short time we spent there, we gave that particular village the most complete and comprehensive outline of a type 10 culture that you have ever seen. But what really scares me is, that we went somewhat *beyond* type 10. I haven't worked it

out completely, but it looks nearer type 9M than type 10."

"We what?"

"They pumped it out of us," said Sheldon. "Each of our men was questioned about certain cultural matters, and in not a single instance was there duplication. Each of the set of questions asked was a different set of questions. Just as if those *Kzyzz* were assigned certain questions."

"What does it mean?" asked Hart.

"It means," said Sheldon, "that we have interfered in one of the slickest social setups in the entire galaxy. I hope to God . . ."

"Slick social setup! You mean the *Kzyzz?*"

"I mean the *Kzyzz*," Sheldon said.

"But they never amounted to anything," Hart said. "They never will amount to anything. They . . ."

"Think hard," said Sheldon, "and try to tell me what is the most outstanding thing about the *Kzyzz* culture. We have a history of 500 years of trade with them. During those 500 years there is one fact about them that sticks up like a bandaged thumb."

"They're dumb," said Hart.

"Not from here, they aren't."

"They never got anywhere," said Hart. "Weren't even going anywhere, far as I could see."

"That's part of it." said Sheldon. "Static culture."

"I'll be damned," said Hart, "if I'll play guessing games with you. If you have something on your mind . . ."

"I have *peace* on the mind," said Sheldon. "In all the 500 years we've known the *Kzyzz*, there has been no dissension among them. They've never fought a war. That is something that cannot be said for any other planet."

"They are just too dumb to fight," said Hart.

"Too *smart* to fight," said Sheldon. *"The* Kzyzz, *Master Hart, have done something no other people, no other culture, has ever been able to do in all galactic history. They've found a way in which to outlaw war!"*

FOR THOUSANDS UPON thousands of years, empire after empire had been built among the stars and upon the many planets that circled round the stars.

And one by one, lonely and beaten, each empire had fallen, and one by one other empires had risen to take their place and in their turn had fallen. And those that existed in this day would fall in time.

That is the old, old cycle, Sheldon told himself, *the ancient disease of force and arrogance and desperation—the ageless pattern of cultural development.*

Never had a day existed since the first beginning that there had not been war at one place or another within the galaxy.

War came about because of economic pressure, mostly, although there were other causes—the ambitions of a certain being or of a certain race, the strange death-wish psychology which bloomed in certain cultures, an overweening racism, or a religion that spoke in terms of blood and death, rather than in terms of love and life.

Break down the causes of war, Sheldon thought, *and we would find a pattern—certain factors which made for war and certain other factors which made for victory, once war had been invoked.*

Now, suppose we made a study of war, its causes and the winning of it. Suppose we worked out the relevant relationships which each factor held to all the other factors, and not only that, but the relevant power of certain groups of factors against other groups of factors—factors of racial ingenuity and technology, of the human spirit, of logistics, of cultural development and the urge to protect and retain that culture, and hatred or the capacity to hate, all the many factors, tangible and intangible which went into the making and the winning of a war.

And broken down into concrete terms, what would some of those factors be? What factors pushed a culture to the point of war? What factors made a victor? Certainly not just steel and firepower, certainly not courage alone, or generalship alone, or logistics or any other thing that could stand alone.

There would be other things as well, little, inconsequential, homely items, like sitting in a chair instead of squatting on the floor to eat, or using a knife and fork and not fingers. And other things, like dirty stories and better drinking likker and a better pipe fashioned from a reed. For into all of these would go certain principles—the principle involved in the making of a better beer might light the way to manufacture a chemical that could be used in war; the perverted wit that shaped a dirty story might be turned to more destructive use in the propaganda section; the knowledge that made a better musical instrument might be extended to fashion an instrument that was not musical, but deadly.

It would be abilities such as these which would supply the economic pressure that might start a war, or contribute to that sense of superiority and intolerance and invincibility which might incline a tribe to war.

And if we watched the factors which represented these and other abilities, we would know when a war was about to pop.

And it was these same basic abilities and attitudes, plus a million other factors, which would determine who would win if a war should start.

Knowing this, we could assign certain actual values to all these cultural factors, although the value, as in a hand of cards, would be increased or decreased as they occurred in combination.

Sheldon got up and paced the tiny room, three steps up and three steps back.

Suppose then, he thought, *we made a game of it —a game of war, with all the factors represented by game pieces assigned sliding values. Suppose we played a game instead of fought a war. Suppose we let the game decide which side would have won if there had been a war.*

Suppose, furthermore, that we watched cultures and detected the rise of those factors which finally lead to war. Suppose we could say that if the rise of certain factors should continue, war would then be inevitable in five years or ten.

Suppose we could do this—then we could catch a war before it started. We could see the danger signals and we would know the crisis point. And when we reached the crisis point, we played a game—we did not fight a war.

Except, Sheldon told himself, *it wouldn't work.*

We could play a game and decide a war, and once it had been decided, the factors that made for war would still be there; the crisis point would stand. We would be right back where we started; we would not have gained a thing. For the game, while it might decide who would have won the war, would not upset or correct the economic pressure, would not erase the crisis point.

No doubt the game could show which side would have won. It could predict, with a small percentage error, the outcome of a war. But it could not wipe out excess populations, it could not wrest trade advantages from the opposing side—it wouldn't do the job.

It wouldn't work, he told himself. *It was a beau-*

tiful theory, a great idea, but it just wouldn't work.

We'd have to do more than play a game. We'd have to do a great deal more than play a game.

Besides determining who would have won the war if there had been a war, we would have to remove voluntarily the factors which had brought about the war —the solid, substantial facts of economic pressure, of intolerance, of all the other factors which would be involved.

It wasn't only the matter of playing a game, but of paying a price as well. There would be a price for peace and we'd have to pay the price.

For there would be more than one set of factors.

There would be the set that showed a war was coming. And there would be another set which would show that beyond a certain point the hard-won formula for peace simply wouldn't work.

It would work, perhaps for a type 10 culture, but beyond that, the factors involved might get so complicated that the formula would collapse under its own weight. A type 10 culture might be able to deal with a factor which represented the cornering of the market on a certain food, but they could not deal with a factor which represented the complexity of galactic banking.

The formula might work for a type 10 culture, but it might not work for type 9; it might be utterly worthless for type 8.

So the Kzyzz *not only played the game, but they paid the price of peace. And the price of peace was to run the other way. They retreated from advancement. They went clear back to 14 and they stayed there for a while, then went forward rather swiftly, but not as far as they were before they retrogressed. They went back voluntarily, and they stayed back, so they wouldn't fight a war.*

They went back, not because war was less likely in a type 14 culture than in a type 10 culture, but they went back so that the formula, once it had been used, would be effective; they stayed back so that they had some room to advance before they again reached the point beyond which the formula would break down.

But how would they go back? How would they retreat from a 10 to a 14 culture? Retrogress—sure they would retrogress. They would leave their comfortable village and go back and live in squalor and all the time the gameboard and the pieces and the position values they had earned in their type 10 existence would be safely locked away inside the god-house. There would come the day when they had advanced far enough so they could play the game, and they played it then, according to the rules and with what they had—unless they hit the jackpot, and a space-ship from a higher culture landed in their midst and handed them on a silver platter, as it were, a load of atom bombs to be used in a bow and arrow war.

Sheldon sat down at his desk and held his head in his hands.

How much, he asked himself, *how much more did we give them than they had before? Have we wrecked the formula? Have we given them so much that this village just outside the ship can bust the formula wide open? How much tolerance would there be? How far could they advance beyond a type 10 culture and still be within the safety limit?*

He got up and paced the floor again.

It's probably all right, he told himself. *They've played the game for 500 years we know of—for how many thousands of years more than that we simply cannot know. They would not willingly break down the formula; they would know the limit. For there must be a deeply-ingrained fear of war within their very culture, or otherwise they would not continue to subscribe to the formula. And it's a simple formula, really. Simple. Like falling off a log! EXCEPT—how did a people deliberately retrogress?*

Hypnotism? Hypnotism wouldn't work, for what would happen to the hypnotist? He'd remain as a random and dangerous factor.

A clever machine, perhaps, except the Kzyzz *had no machines at all. So it couldn't be machines.*

Drugs, maybe.

There was a root, and out of the root a drug was made to fight a disease peculiar to a certain sector of the galaxy—the *babu* root. Zan was the only place where the *babu* plant was grown.

"Good Lord," said Sheldon, "I didn't think of that. I read about it. What was that disease?"

He dug out his reels and put them in the viewer and found the dissertation on the use of the *babu* root, and he found the name of the disease, which was unpronounceable. He looked through the index of his reels and found the reel with the medical information, and there were few lines on that strange disease:

. . . nervous disorder, with high emotional tensions involved, in many cases stressing a sense of guilt, arising from the inability to forget past experiences. The drug induces a complete state of forgetfulness, from which the patient gradually recovers, retaining basic precepts rather than the welter of detailed experiences, the impingement of which contributes to his condition.

That's it, of course! That's the perfect answer! The Kzyzz *ate of the* babu *root, perhaps ceremonially, and they forgot, and in the forgetting they sloughed their culture from them, retrogressing four entire culture points. Then, after a time, the effect of the* babu *root would gradually wear away and they would remember, and remembering, advance up the cultural scale. They would remember, not the details of their former culture, but only its basic precepts, and in that way they'd not climb as high as they had been before. In that way they'd leave a margin through which they would advance toward the next crisis. Then once again, they'd eat of the* babu *root and once again war would be averted.*

For, while the game would determine who would have won the war if one had been fought, the forgetting and the slow recovery from the babu *would wipe out the cause of war, would remove the crisis point.*

The formula worked because, even before they played the game, the factors of war would have been upset and the crisis point have already disappeared.

"God forgive us," Sheldon said, "our little grasping souls."

He went back to the desk and sat down. With a hand that suddenly was heavy, he reached out and thumbed up the communicator for a call to Hart.

"What is it now?" rasped Hart.

"Get out of here," Sheldon ordered. "Get off this planet as quickly as you can."

"But the root . . ."

"There isn't any root," said Sheldon. "Not any more, there isn't any root."

"I have a contract."

"Not now," said Sheldon. "It is null and void, contrary to galactic interests."

"Contrary!" He could hear Hart choking on his rage. "Look here, Co-ordinator, they need that root out in sector 12. They need . . ."

"They'll synthesize it," Sheldon said. "If they want it they'll have to synthesize it. There is something more important . . ."

"You can't do this," said Hart.

"I can," said Sheldon. "If you think I can't, try me out and see."

He snapped the toggle down and waited, sweating out the issue.

Ten minutes passed before he heard the men running in the ship below, preparing for blast-off.

HE WATCHED THE PLANET fade behind them as the ship fled into space.

Courage, he said to himself, thinking of the *Kzyzz, the bare, cold courage of it.*

I hope it's not too late.

I hope we didn't tempt them too far.

I hope they can offset the damage that we did.

There must have been a day when the Kzyzz *were a great race, building a great civilization—greater, perhaps, than any culture now in the galaxy. For it would have taken a fantastically advanced people to have done what they have done. It was no job for a type 10 culture, nor for a type 6 culture, which is the best that Earth itself can boast.*

It had taken intelligence and great compassion, sharp analytical ability, and sober objectivity to figure out the factors and how they could be used.

And it had taken courage beyond imagination to activate the course those ancient *Kzyzz* had worked out—to trade a culture that might have reached type 2 or 3, for a type 10 culture, because their plan for peace would not work beyond a type 10 culture.

Once having worked, it must now continue working. All the courage of the race must not now be lost. It is a formula that must not be allowed to fail. It must not be allowed to fail because of the profit that traders made out of the babu *root. It must not be allowed to fail through contact with other uncouth creatures who might be higher on the cultural yardstick, but who are without the common sense and the courage of the* Kzyzz.

And another thing—we must not run the chance that the babu *root become a mere article of commerce. We could not blind the* Kzyzz *to the greater value of the root, the value in which lay the greatest hope the galaxy had known.*

Sheldon went back to the chart he'd made and checked through the information which the *Kzyzz* had pumped out of the crew, and it added up to just slightly more than a type 10 culture—a type 9R, perhaps. And that was dangerous, but probably not too much so, for the type 10A, if the *Kzyzz* ever got that far, probably still represented a certain margin of safety. And there was the matter of the lag in the culture, due to the *babu* eating, which probably would add an additional safety margin.

". . . blast-off."

But it had been close. Too close for comfort. It demonstrated another factor, the factor of temptation—and that was something that could not be allowed to continue.

He went back to the record reels and spent hours pouring over invoices and once again he saw the cold, stark courage and the insistent dedication of the *Kzyzz.*

There was not a single item on any of the invoices which went beyond a type 10 culture.

Imagine, he told himself, *settling for a better hoe when they could have had atomic engines!*

Imagine, for 500 years, refusing merchandise and comfort that would have made the Kzyzz *a greater people and a happier and more leisured people.*

Greater and happier—and more than likely. dead.

Once long ago, in mighty cities now hidden in the dust of the planet's surface, the *Kzyzz* must have learned the terrible bitterness of a most artful and accomplished war and must have recoiled from the death and agony and the blind futility, and the knowledge of that day still dwelled within the minds of the *Kzyzz* of today.

And that knowledge the galaxy could not afford to lose.

Sheldon picked up the chart and rolled it into a cylinder and slipped a couple of rubber bands around it. He put the reels away.

For 500 years the *Kzyzz* had held out against the lure of traders who would have given them anything they asked for the *babu* root. Traders who, even if they had known the truth, still would have willingly and thoughtlessly wrecked the protective type 10 culture for the sake of profit.

They had held out for 500 years. How much longer could they hold out? Not for forever, certainly. Perhaps not for a great deal longer.

The chief and his tribe had weakened momentarily in acquiring information beyond the type 10 culture limit. Might that not mean that already the moral fiber was weakening, that the years of trading had already sown their poison?

And if the *Kzyzz* had not held out—if they did not hold out—the galaxy then would be the poorer and the bloodier.

For the day would come, many years from now perhaps, when it might be safe to make a survey, to conduct a study of this great thing the *Kzyzz* had accomplished.

And out of that study certainly would come the first great step toward peace throughout the galaxy, a hint as to how the principle might apply without the stultifying need of a static culture.

But the study itself could not be made for many years. Not until the random factors of the last 500 years of trade had been swept away.

He sat down at the desk and pulled out the voice-writer, inserted a sheet of paper.

He spoke a heading which the machine printed quickly:

Recommendation for the indefinite closing of the planet Zan to all visitors and traders.

Foreword

Since the early thirties, every Christmas I have printed an annual greeting booklet in lieu of a Christmas card. These booklets, in several colors, measure about 6½ by 5 inches and contain from 26 to 36 pages. For a good many years they satirized the cover and format of a well-known magazine. From 5000 to 6000 booklets were printed annually and circulated among my friends in the radio-electronic and publishing industries. Every idea and word in these miniature magazines is a product of my pen.

The 1950 issue was titled **Newspeek.** ***Its cover bore the legend,*** **"World War III—in Retrospect."** ***The story showed a problematical future world war—and in the main was written to bring home the futility of War.***

Exactly 10 months later—on October 27, 1951, **Collier's** ***magazine brought out a special issue labeled "Preview of the War We Do Not Want." In this issue was duplicated the entire basic idea of my then 10-months-old*** **"World War III—In Retrospect,"** ***except that the 128-page*** **Collier's** ***version was longer, gorier—and most important —it used the Atom-bomb.***

For the record, note, that exactly 9 of **Collier's** ***editors and staffers were on my mailing list. Hence,*** **"World War III—In Retrospect"** ***was well-known to*** **Collier's** ***organization. Nevertheless, no credit for the idea was given in*** **Collier's.**

For some time, many of my friends have urged me to publish **"World War III—in Retrospect"** ***in a general circulation magazine. I am doing so now, in order to acquaint you with the*** **original** ***story. It is reprinted here, exactly, with one change—for in the 1950 version, World War III started in 1952—Collier's, incidentally, copied that date, too! It will be seen that I also changed that date to 1954, in the present version.***

—Hugo Gernsback.

The Submarauder

THE U.S. ON DECEMBER 25, 1966

Meaning of the Peace

The long road from Korea 1950 A.D. to the signing of the peace treaties with Russia and China last week, after 14 exhausting war years, is at an end.

True, the shooting war was over ten years ago—March 1955—with the signing of the two armistices with our erstwhile enemies; nevertheless, till the two enemy states had fulfilled their obligations; there could be neither a true nor legal peace.

With the world peace celebration at an end now, let us take stock as far as the United States is concerned.

The provisions of the peace treaties with Dr. Popoff's Russia and Ming-Soong's China specify U.N. occupation of both Russian and Chinese key cities and a total of 59 strategic points in both countries for 40 years longer. (The armistice terms specified a total of 50 years, of which ten years have already elapsed.)

The U.S. share of occupation troops will be a total of 520,000 men to guarantee the peace during the next four decades. This will be a high cost to bear by the already overburdened American taxpayer, but it is cheap if it assures 40 years of peace.

After all, the few billions a year that it will cost us is insignificant compared to the present U.S. national debt of 4,670 billion dollars. Further, we must be prepared to continue to help the backward nations of the world for many years to come, if we do not wish population explosions to occur in the Asiatic pressure centers of India, Pakistan, and Indonesia, who now have a total population of 496 million.

Atomic energy must be provided on a grandiose scale for these Asiatics, as well as for other pressure centers of the world, particularly the "have-not" countries, if permanent world peace is to be maintained.

As has often been remarked during the past ten

WORLD WAR III — IN RETROSPECT

by HUGO GERNSBACK

(Illustrations by Frank R. Paul)

Frank R. Paul

Mr. Paul was the first science-fiction magazine illustrator in the field in 1926, and has become the most popular and beloved artist ever to work in the medium. His long association with Hugo Gernsback has made his work a virtual trade-mark of Gernsback Publications.

years by our statesmen: Cheap atomic energy is the key to world peace. The near-extinct Communism or other new isms cannot breed discontent or engender wars if the world's populations have everything they need.

Nevertheless the U.N.'s vigilance over atomic energy must never cease. Power plants in the hands of revolutionists seeking world conquest could manufacture electronic-guided, trans-world weapons in less than a year. Hence the more atomic plants in various parts of the world, the greater the need for U.N. supervision. This again means more U.N. manpower, not only in inspection bodies but in far-flung intelligence staffs. That automatically means a further drain on the world's taxpayers.

U.S. Money Reform

Congress' most pressing business in 1967 will be obviously a practical and sensible dollar reform. Compared to the pre-World War II purchasing power, the U.S. dollar last week was down to 10¼ cents. It has been steadily declining since 1941, with few reversals in the trend. True, the dollar has company in this, as nearly all money units the world over have similarly declined, with the exception of the Swiss franc.

None of the hundreds of proposals that have been made lately, by economists and others, for a real money reform seem to hold water. The radical school of world-wide repudiation of all state debts is looked upon with horror and dismay in Washington, London, and Paris.

On the other hand, the *atom-energy dollar*—the AED—as a uniform world currency seems to gain strength as the months pass. Such a currency based upon the atomic-energy kilowatt—instead of gold—would have the same intrinsic value always—just as the meter or the yard. As atomic energy becomes cheaper the purchasing power of the AED *increases.* The only fly in the soup: how and on what basis could the world's nations convert their present state debts into atom-energy dollars?

Russia's Dr. Alexis Popoff

China's President Ming-Soong

THE ACTUAL WAR

WORLD WAR II:

War That Had No End—1945-1950

Historians will have great difficulty in demarking the end of World War II, which began on September 1, 1939, and the actual beginning of World War III. Officially the military war between the Allied Powers and Hitler's Germany—the Third Reich—ended on May 8, 1945. The shooting war between the Western Powers and Japan came to a close on August 14, 1945, with Japan formally surrendering on U.S. Battleship Missouri on September 2, 1945.

Mainly due to Soviet machinations, obstructions, and chicanery, no peace treaties were ever signed with Germany, Austria, or Japan, by the Western Powers and Russia, their former ally.

1951—Soviet Machinations

The defection of Russia from the Western Powers, which began in 1945, steadily accelerated in tempo. The Berlin blockade by the Russians aimed to

expel the Western powers in 1948-49 was but a sample of what was to come. The celebrated American airlift, however, which supplied food and fuel to Western Berlin, completely upset Moscow's plan, and for the time being the Russians were check-mated—at least in their Berlin venture.

Supported, armed, and prodded on by Russia, the Chinese Red forces of General Mao-Tzé-Tung defeated the Nationalist armies. China, now in the grip of the Communists, signed a friendship and mutual assistance pact with Russia early in February 1950. General Chiang Kai-shek's Nationalist Chinese Government with several hundred thousand troops sought refuge on the formerly Japanese-held island of Formosa.

Encouraged by Communist China's success, Soviet Russia armed the Red North Koreans who promptly invaded the South Korean Republic in June 1950.

President Truman, however, upset the Kremlin scheme by invoking the U.N. and promptly throwing U.S. and U.N. forces into Korea. Forced into a small beachhead around Pusan by the Red forces, the U.N. armies turned an early defeat into a notable military victory, completely defeating the North Koreans who had been augmented by Red Chinese troops in 1951.

This setback deterred Russia but temporarily in their fanatical determination to Communize the world. Not strong enough as yet to engage into a full-scale war with the U.S. and the rest of the world, the men in the Kremlin continued to wage their Cold War, using their satellites whenever and wherever they could.

The Indo-China Communist campaign which had been gathering momentum for several years, burst into a full-fledged war early in 1954. Aided and abetted by Chinese troops—masquerading in Indo-Chinese Vietminh uniforms and using Russian arms—French Indo-China was overrun in 1954, in spite of U.N. help. U.S. and U.N. troops from Korea arrived too late, and there were not sufficient divisions available to turn the tide against the Reds.

Considerable numbers of U.N. forces had to be retained in Korea so that South Korea would not be overrun by the Chinese.

TRIPLE INVASION:

Siam, Burma and Malaya Overrun

While the Indo-China invasion was in full swing, Red China, egged on by the Soviets and supported by Russian arms on a prodigious scale, invaded Siam, Burma, and Malaya as well. By the end of 1954 the three states had been completely overrun, and henceforth took their orders from Moscow, through the usual Kremlin-dictated Communist setup.

One of China's and Russia's urgent reasons for possession of Siam, Malaya, and Burma was to hamper the U.S. in its future war effort. The U.S. produces only about 8 percent of the important metal, tungsten, *but she uses one-fifth of the entire world's supply.* China, Korea, Malaya, and Burma have 80 percent of the world's tungsten. Malaya was the chief source of U.S. tin supply. The U.S. consumes 40 percent of the world's tin supply and produces only 1 percent.

The United States and the other Western Powers did not view these aggressions with indifference, nor did the U.N. Nevertheless, Washington, London, and Paris knew full well that to fight the Communists on a dozen fronts would be suicidal. Moreover, China was not in the U.N. As in World War II, the U.S. realized that Europe was next on the Soviet time-table, and proceeded accordingly to build up the armaments of Western Europe, so that when the Russians started rolling west, perhaps they could be stopped on the Rhine in a "holding" operation.

So, for the time being, strategy dictated that no intervention should be undertaken to liberate Indo-China, Malaya, Siam, or Burma.

With the advent of the Korean war in 1950 U. S. scientists threw themselves completely into war-defense work and, spurred by the armed Forces, in due time had come up with an astonishing array of war new machines and devices. But it would be several years before the blueprints could metamorphose into the finished product rolling from the assembly lines.

Thoroughly aroused by the end of 1954, the U.S. now began to rearm for an all-out total war on a scale that paled its 1941-1945 effort.

Early in 1954, Stalin, realizing that a showdown between Russia and the West was not too far distant, arranged for a conference between top U.N. representatives—but in particular U.S., British and Soviet Generals—in Berlin. After several weeks of feverish conference, the so-called *East-West Atom-Bomb Taboo Agreement* was signed by the various powers.

Bereft of its long, legal-diplomatic language the document simply meant that the signatory powers agreed not to use atomic bombs of any kind against each other. The agreement provided that the signatory powers also bound their allies from using atomic bombs for war use.

While cynics all over the world did not believe that the agreement was worth a single exploded atom, nevertheless, now, at the end of World War III, the astonishing truth remains that during the entire global war not one atomic bomb was used by any of the belligerent powers.

During the total war period while Russia was being punished more severely than the Nazis had ever been—when all her industrial plants were pulverized and gutted—why did she never use her stock of atom bombs? The answer lay in a single word: FEAR. Nothing else.

Postwar investigation reveals that at no time did the Russians ever have more than 100 A-bombs—they had not a single super-atom-bomb of which the U.S. alone had hundreds.

Moreover the Russian A-bombs were of the "simple" type, similar to the one used by the U.S. over Hiroshima in World War II. Russia knew our atomic bomb strength full well and was deathly afraid of retaliation, should she use an A-bomb first.

The Kremlin realized quite well that we had the potential not only to destroy completely *all* Russian big cities, but that in the process, tens of millions of Russians would be annihilated as well.

YEAR 1954:

The Yellow Peril—Red China Becomes War Power

By 1954 Red China under Mao-Tzé-Tung, aided by thousands of Soviet technicians, had become self-sufficient in war matériel of all types. Great modern war plants—many disguised as industrial factories—dotted the land, usually well removed from coastal areas. Many important strategical plants making airplanes, tanks, munitions, etc., were completely underground.

A five-year plan (1951-1956) to make Red China completely self-sufficient in foodstuff, textiles, and all other modern necessities was vigorously pushed by Mao-Tzé-Tung, giving the Chinese abundant promise that it would succeed.

Russia's former war lord Josef Stalin

China's former war lord Mao-Tzé-Tung

Chinese Invasion barges in their war against Japan

China, of 480 million—the most populous nation of the world—was coming of age. The white man's ancient bugaboo, the "Yellow Peril," would soon be a reality.

Korea, Once More. Early in 1954 Russia and Red China, dismayed and annoyed by the military stalemate in Korea, thought the time ripe for communizing all of Korea. Accordingly, 40 divisions equipped with the latest weapons and an abundant air force were thrown into battle-scarred Korea.

This time it worked for the Communists. By occupying almost overnight all Korean harbors by amphibious forces, the Reds made sure that their push would succeed. The puny, four U.N. divisions—the foreign, holding forces in Korea—were overwhelmed in two weeks and taken prisoners. Korea, too, was now completely Red from North to South.

Japan Campaign

Emboldened by their recent successes, the Chinese and Russians soon played their Asiatic trump card. The China Red leaders had never forgotten the Japanese invasion of China, while their Russian friends had never forgiven the unilateral U.S. occupation of Japan in 1945 and thereafter. By midyear 1954, their plans perfected, they struck.

For over a year Russia and China had processed some 12,000 lightweight, shallow landing barges. These were constructed with substantial wooden bottoms and with high steel sides to keep out ocean waves. Each barge was propelled with powerful diesel engines, and would carry 100 fully armed men. Other barges carried war matériel with 10 men each.

These barges, all well camouflaged, were anchored along the South Korean coast—only 100 miles away from Japan.

On a warm summer night with favorable tides, over 980,000 armed Chinese—all well trained and provisioned—crossed the Strait of Korea and landed on the beaches of the two nearest Japanese islands of Kyushu and Honshu.

While Japan had become aware of the imminent invasion several months before, neither she nor the U.S. had realized the magnitude of the threatened operation.

The six U.S. submarines and the three U.S. cruisers could not cope with the thousands and thousands of fast moving, extremely mobile barges. While 800 were sunk by the combined Japanese-U.S. effort, most of the Chinese barges got through under cover of darkness. The Chinese landings were widely dispersed, too, making it almost impossible for the insufficiently armed Japanese forces to cope with the invader. The ensuing Japanese débâcle was complete—another Communistic success for the elated Kremlin.

It should be remembered that the U.S., though warned of a Russian or Chinese invasion as early as the beginning of the 1950 Korean aggression, frittered away valuable time. Nor did the U.S. sign its peace treaty with Japan till early in 1951.

Japan, her main war industries destroyed or made inactive during the 1945-1952 occupation, could not possibly have armed herself in two short years. By fall 1954 the U.S. had become fully aware of the Chinese-Russian danger and had begun to send war matériel to Japan—but again as in World War II, Western Europe had priority. Hence the U.S. effort once more proved far too little and far too late.

Thus when the full-fledged invasion came, Japan had too little of guns and ammunition. Rifles and hand arms in all classes were antiquated. Worst of all, she had less than one thousand warplanes, most of them outclassed by the Russian fast fighters and bombers manned by Chinese. Most of the Japanese planes that got off the ground were destroyed immediately. Those on the ground were bombed so thoroughly that the air war over Japan was finished in three days.

OKINAWA "PEARL HARBOR":

U.S. Nearly Loses Military Base

As will be recalled, the 1951 U.S.-Japanese treaty ceded Okinawa to the U.S. (Trusteeship). The U.S. therefore had little personnel or bases in Japan proper. But our Okinawa base was well staffed with men. We had a fair supply of war matériel and planes. Over a dozen submarines and an assortment of surface war vessels were stationed at the island.

On the morning of the Chinese invasion of Japan, on that historic August 6, 1954, Red China sent 300 large bombers from the Chinese mainland over Okinawa to "neutralize the American enemy base."

While our losses were not equal to those of Pearl Harbor, casualties were over 1,600 men dead or badly wounded. Nearly 300 planes were lost and 12 surface vessels sunk. Only about 50 large modern bombers were saved, principally because they were stored in man-made caves underground.

The enemy paid dearly for this new international outrage. Our alerted forces, particularly our fighter planes from the carrier *Lexington*, shot down 28 bombers which fell on Okinawa, 58 others were destroyed, falling into the ocean around Okinawa.

Many of the crew bailed out and were fished out of the ocean. *All pilots and co-pilots, navigators and bombardiers were Russians. So were 60 percent of the crews shot down over Okinawa. All bombers were Russian-made.*

Later it was ascertained that ALL planes operating over Japan on the day of invasion were Russian, with 50 to 60 percent Russian personnel.

The Soviets finally had given up all pretense of letting its duped satellites make war for them. They had come into the open—and were now frankly on their own.

R-Day Arrives. August 6, 1954, proved to be *R-Day* in earnest, for the day of the invasion of Japan also was the day when Berlin was seized after a hot and fierce but short battle. What had been known to all military men since 1945 came to pass. Berlin, a tiny island in a turbulent, vast Russian sea, was untenable for the Allied powers in the face of the overwhelming superiority of Soviet forces. It took only three days for the Reds to occupy Western Berlin.

Simultaneously, the Russians started to advance westward on the Elbe, encountering no serious resistance till they approached the formidable Rhine defenses thrown up in depth by the Western powers.

In the fall of 1954 the Allies had over two million men in the field, the Americans, French, and British continuously increasing their forces. U.N. legions from all over the world also kept increasing the European armed forces on a continuously accelerating rate.

The U.S., having known that Russia would strike sometime in the second half of 1954, was not too surprised at the Okinawa outrage. While temporarily stunned, Americans generally took the advent of total war with Russia in their stride. They gritted their teeth, settled down for a long war, and applauded Churchill's new dictum:

"More blood, more sweat, more tears toward final victory and world peace."

Most Americans welcomed the end of the nerve-racking Cold War—now they were sure what they were warring for.

The period 1950-1954 had been one of feverish activity in the U.S. New armaments, new arms, new electronic war achievements, new and improved personnel training had in that incredibly short period armed the country on a prodigious scale believed impossible only a few years ago. Undreamed of secret weapons and war machines had come forth in profusion.

But the high command had also a master plan. The whole strategy was based on the simple idea not to make war on the Russian people but only war on its rulers wherever that was possible. It had long been realized that the main body of the Russian population were not Communists, nor did they belong to the party. Consequently if the ruling party could be neutralized, the task of restoring world peace would be immeasurably easier.

As one five-star U.S. general put it: *"If you fight a huge octopus, aim for the head—never the tentacles."*

The U.S. Super Weapons

Top priority was centered on two urgent needs:

1. Prevent enemy planes from bombing U.S. cities and war production centers.

2. Prevent Russian submarines from sinking our ships, or bombing our coastal cities, with atom or other bombs. As it was also known that the Reds had a number of super-schnörkel submarines capable of discharging small bomb-carrying planes, the danger from this source was acute. Remember, it was not known whether or not the Russians would use atom bombs. *Our defense forces throughout the war had to assume that they would.*

SUBMARINEGATOR:

The Advent of "Rasura"

Late in 1953, the U.S. Navy in collaboration with the British Navy had perfected the—*submarinegator*—RASURA—which became better known to the public under the popular name of—*Schnörkiller*. While neither navy has ever published the full technical details of the intricate device, the general *modus operandi* is as follows:

In the year 1919 an American, Dr. James Harris Rogers, demonstrated his newly invented underground system of radio communication. It was used extensively by the U.S. Navy at the Great Lakes Radio Station and in the U.S. Navy Radio Laboratory, Norfolk, Va. Later on the system was improved by Edward T. Jones for long-distance underwater radio.*

The U.S. Navy in 1918-19 used the underwater radio signaling system extensively. Surface signals were received over distances of 6,000 miles by submerged submarines. Actual transmissions between two submerged submarines were recorded over 3 miles.

In 1950-53 this basic idea for RAdio SUbmarine RAnging—RASURA—was carried forward to a brilliant success by British and American scientists. By means of special electronic equipment and using the newly invented *multiple-pulse frequencies*, it became possible to transmit radio waves of great intensity over long distances under water. These waves could not be detected above water, because the ocean's surface reflected them.

When these waves struck a submarine or the submerged part of a ship they were reflected back like radar waves. Specially devised instruments on the ranging ships which could be surface vessels or submarines—gave the distance of the submerged object. And its course could be automatically plotted in a few seconds. Best of all, the range at which submarines could be detected was over 2,000 miles. These particular waves bounce back only from metallic objects. Neither whales, schools of fish nor wooden ships reflect *Rasura* waves.

All Red Submarines Sunk

By the second year of World War III the British and U.S. Navies combined had sunk every one of the 550 Red submarines afloat that came into range, either by surface warships, or bombers, or in teams of both. Usually, destroyers, *Rasura* equipped, would get the sub's range, if it were too distant to hunt down, the destroyers alerted the nearest bomber base. Accurate *fixes* were radioed to the bomber, which then sowed a pattern of the new super-depth bombs around the sub. This was kept up until it was sunk. None ever got away, because the range was always known accurately.

As the Russians never captured one of our ranging ships, and as within less than 6 months the majority of the Soviet subs afloat—550, all told—had been sunk, they gave up their suicidal submarine war.

*See *Radio Amateur News*, July 1919, page 10; *Radio Amateur News*, December 1919, page 274. Also *The Electrical Experimenter*, March 1919, page 787.

Nor did they ever learn the true nature of *Rasura* for the duration of the war.

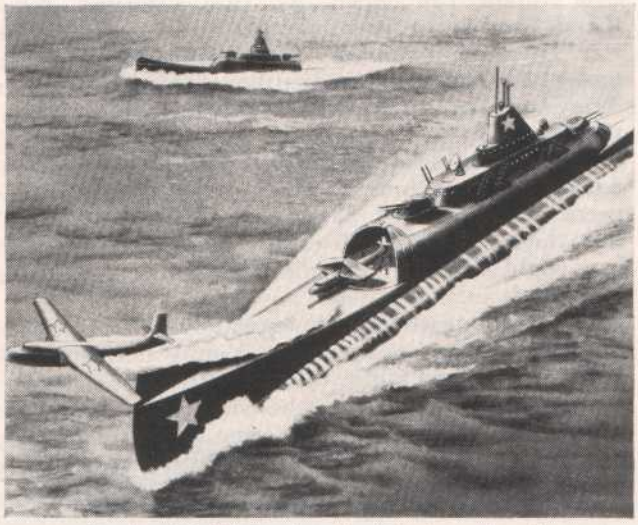
STRATORADAR:

New High Altitude Planes Boost Radar Range

Long before 1954 U.S. scientists had worked intensely on radar nets to protect our cities from enemy bombers. Unfortunately radar cannot reach beyond the horizon. Nor is it practical to erect very high towers reaching tens of thousands of feet upward. Even towers, like the Empire State Building, 1,200 feet high, reach only 50 miles as far as radar is concerned. Therefore enemy bombers flying at 500 miles per hour can be seen only 44 minutes before they reach the radar observation post. While the ordinary horizon radar range is about 50 miles from a 1,200-foot elevation, this "line-of-sight" distance (range) is extended to about 367 miles when the enemy bombers fly at an altitude of 50,000 feet above the earth. This gives the defenders insufficient time to take effective countermeasures.

It is true that on land—Canada cooperating with us—we could have built radar outposts in Northern Canada, so that the Russian bombers coming in from the north could be spotted further away, giving our fighters and interceptors more time to meet the invader. But such a scheme obviously is impossible on our eastern and western coasts.

For this reason the U.S. adopted the *stratoradar* system which gave us a greater time-alert period. And instead of having to build thousands of radar beacons in Canada and on our coasts and the Mexican border,

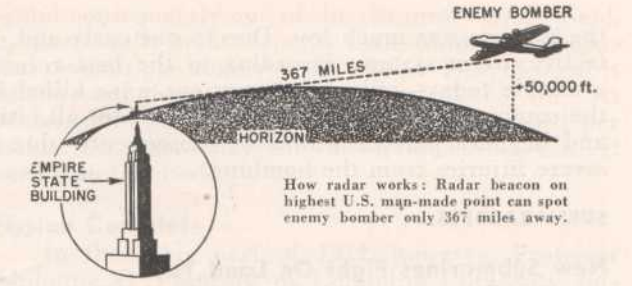


Russian Schnörkel sub with 4 bombers aboard.

less than 50 stratoradars gave superior protection throughout the war.

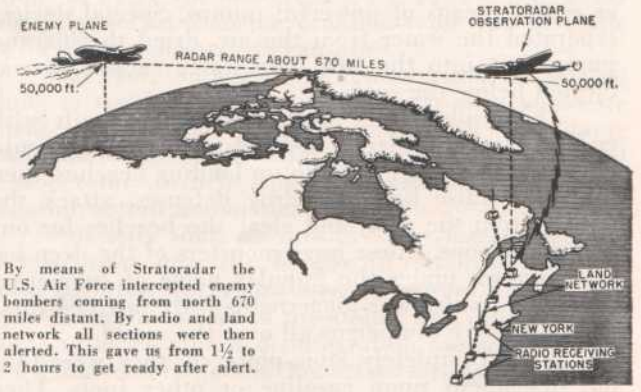
Stratoradar works as follows:

A large 4-jet plane—well-armed to protect itself in case of a raid—constantly flies in a small circle about one mile in diameter. Its course is radio-controlled from the ground by a special radio post. It flies either near one of our Canadian or Mexican frontiers, or over our east or west coasts. The stratoradar planes fly at fixed height of about 50,000 feet. The plane has special radar gear which makes a "sweep" over a predetermined arc. At the Canadian border this sweep is of course always northward. Irrespective of the plane's circling, the radar sweeps its assigned direction exactly, as if the plane were motionless. This is made possible by a special gyroscopic-directional gear, unaffected by the plane's motion in any direction whatever.



How radar works: Radar beacon on highest U.S. man-made point can spot enemy bomber only 367 miles away.

Stratoradar can spot enemy plane 670 miles away, giving us much longer time for alert.



By means of Stratoradar the U.S. Air Force intercepted enemy bombers coming from north 670 miles distant. By radio and land network all sections were then alerted. This gave us from 1½ to 2 hours to get ready after alert.

Stationed at a height of 50,000 feet the radar eye can now see over a distance of 670 miles. As enemy bombers must fly high, too, they are usually at a height of 40,000 to 50,000 feet. Flying lower is too risky because of anti-aircraft fire. Therefore, the radar can spot the enemy over 600 miles away. Flying at 400 miles an hour gives our fliers 1 hour and 41 minutes time to intercept them; at 500 miles an hour we have 1 hour and 21 minutes to meet the enemy—ample time for our fighter planes.

As each stratoradar plane scans a radius over 500 miles wide, we theoretically needed only 6 stratoradar planes to safeguard the Canadian border of 3,000 miles. For practical and operational reasons there was, however, a string of 15 such planes along the border, flying uninterruptedly day and night.

Canada for her own protection stationed a multiplicity of stratoradars far north and at both oceans as well, the two countries working together as a matter of course.

The stratoradar planes were relieved every 8 hours, each post therefore having a shift of 3 planes per day. There was one extra plane as a spare, and no planes were ever exposed on the ground. Underground bombproof hangars were provided for all grounded planes. All ascending alternate planes began their radar sweeps before the first plane began its descent. In this manner we had a completely uninterrupted and efficient radar defense net.

While no defense can ever be perfect on sea, on the ground, or in the air, nevertheless our stratoradar installations proved exceedingly effective. Of the 200-odd Soviet planes which broke through to Continental U.S. defenses, only 20—less than 10 percent—reached their targets in Pittsburgh, Detroit, Chicago, New York, and Washington.

The Russian super-demolition bombs inflicted the heaviest damage in Detroit, but even here the effect on the war effort was negligible. In the other cities

the damage was much less. Due to our early and effective alarm system, according to the best records available today—only 14,480 persons were killed by the combined Red bombings. This takes in all cities and includes persons who died subsequently due to severe injuries from the bombing.

SUBMARAUDERS:

New Submarines Fight On Land Too.

The U.S. in the early years of World War III had begun building a vast fleet of atomic-powered submarines, heavily armed with powerful 10-inch guns. They were fitted with the new highly effective superschnörkels, which left practically no wake on the surface *(see illustration, page 26)*.

Running several inches *below* the surface of the water, schnörkel "breathers" sucked in water as well as air by means of powerful pumps. Special devices separated the water from the air, dried the air and pumped it into the sub. The water sucked in was ejected below the surface.

These submarines were furthermore built with endless tracks similar to those of tanks, so they could rise from the ocean and run up landing beaches, then inland to raise havoc, destroy defenses, attack the enemy from the rear, and clear the beaches for our invasion troops. These huge monsters of the deep became known under the popular name of *submarauders*. The fearful war juggernauts fully justified their name in many campaigns all over the world.

Being completely atom-powered, they were thus not dependent upon gasoline or other fuels. They could run over 25,000 miles self-contained—a far greater distance than was ever required. They carried ample provisions for the large armed crew and a prodigious supply of various munitions. On account of their great land speed—over 60 miles an hour—they were not easily hit by the enemy—besides they were equipped with the miraculous—almost thinking —*electronic autoguns*. (See following.)

Smoke Enclouders

Like our Navy destroyers they also used special chemical smoke *enclouders*. If threatened by enemy artillery, the *submarauder* would eject a vast billowing cloud all around it, extending for several hundred yards in all directions. This made it an extremely difficult target. There were many other protective devices, such as radar, anti-radar, electronic microdetectors to detect and blow up land mines, etc.

However, no submarauders were used against the enemy till all of the Russian submarines had been cleared completely from the seas. They were then used *en masse* as a surprise weapon, simultaneously in many theaters all over the world.

The Electronic Autogun

At the end of World War II and in the Korean Campaign the enemy frequently used specially muzzled guns and new smokeless powders, making it impossible for our gunners to see the gun flash. Seeing no target to hit nor any flash, our forces were often at a great disadvantage. Our gunners frequently could not discover the enemy guns to silence them with our own fire.

Long before this our scientists had been considering this phase, and many suggestions had been made to our Defense Department. The result was the development of an *electronic autogun*, popularly dubbed the *braingun*.

It is similar in some ways to the electronic AA (anti-aircraft) gun which automatically tracks the enemy plane and despite any evasive turns or twists, hits its target. Such guns, radar equipped, find the enemy plane even if it hides in the clouds.

But a well-camouflaged gun is different. If it is partly hidden by a ground elevation or backed by a hill, radar is useless. Therefore the braingun must rely upon other detecting principles. The two chief ones are sound and beat. The braingun is equipped with highly sensitive ears, located in parabolic sound collectors. In front of the collector is an incredibly sensitive infra-red detector.

Now, infra-red radiation travels with the speed of light, whereas sound travels only with a speed of 1,100 feet per second. The autogun automatically moves the parabolic collector rapidly from side to side in the enemy direction. Should an enemy gun fire, the parabolic collector instantly detects it, due to the heat of the even invisible flash. The collector now freezes into a position which automatically gives the autogun the position of the enemy gun. It starts firing almost instantly at the target, destroying it.

Seconds later the sound waves of the enemy gun arrive and assist the autogun still further to get the final exact range of the enemy.

These brainguns, large and small, are highly effective. As finally evolved they do not require human hands to fire them—the "gunners" have become only ammunition suppliers or "shell-boys." All they do is load the autoguns—the autoguns do the rest. Many of the newer ones even load themselves from an elevated ammunition hopper.

Suppose the enemy too uses autoguns. What then? They did so in a few cases near the end of the war. There are a number of excellent counters to this, too, which our army used, although to this date our Army Department has refused to release any information on it. It is still classified.

When physicists first investigated ultrasound (supersonic—faster than sound) they were struck with a great variety of odd phenomena. It was discovered that these sounds which cannot be heard by human ears could kill many organisms as well as animals as large as frogs.

In the late 40's one investigator working with a powerful 800-cycle audio-sound unit became completely paralyzed while operating the machine. The paralysis was so great that he could not turn off the machine. Finally an assistant came to the rescue. The American technician—S. Young White—seemed none the worse for his experience.*

Since that time physicists busied themselves with ultrasound for war purposes. They finally succeeded in their efforts in 1953.

A team of two American scientists, Joseph Kane and Frank Sims, using a special supersonic "intermittent-pulsating" frequency at a power of 2 kilowatts, were able to put human beings into a cataleptic state similar to that normally occurring in deep hypnosis. Depending how long the subjects were exposed to these supersonic waves, they could be put into the deep cataleptic sleep for from one to six hours. During that time the body of the subject became as stiff as in rigor mortis. He could not move a muscle.

It was found that such supersonic catalepsy-inducing radiation could affect humans and animals over distances as far as 5 miles, provided suitable reflectors were used to train the waves in the appropriate direction. Usually the dosage of 30 minutes was sufficient to induce a 6-hour period of catalepsy in the distant subjects.

*See *Audio Engineering*, May, 1947, page 31.

The machine finally evolved for war purposes can be mounted on special trucks for fast mobility. It can be camouflaged perfectly and is usually used from prepared positions in the front lines facing the enemy. A number of these machines—dubbed *telehypnos*—are used in unison. The inaudible ultrasonic waves are now "sprayed" on the enemy who instantly becomes stiff and unconscious. There is no known counter for these waves except deep dugouts, thick concrete vaults, or caves which the ultrasonic waves cannot penetrate effectively. Even the crews inside of tanks were not immune, as the ultrasound easily finds its way through the crew's breathing vents and other openings.

It should be noted that our operators *behind* the ultrasonic reflectors were not affected much; only those who were in the direct path of the concentrated beams were subject to the full effect.

During raids or assaults the *telehypno* radiating units were first switched on for 30 minutes, then turned off. Our forces then surged ahead toward their objectives, while subsequent waves took the unconscious enemy forces prisoner.

The telehypno was an effective surprise weapon. It proved singularly efficient in trench warfare and beach-landing operations. In the latter case the telehypnos were of course installed in our *submarauders*.

ATOMIC PLANE:

Poincaré Perfects Atomic Power

Atomic powered planes had been conjectured ever since the advent of the atom bomb in 1945. Every major airplane builder had toyed with the idea. The great problems always were how to protect the crew from the deadly radiations and how to employ the atomic power in the most effective manner.

The answer came when a group of American scientists succeeded in taming an atomic bomb explosion—slowing it down to perform useful work. This was tried long before the first atom bomb was exploded—in the well-known atomic pile. But such a pile is very inefficient and the heat generated is not sufficient to be *directly* used in jets for propulsion purposes.

It was always known that any one of the 94 elements* could be used for atomic energy once the key was found. More important, it had been known since 1941 that one of the most abundant elements on earth —and consequently one of the cheapest—could yield, *proportionally* greater energy than uranium. (The actual amount per atom would be less.) That element is silicon—one-third sand. It was calculated that its nuclei could yield over 13 million electron volts per fission. But even today, the silicon nucleus has not yet been disintegrated.

*There are 102 known elements now, as of October 1, 1966.

Fission Complete

In the early part of 1952, however, Professor Alphonse C. Poincaré of Columbia University succeeded in bringing a number of other common elements to complete fission, i.e., split their nuclei. All of these elements were abundant and comparatively cheap. For security reasons the names of such elements have not been divulged to this date, nor may they be for some years to come.

We only know the five elements by the designations of F_1 (F for fission), F_2, F_3, F_4, F_5. Bombs far more powerful than the uranium types can be made with all F-elements—so can piles.

But Prof. Poincaré went much further. He showed how to regulate completely fission from a moderate heat of the unit to a point just below the titanic A-bomb explosion. This he accomplished by a special "moderator" which stops any destructive-explosive chain-reaction automatically.

Not only that, he invented the famous atomic-regeneration process, whereby all *radiation is turned into harmless but useful electric current.*

Since the advent of the atomic age, ushered in by the Curies, all atomic disintegration was accompanied by dangerous radiation. *Yet all such radiation is electromagnetic.*

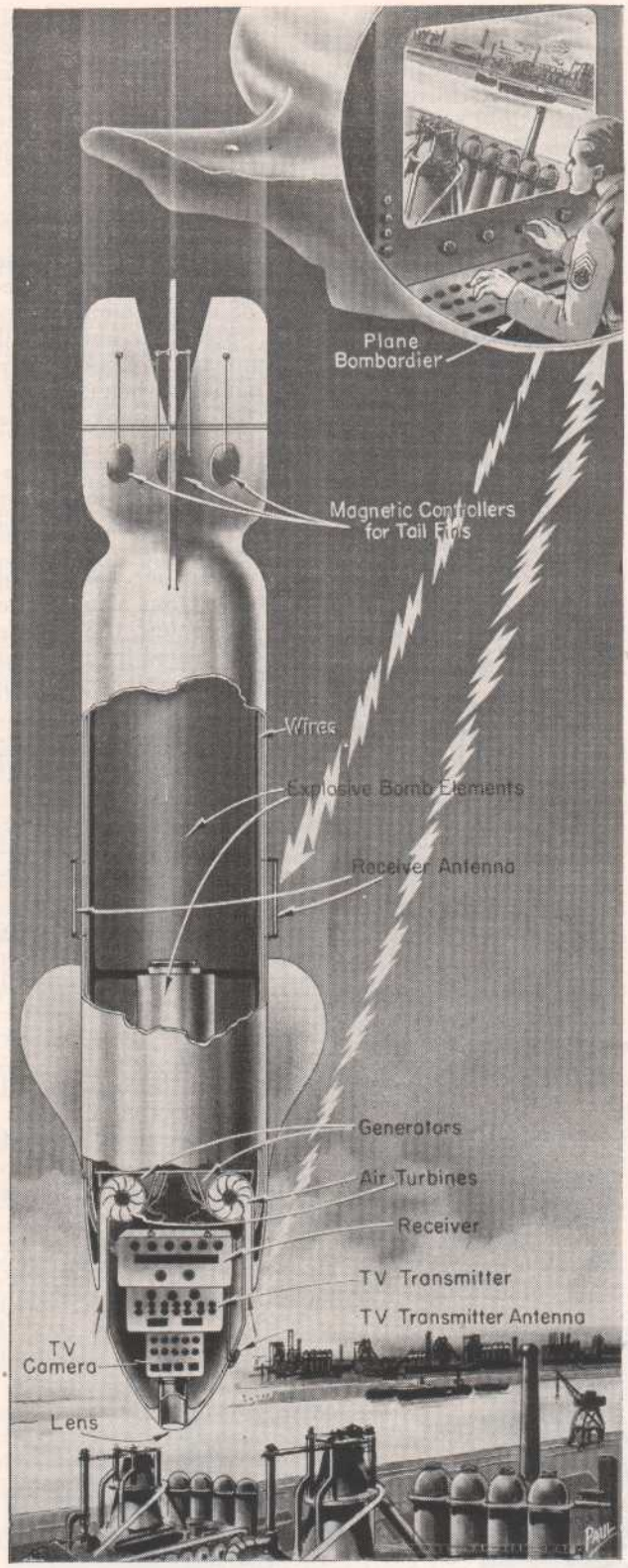
Poincaré stopped all such dangerous rays by means of the famous *Poincaré power grid* which instantly turns any of all types of radiation into useful electric current, which can be used as power or heat.

When the Poincaré atomic power plant is installed in our huge planes the terrific heat blast let loose from the atomic disintegration is so powerful that the *granitite* jets glow white from the heat. The resulting thrust engendered by the atomic blast is of such great force that a plane can easily do 1,000 to 1,200 miles an hour at an altitude of 100,000 to 150,000 feet. The efficiency increases the higher it rises.

Coming off the production lines in quantity by the middle of 1954, the atom-plane proved to be our most potent single war machine.

The U.S. Electronic Autogun (Braingun)

Ultrasonic Telehypno



With the Television Bomb the bombardier can bomb the target far more accurately than is possible by any other known means.

Outdoing all other known planes in speed and power, it could stay in the air for days without alighting. No fighter plane could engage it at the great height it operated—25 to 30 miles up. No known anti-aircraft gun could shoot that high effectively. As the Poincaré atomic power plants use up but a few pounds of F_2 in a year's time, the plane theoretically could have stayed aloft for months at a time. But the early atom planes heated up too much and had to have their burned-out jets replaced frequently.

As neither the Russians nor the Chinese were able to match our atom-planes, the U.S. Air Force had things much their own way over all enemy country. This was so, particularly on account of the newly designed *television bombs*, which were coming off the production lines in the fall of 1954.

TELEVISION BOMB:

Bombardier "Sees" Distant Target

Up to the end of World War II bombing from great heights was a hit-or-miss proposition. Far too often only one or two out of ten bombs were really effective. The waste of bombs usually was appalling, particularly during overcast weather and when the bomber had to contend with attacks by fighter planes, anti-aircraft guns, etc. This situation was somewhat rectified toward the end of World War II when the *guided bombs* came into use.

Finally we evolved the *television bomb*, which put to an end most miss-hits and near-misses.

The television bomb is usually of the block-buster type—a huge thing often weighing 10 tons. At its nose it has a television camera operated by special batteries or by a small electric generator powered by an air turbine which is fed by the airstream as the bomb falls. The bomb has special fins and a tail, both of which can be moved to guide its fall. The steering is done from the bomber by radio remote control.

The television bomb thus is a regulation guided weapon, except that now the *television-bombardier* watches on his television screen the *exact* progress of the falling bomb. By radio control he can so manipulate the bomb's flight that it is easily guided to any building or target selected. No more fumbling and misdirected bombs. The bombardier can watch the bomb's progress through the thickest clouds, through rain and snow. Up to the instant of striking the target, the bomb's path is watched lucidly and clearly on the bomber's screen.

1954 Eventful

By 1954 the U.S.S.R. had chalked up a number of other successes. With the help of its satellites, Yugoslavia had been occupied while Tito and his Government had fled into exile in London.

An attempt to conquer Iran had only half succeeded, due to the foresight of the general staff of the United Nations. About half of Iran was in Red hands, half of it occupied by United Nations forces.

Denmark, too, was occupied in December of 1954. So was most of the Netherlands.

While the Russians made a number of attempts to cross the Rhine after their successful westward push in 1954, they never succeeded in this effort. Always cautious in their forward pushes, they calculated that time was on their side and that by a war of attrition they could finally push the combined United Nations forces into the Atlantic. The Kremlin believed their submarines would eventually sink all allied shipping, depriving the Western armies of all new manpower and war matériel. Then the final Russian push would defeat the United Nations armies in Europe.

Readers who followed World War III since its inception will remember that the Rhine fortification barrier ran from Rotterdam to the Swiss frontier with the Allied forces deployed in depth along the Western bank of the river.

Wisely, the Russians never attacked the Swiss. This powerful European redoubt stood up to Hitler and did so with Stalin. Anyway, the Russians did not feel like stirring up this powerfully armed hornet's

nest. Once the United Nations' armies were defeated, it would be ample time to look after the Swiss.

A similar train of logic was used with Italy and Greece. The Kremlin, as always, was playing a cagey and waiting game. "Why spread ourselves thin, like Hitler," was Stalin's argument, "when we will get them in the end, without firing a shot! On the other hand, all the countries we leave alone *now* will be grateful to us later and make our job that much easier after we have won the war."

The great hopes of the Kremlin—placed in their submarines—went for naught, however, as we have seen, due chiefly to American inventiveness and RASURA. By the end of 1954 all Russian submarines —schnörkel and nonschnörkel—were at the bottom of the seas.

In retrospect, let us digress for a moment.

Says one of the famed Russian writers Turgenev (1818-83) in his novel, *A House of Gentlefolk*, Chapter 33:

"Russia has fallen behind Europe. We must drive her on. It is said we are young—that's nonsense. Moreover, we have no inventiveness. Homakov (a character in the novel) himself admits that we haven't even invented mousetraps. Therefore, whether we will or not, we must borrow from others."

This Russian characteristic was well understood by the Western Powers ever since the advent of the atomic bomb. Henceforth they adapted the most stringent and extraordinary security measures in connection with all new war inventions, so much so that there were but few leaks. From that time on Russia was doomed—it was only a matter of time till our superior weapons produced *en masse* would annihilate her war-making power.

MAGNENAPALM BOMBS:

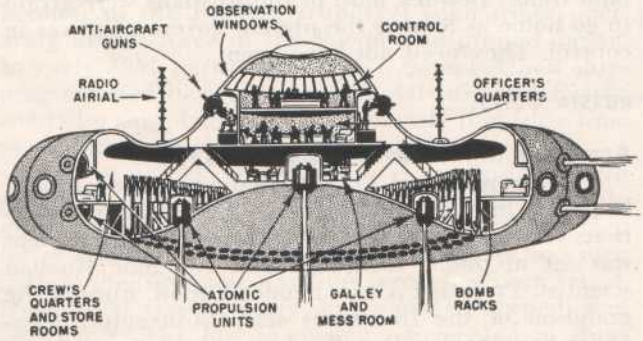
1955—Western Powers Ready

By 1955, all the great-producing Western Powers, the U.S., Canada, Great Britain, and France were ready for the final phase of the European-Russian war.

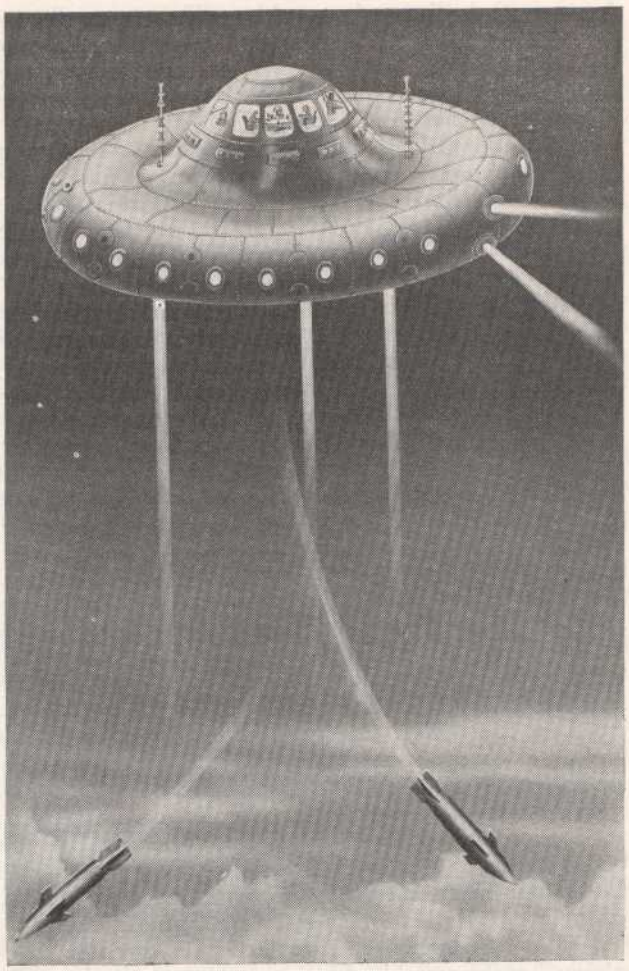
Immediately after the first bombing of U.S., Canadian, British, and French cities, American and British bombers retaliated on Russian cities with their newly developed *magnenapalm* bombs. These bombs were not only terrifically effective blockbusters but the napalm-magnesium* combination was the most devastating fire spreader ever known. It should be realized that the first retaliatory bombing raids on Russian cities were made by our huge 4- and 6-motored bombers, *not* by our atomic-powered planes, which did not come into general use till later.

Russian Cities Bombed. Our bombers successfully bombed Moscow, Leningrad, Stalingrad, Kiev, Dniepropetrovsk, Odessa, and Sverdlovsk. We know now that these raids, which extended over 3 months, were

*Napalm bombs were used in the Korean war with excellent results.



Atomic Plane, powered by atomic energy makes 1200 miles per hour, rises 20 to 25 miles. Anti-aircraft fire, fighter planes, can't reach it.



Atom Plane dropping Television Bombs.

highly effective in slowing up much Russian war work. The known dead from these bombings amounted to 46,800. Permanently injured were 90,400. These are official Russian figures. No correct estimates on the material damage have been published so far.

Despite glowing newspaper accounts of that time, our air losses were much higher than published then. We lost 381 big bombers, with 3,072 officers and men; 2,041 parachuters were taken prisoner.

After these successful Allied raids, the Russians for a time made no serious further raids on U.N. cities, they evidently reasoned that if they did, the inevitable retaliatory U.N. raids would slow their war effort too much, and that it would be far better to build up their armaments till Russia became sufficiently powerful for the all-out push. But these careful calculations misfired, too, as later events proved.

U. N. STRATEGY:

Russians Get Big Surprise

During 1955 the contending enemy armies on both sides of the Rhine had each other checkmated. The Russians could not budge the Western Powers, nor could the latter drive back the Reds. Neither was really trying for an all-out struggle in 1955, for identical reasons—neither was sufficiently strong at that time. The Russians were still building up their manpower "to wage a successful war simultaneously in Europe, in the Near East, and in the Far East." The U.N., on the other hand, did not base their strategy so much on manpower as on a torrent of new weapons, mostly produced in the U.S.

By the summer of 1955 the U.N. High Command began bombarding Russian cities and soldiers on all

fronts with billions of pamphlets. These were floated down on June 20 from the first atom-planes to cross enemy lines. The operation was a complete success because no enemy plane or anti-aircraft gun could cope with our atom-planes.

The pamphlets—printed in Russian—set forth in simple language that the Western Powers had no designs on territorial Russia, that what the West desired least was to make war on the Russian people. The West's quarrel was only with Russia's misguided rulers who wanted to rule the world. This the U.N. Powers would never permit. Proofs of the Russian leaders' aggressions were then cited in an elaborate presentation with maps, figures, and dates. The message was signed by the heads of all the United Nations.

It is now known that the majority of the Russian people read these pamphlets, even though they destroyed or buried them promptly in fear and terror of the Russian secret police. But the very fact that the Allies were able to deliver the pamphlets, despite the "invincible" Russian air force, made a deep and lasting impression.

Ten days later a similar paper avalanche descended on the Russians. Now they were carefully informed that henceforth the Allied Powers would be complete masters of the skies. The population was warned that all further resistance would be useless, but that the Allies, true to their promise, would not wage war on the Russian people. The war would only be with their Russian masters and their war machine. The Russians were told that beginning on July 1, 1955, thousands of atom-planes would be over Russian cities ready to destroy all war-making plants of all kinds, annihilate all railroad communication centers, all bridges, all oil refineries, all steel plants, etc.

The Russians were informed that our new television bombs were highly accurate and that no cultural establishments, housing, etc., would be bombed (with certain exceptions where these were in the same blocks as the factories). The targets and their location were carefully listed and the people warned not to stay in the target area. This gave them 24 hours warning—sufficient to seek safety.

Atom Bombers Over Russia

Promptly on July 1, over 3,000 atom-planes appeared over several dozen Russian cities and other strategic military locations. Radio warnings from our planes were broadcast on Russian wavelengths, in the Russian language, that bombing would begin in 15 minutes. The date of July 1, 1955, will always be remembered by the Russians. On that day over 96,000 tons of high explosives, fire-bombs, and blockbusters were delivered with telling effect.

But what impressed the population most deeply was that only a few hundred people were killed in this, the greatest and most severe mass-bombing in history. And even these deaths could have been avoided. It appears that some of the higher placed authorities of several war plants did not take the Allied warnings seriously, hence they did not allow their workers to absent themselves. When the planes' radio warnings came, it was too late. In the rush to evacuate these few affected war plants, people were crushed and trampled to death in the ensuing panic. Very few people died, however, from actual bomb hits.

These mass bombings were repeated for several weeks till all targets were completely demolished.

The approaches of all known underground plants were so thoroughly destroyed with "earthquake" bombs that for weeks all the roads and approaches were completely impassable. All of the underground plants were watched day and night by our observation atom-planes.

At night constant observation of all roads leading to and from the plants were made by infra-red light from our atom planes. Any traffic that appeared was bombed.

But all traffic leading out from Russia to the West was under especial scrutiny 24 hours every day for month after month. Over 2,000 atom-planes were assigned to this special duty. Stationed over 30 miles up, this great air armada could observe every single yard. No traffic to or from Russia escaped our atom planes.

This stratagem of course was complete attrition of the Russian armies stationed in Europe, and it succeeded brilliantly.

This time the Supreme Command of the U.N. forces did not repeat the mistakes of Napoleon and Hitler, by pursuing Russian forces into Russia, only to be bogged down in the wilderness. Our aim was to disarm the Russian armies in Europe, then occupy the main Russian centers and bring order into the country.

By August 1955 we had started making amphibious landings in force, east of the Rhine behind the Russian lines. We were greatly assisted in this by some 1700 submarauders which created such confusion among the Russian forces, stationed on the lower Rhine in Holland and as far south as Cologne, that over 800,000 prisoners were taken in a few days.

Our amphibious operations were supported by our atom-planes—which not only created complete havoc in the Russian air force by destroying all enemy planes as they landed—but which also, by means of special guided missiles, thoroughly disorganized the Russian land forces.

By this time the Russians and their allies who had been stationed near the Rhine were in full retreat. They regrouped, however, for a stand along the Elbe. This move was also short-lived. Remember, no supplies of any kind reached their lines from Russia, so they were forced to use whatever arms and matériel they had on hand and what food they could forage from the by now impoverished East Germans and Austrians.

Soon there was but little organized warfare, due to the effectiveness of the constantly increasing harassments by our submarauders and our completely unopposed Air Force, which decimated the remnants of the once powerful Russian Army.

Helped by U.N. pamphlet-and-leaflet snowstorms, which urged the Russian forces to give up and go home, this soon had a telling effect. The Russians by the end of November 1955 had surrendered by the millions. Altogether over 3,500,000 men were disarmed and taken prisoner. None could be repatriated that winter due to the stoppage of all railroads and other land traffic. Besides, most of the Russians were afraid to go home as long as the present government was in control. They need not have been.

RUSSIA QUITS:

Armistice Signed with U.S.S.R. in 1956

In the winter of 1955-56 spontaneous revolutions broke out in nine large Russian cities. All communications were seized and a new provisional government was set up under a trusted and energetic Russian scientist, Professor Alexis Feodor Popoff, himself the grandson of the illustrious scientist-inventor, Alexander Stepanovich Popoff, of wireless detector fame.

Immediate steps were taken by the new Popoff

government to come to terms with the U.N. By that time 5 of the 15 Kremlin rulers had committed suicide. Stalin himself had died of a heart attack in February 1956. The other Kremlinites had fled to parts unknown along with a great number of Russian war criminals wanted by the Allies.

TERMS OF ARMISTICE

On March 1, 1956, an armistice was signed between the Russians and the United Nations.

The terms in short:

1. Total disarmament of Russia, with delivery of all arms, munitions, and atom bombs to the U.N.

2. Dismantling of all war plants, with the destruction of all tools, dies, and implements used in the manufacturing of war matériel.

3. Occupation by U.N. forces of 11 Russian strategic key points for a term of 50 years.

4. The institution of a democratic government elected by popular, secret vote.

5. Complete and free intercourse with the rest of the world without traveling restrictions in and out of Russia.

6. The U.N. undertook to protect Russia from other aggressor powers for a term of 50 years and agreed not to meddle in Russia's internal affairs.

7. A final peace treaty was to be signed between the U.N. and Russia in 1966, if by that time Russia had completed the payments of all reparations to the countries she had invaded.

Last week, on December 16, the peace treaty with Russia was finally signed at the U.N. headquarters in New York. Thus we are now, at long last, officially at peace with Russia.

The Russian people have come a long way since that memorable morning of August 6, 1954, the start of World War III, 12 long years ago. In the words of our President:

"Thanks to the brilliant leadership of Alexis Popoff, the new Russian Republic has prospered unbelievably since 1956. I know that my fellow Americans wish the Russian people well, too. May their peace be everlasting."

WAR WITH CHINA:

Atom-Bombers Finish China Reds In 1955

After the invasion and occupation of Japan by China in 1954, the U.S. Navy in collaboration with other U.N. countries, chiefly England and Australia, built up our Pacific outposts for a showdown with the Russian-Chinese aggressors.

It was a long and bloody uphill fight, chiefly on account of the Russian schnörkel submarines operating in full force in the Pacific and around Japan. In early 1954 particularly, the U.S. and Allied shipping suffered heavy losses. Our Atlantic and Pacific coastwise shipping was hit so seriously that for a time nearly all maritime traffic stopped.

Early in 1954 our Navies were fully *Rasura* equipped and within 8 months the last Russian submarine was dispatched to the bottom. But our own losses had been severe—over 39,000 officers and men both of the Navy and Maritime forces had been killed. Over 3,400 vessels, Navy and privately owned, had been sunk. The loss in money represented in ships and cargoes went to over 11 billion dollars.

From this point on, our strategy aimed first to isolate completely Japan from the mainland so that the Russo-Chinese occupation army would be cut off from all future supplies. Our atom-powered submarine force by then had grown to large proportions and soon no surface sea traffic was moving through the Korea Strait or to the mainland.

Our submarines were mostly based in special concrete covered sea-coves on Okinawa and at our Philippine bases and other Pacific Islands as far East as Hawaii.

Throughout the years Okinawa had been fiercely contested and bombed almost daily. While our losses had been very high during the war, neither China nor Russia had ever been able to budge us from this, our furthest Western Pacific outpost.

Our submarines now began to systematically destroy all surface sea traffic around the China coast and in the Korean waters as well as along the Russian Siberian coast. By the end of 1954, not even fishing vessels were visible. *The pressure was on!*

This war of attrition continued up to 1955. Early that year, China, growing desperate in the attempt to keep its occupation army in Japan supplied with matériel, tried a number of new barge-expeditions through the Korea Strait. All of these failed—very few barges got past our submarine blockade.

By that time our Philippine-based air-jet armada had grown to such proportions that we began to win the air war over Japan and the surrounding waters.

Beginning of the End

But the beginning of the end of the Asiatic part of World War III came early in 1955, when our atom-planes finally went into action. These planes at first operated direct from our West Coast for security reasons. Flying at speeds as high as 1,200 miles an hour, the Pacific could be spanned in less than 6 hours with ease, reaching the most distant Chinese city an hour later. Or by flying the shorter, nearly all land route: U.S.-Alaska-Siberia-China, a distance only slightly over 6,000 miles, we could reach central China in 5 hours.

The same air strategy which we used so successfully in Russia came now into play. All Chinese Red cities were inundated with billions of leaflets setting forth the U.N. policy, that the Western and their Allied U.N. Powers had no quarrel with the Chinese people but only with those responsible for the war.

The population was told of the great power of our atom-planes which, 24 hours later, beginning July 1, 1955, would start bombing all Chinese military and strategic targets. The destruction began on the same day as its Russian counterpart and continued uninterruptedly for several months.

As our atom-planes used only television bombs, a relatively small number of Chinese were killed. This made a most favorable impression on the Chinese population, exactly as it did with the Russians. During August 1955, using a mass formation of submarauders and thousands of landing craft—which, with over a million U.N. troops, had been based on Luzon, Philippines—we occupied, mostly by surprise, the important Chinese coastal cities of Shanghai, Canton, Tientsin, and Peiping, and the Korean city Pusan. Hongkong, which had been wrested from the British by the Chinese in the summer of 1954, was also liberated by our forces.

Due to our complete mastery of the air and our great superiority of land weapons, our U.N. forces did not meet serious opposition anywhere, although the subsequent guerilla warfare proved extremely bothersome for many months.

Red China Quits in 1955. The principal units of Red Chinese armies had been cut to pieces by the end of 1955 and all organized warfare had ceased. The war with China had come to an end, chiefly because of the intense summer bombing of Chinese war plants. Russia had long ceased to supply China with supplies, so the Chinese war, steadily losing its momentum, ground to a halt.

Mao-Tzé-Tung and his associated generals and advisers fled to the Tibetan interior and were not apprehended till 1958. Mao-Tzé-Tung died by his own hand, as did a number of his followers. Others were brought back to Peiping where they stood trial. All were imprisoned.

Japan Liberated

Simultaneously with our amphibious landings at Chinese coast cities, we also threw a large force on the Japanese island of Honshu. This particular landing was effected successfully on the large Tokyo plain, key to Japan.

Here, unlike in Russia and in China, it was not necessary first to reduce Japanese strategic targets by bombing, because it was felt that the Japanese people would help us in disarming the Chinese and Russian occupation forces. This assumption proved correct. Cut off from the mainland for over one and a half years, the occupation forces did not have much heart left to put up a determined fight, except on the southern Japanese island of Kyushu. But we were now rapidly arming the Japanese and by late fall of 1955 all Russian and Chinese occupation forces had been made prisoners.

Outside of three weeks' fighting around Tokyo after the U.N. landings, all subsequent fighting on Japan proper was done by the Japanese. By January 1956, Japan was free once more.

Siberia Campaign

The third and final phase of the Pacific War took place in Eastern Siberia. As planned by the U.N. High Command it was necessary not only to completely isolate the Russian Siberian armies, but to immobilize them too, so that they could not move.

This was accomplished entirely by a comparatively small atom-plane air force of 600 planes. As a first move, all war plants were completely destroyed. Next, all bridges and all marshalling railroad yards were totally pulverized. Now followed an around-the-clock bombardment of the right-of-way of the double-tracked Trans-Siberian railroad. First a 500-mile stretch of right-of-way was *melted* by high heat *magnothermite* bombs. This fused and melted the rails and made them completely useless. The operation was carried out between Krasnoyarsk and Ulan-Ude.

Another, the northern link of the Trans-Siberian railroad, was similarly reduced between Taishet and Kirensk. Simultaneously all visible rolling railroad stock from Novosibirsk to Vladivostok was destroyed by television bombing.

These operations completely bottled up the Siberian Russian forces, and made them useless as far as Russia was concerned till the armistice was signed between Russia and the U.N. on March, 1956.

The Chinese Terms

On August 10, 1956, an armistice was signed by provisional President Ming-Soong of the New Republican China and the U.N., paralleling in most instances its Russian prototype.

Chinese key points were to be occupied by U.N. forces for a term of 50 years to guarantee world peace.

A final peace treaty was to be entered into by China and the U.N. in 1966 if by that time China had fulfilled all her obligations and reparation payments to the countries she had invaded during the war, namely: Korea, Japan, Indo-China, British Hongkong, Siam, Malaya, Burma, and Tibet.

The Chinese peace treaty was signed last week, December 16, and World War III is now finally and officially over. +

Cost of World War III

The casualties of the belligerents, as far as it is possible to ascertain them today, on Christmas, 1966, are as follows:

► **Dead: Between 2,750,000 and 3,000,000.**

► **Missing: Over 850,000.**

► **Seriously wounded: 4,250,000.**

► **These figures do *not* include the dead, the wounded, and the missing civilians, but they are probably much larger than the military figures. Nor do they include the dead due to starvation, nor the wrecked lives of countless other displaced persons numbering millions.**

► **Total cost: This can only be guessed at, but it probably runs over 9,875 billion dollars—that is, *our 1966 dollar, now worth about 10¼ cents* of the World War II dollar.**

► **The winner: *No nation.* All LOST World War III. If by good luck we can keep the peace for the next 100 years, our descendants by that time, in 2066, may have paid for that insane world's folly, begun in Sept. 1939.**

THROWBACK in time

Frank Belknap Long

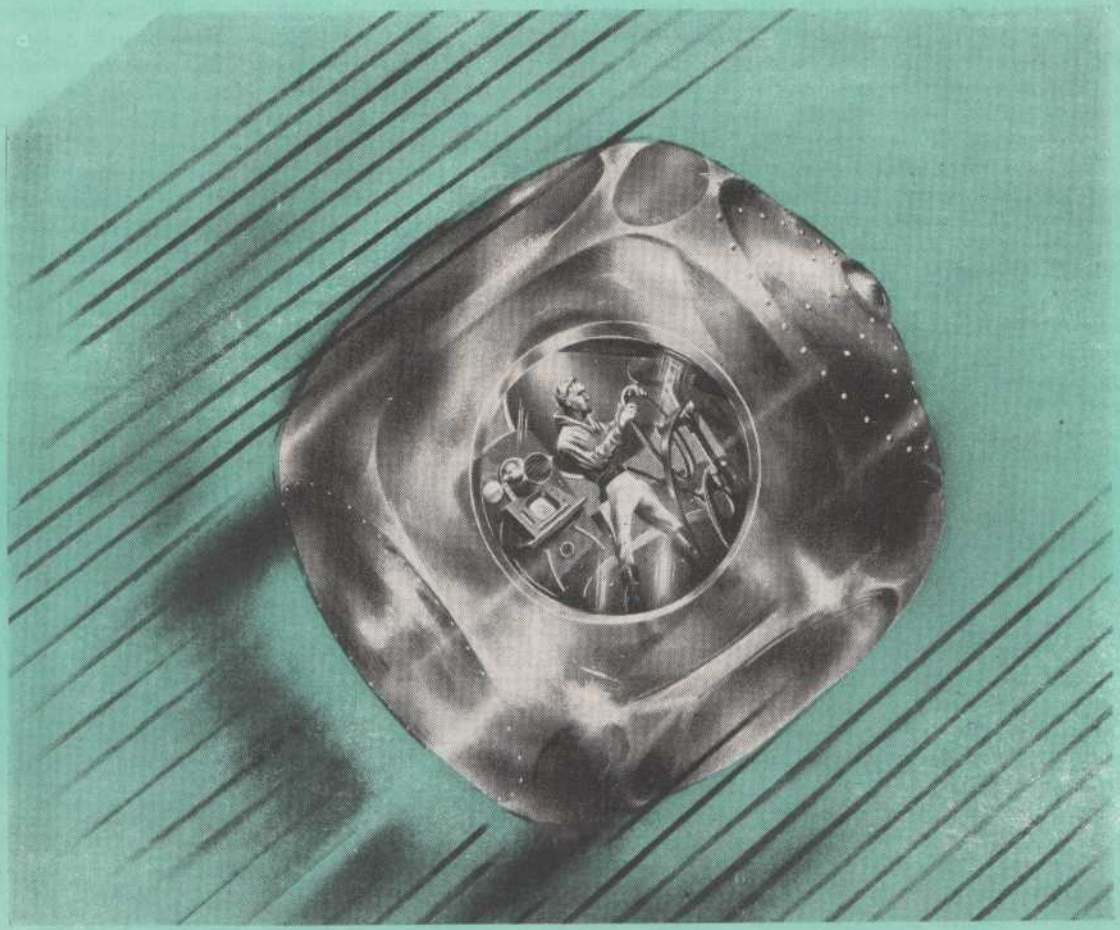
A graduate of New York University, Frank Belknap Long has been writing science-fiction almost without interruption since 1923 and has earned an enviable reputation for the high quality of his prose. His short stories have been published in twenty-five anthologies as well as two fiction and two poetry book collections.

by **FRANK BELKNAP LONG**

(Illustrations by Martin Kollman)

Time travel has a long and honorable tradition as a science-fiction theme. While at times it presents hopeless paradoxes, it rarely fails to entertain. Few stories attempt to present a logical theory or explanation for two-way time travel. Science simply does not know enough about the relation between time and matter. Here, the writer promulgates a new theory and situation in time travel. You may argue his theory, but will find that he has used it to good effect in a touching and memorable science-fiction story.

"As he bent above the controls a great wonder took him."



Vainly does each as he glides
Fable and dream
Of the lands which the River of Time
Had passed ere he woke on its breast,
Or shall reach when his eyes have been closed.
—MATTHEW ARNOLD

HE WAS TIRED of his world. He was tired of the twilight glow on terraced gardens and the white educational halls with their endless rows of sterile exhibits. He could no longer endure the vulture-black rockets that screamed across the sky, and he was weary unto death of the vast and intricate machines which did man's work too well, leaving no pathways open for new deeds of strength and purpose.

Toward women he had less antipathy, but in his secret thoughts he could make nothing of them. Superb they were in face and figure, but they had allowed their biogenetic concern for absolute perfection in the rearing of children to blind them to the more

adventurous aspects of courtship. How could a man find joy in a bride who couldn't be drawn or painted without assuming the sternly forbidding aspect of a cliff wall facing into the sunset? How could a man find joy without warmth and radiance, tenderness and compassion?

Surely such questions were reasonable, but in the world of his birth, Ruk Lann had asked these questions in vain. Having asked them, he had waited as a patient man must, until every opportunity for happiness had been exhausted.

It was only then that he had allowed himself to become savagely embittered. As he had more than half expected, his emotions would permit no compromise once he had surrendered himself to the more rebellious side of his nature.

In the judgment of those about him there was no excuse for such a surrender, because that which he desired most was against their reasoning. He longed to stand in barbaric isolation as his remote ancestors had done, feeling the wind and rain on his face, shouting his challenge to hostile skies.

He stood now defiantly facing his five judges, whose verdict might pronounce him guilty of the most serious crime a man of the twenty-seventh century could commit. In attempting to travel in time, Ruk Lann was like a man reaching out his hand for a forbidden fruit, his hazard being that, when he had it firmly in his grasp, he might find himself despised and friendless.

The machine, the evidence of his guilt, was still intact. It towered in shadows a few yards from where its maker stood; both were untouched by the glowing golden light which filled most of the enormous judgment hall. His judges had determined that he should stand thus in shadow, with his shining invention also purposefully mocked, the darkness covering its gleaming intricacies of metal, glass, and atomite.

If only he had moved a little faster! They had broken in on him just as he was entering the machine. Smashed in the door of his laboratory, laid violent hands on him. The outrage still rankled, and he wondered whether he could shame his judges on that score alone, restraining the deep anger and sheer unbelief which he felt as he contemplated his predicament.

"Ruk Lann, have you anything to say in your own defense before we pass judgment?"

This was absurd, of course. He remembered their tenets—that a man who returned to the past could endanger endless bright tomorrows by altering the entire course of human history; that an *evil society* might tolerate this crime, but to alter *their* perfect society was against all reason—monstrous and unforgivable!

Swiftly Ruk Lann studied the faces of his judges, and searched in vain for some sign of sympathy and understanding. How incredible it was to him that these men had experienced no wild and tormented impulses in *their* youth!

Is not man born lonely? Does he not live in solitude most of his days, no matter how bright and shining the road along which he travels? Surely at some point before that road dips to a sunless horizon, there must be in every man the urge to explore the unknown! Surely time-travel could not be in itself a crime!

He came back to the realities of this particular world. The faces of his judges were stony masks, neither cruel nor merciful.

Strab Mang, the eldest, had the brooding gaze of a master chess player, a man sunk in a lethargy of thought, as one planning a decision from which there could be no appeal.

With deliberate effort of will Ruk Lann thrust aside his anger, and became as cautious and calculating as his opponents. He measured each man in turn for flaws of resolution. He could discover none.

The time atobile was forty feet away. Dare he attempt to reach it? It became clear to him at once that to cross the intervening stretch of floor in a race with death would require a supernormal steadiness of purpose. It would mean audaciously plunging into a no-man's-land, pitting his unpredictable reflexes against the deadliest kind of fire-power.

Ruk Lann made his decision instantly. He dropped to one knee.

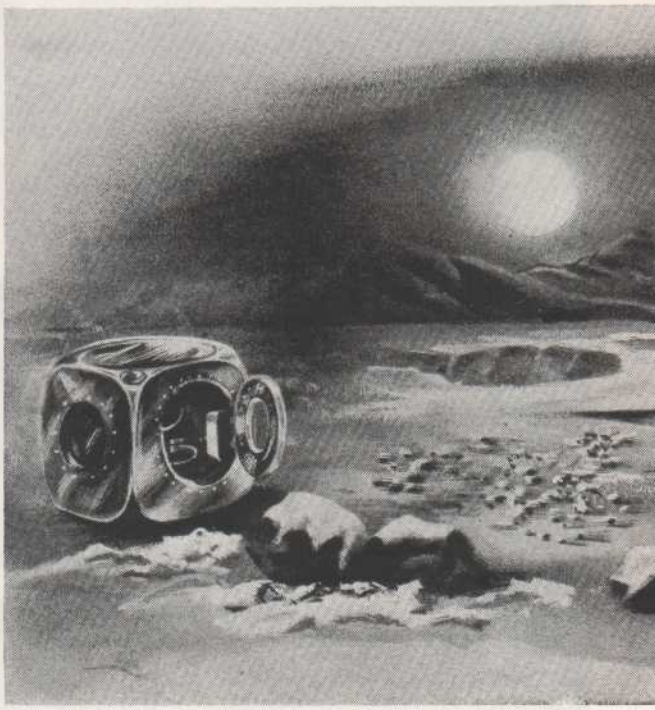
To his judges it seemed he had taken leave of his senses to thus beg for mercy with no concern for his pride.

The confusion which ensued gave him his opportunity. As the judges murmured and exchanged startled glances, he darted forward with an insulting shout of defiance. The shout added to the confusion, causing Strab Mang to stiffen with an anger so violent that he failed to realize that the man who had defied him was already in motion. He came to his feet the instant he recovered from his surprise. But by then the odds had shifted, and Ruk Lann had only a scant few yards to cover to make good his escape!

At Strab Mang's waist hung a compact energy-weapon, whose barrel of fused tungsten glittered with a brilliance as chill as starlight. There was a rustle of ominous import as he drew it forth, and trained it on Ruk Lann's head. He took aim with the calm, despairing precision of a man gambling for the highest of all possible stakes against almost hopeless odds.

Ruk Lann knew moments of mortal fear as he covered the last yards in reaching the machine. He was zigzagging like a pawn at the mercy of a mind so inscrutable and far-seeing that it could check-mate an opponent at every point. But no shots found their mark.

Then he sprang inside the machine, and the con-



trols responded to the frantic tug of his fingers. There was a sudden, deafening roar, and the hall blacked out as if a curtain had been drawn. The cracking of Strab Mang's weapon quickly became a dwindling mockery of sound, a far-off echo in a world to which he would never return.

So INCREDIBLE seemed the miracle of his escape that for an instant his pride soared. Then, as he bent above the controls, a deep humility swept over him. He took pride in his accomplishment, but it was not an egocentric pride. Stronger than that was a realization of his human heritage to invent, to persist, to dare.

For centuries, mathematical physicists had speculated on the close relationship of time and motion. They had long known that men traveling in vehicles at tremendous speeds found, upon emerging that their time-sense had been strangely altered.

When the speed approached that of light, inertia ceased to operate, and an acceleration was built up out of all proportion to the magnitude of the energy used to set the vehicle in motion.

At work in the universe was some incalculable cosmic force which suspended Newton's second law of motion. A moving vehicle could accelerate until it attained a speed so great that it blurred and disappeared.

When such vehicles reappeared they bore evidence of aging. The travelers could remember only that they had lost touch with reality for a nightmare interval of indefinite duration. They returned semi-paralyzed, unable for days to adjust to motion, sound, and color with the same quick perception of normal men and women. They babbled of shifting lights and shadows, of towering monuments seen as in a glass darkly, and of landscapes of a mirage-like strangeness that changed shape with kaleidoscopic rapidity. Despite their babblings, their movements were slow and ungainly. When questioned, their replies came haltingly, as if each uttered word was torment to pronounce.

Routine laboratory tests revealed altered reflexes, and a change in eye cell color sensitivity—a change known to occur only when the ganglion cells of the human eye have undergone exposure to an increase and decrease of illumination over a period of time.

Electronmicroscopy revealed findings even more startling—the presence in bone and muscle, in skin and hair, of virus parasites, unknown to science, but which man's remote ancestors may well have harbored in ages immeasurably remote.

All of the evidence pointed to a time shift at variance with the brief period of the vehicle's disappearance. The best minds were quick to seize upon the wonder, and inquire what it foreshadowed.

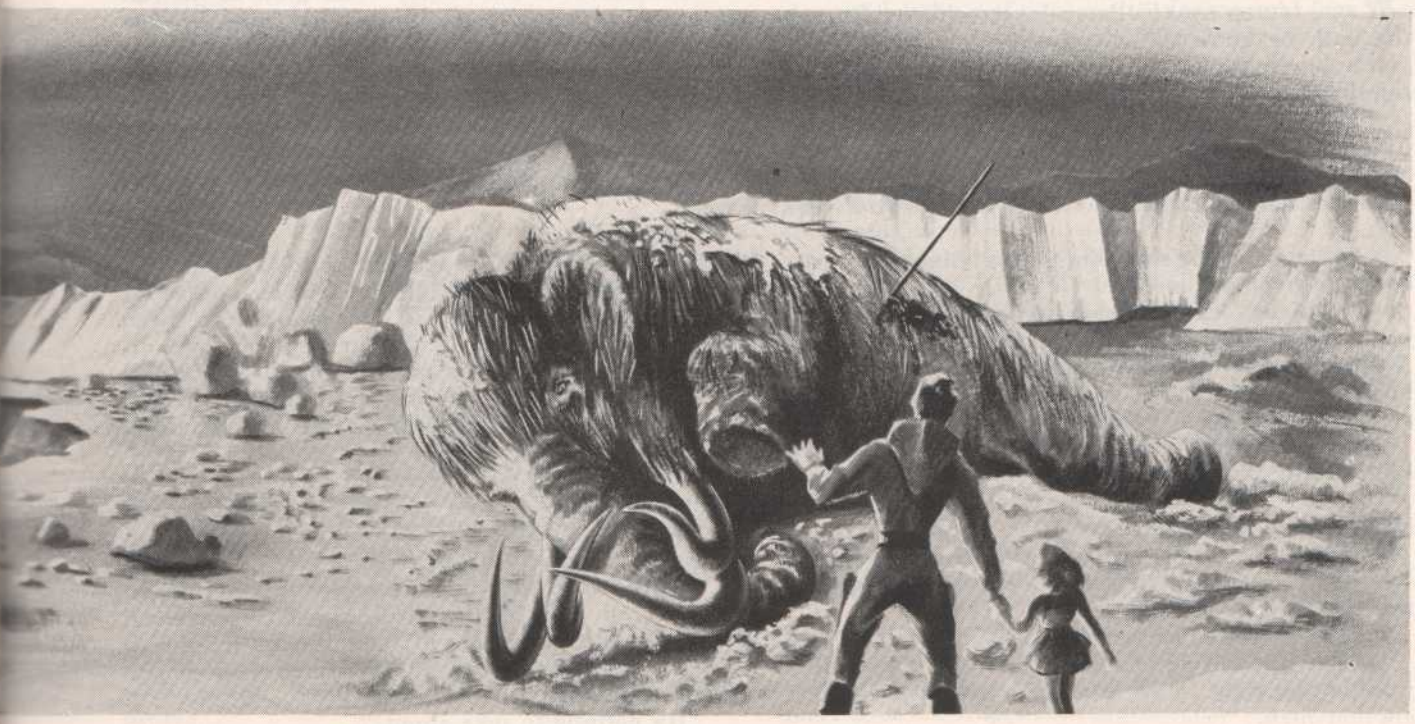
Were there cosmic waves surging through time as there were winds blowing through mountain passes, cosmic surges of tremendous violence which could seize a rapidly moving object and increase its speed until it vanished into the past?

Was the speed of light the core of the mystery? At the speed of light did the past and the future become a shining, merging road down which men could walk—in their ears the thunder of time's passing, their eyes dazzled by a splendor undreamed of?

Einstein had long ago pointed out that every mass affects in some way all space in its vicinity, and that a moving object could be influenced in its motion by the characteristics of the space around it. To an observer resting motionless at one fixed point in space, the past might well seem beyond recall. But were some sudden increase to occur in mass and motion, propelling the observer away from his fixed point at the speed of light, the past would once again unroll before him, assuming the firm contours of reality.

The whole of human history could thus be recaptured and revisited, if certain obscure cosmic energies could be tapped and utilized as mass-changing and speed-accelerating principles.

The possibilities had seemed too technical at first to be fully explored and mastered. Surely the heliocentric theory of the universe had presented no greater challenge to Galileo, or the intricacies of the induced electromagnetic current to Faraday. Not



"The mastodon . . . bellowed in sudden, terrible pain."

even Einstein, who designed a new space-time frame for the universe, faced difficulties so staggering.

Yet Ruk Lann surmounted them. He had constructed a time atobile that could be controlled from within by a human passenger traveling first at the speed of light and then faster, ever faster, as the cosmic surges took hold of it, dissolving all time barriers in its path.

What was even more remarkable—he could remain conscious—sane! Stabilizing units on the control panel itself absorbed all shock, adjusted to the changes occurring as the machine built up internal tensions dangerous to body and mind. He mastered the involved problems so well, that technical difficulties had evaporated like dew beneath the steady glare of the noonday sun.

There would be no shattering of body and mind, no distortion of the time-sense as he went back to the ages of struggle and daring he had dreamed about as a boy—through long golden afternoons, reading the old books, ignoring the microfilms and the dry-as-dust historical appraisals which failed to do the past full justice.

As he bent above the controls a great wonder took hold of him. He had perhaps the finest mind of his age, and yet at heart he was still a youth of twenty, dreaming of lands lying remote and resplendent in some lost world of enchantment which his destiny had commanded him to explore.

Lines from a half-forgotten poem flashed through his mind.

I remember the black wharves and the ships,
And the sea tides tossing free,
And the Spanish sailors with bearded lips,
And the charm and the magic of the ships,
And the mystery of the sea.

For the thoughts of youth are long, longing thoughts.

The sea! High adventure and the sea were two flashing facets of the same jewel, inseparably wedded for all eternity! He'd seek out the sea first. His first stop would be by some shining beach where gulls wheeled and dipped, and the great waves thundered!

"WELL, LITTLE LADY!" Peter Joyce said, striding up the path he knew so well, the crooked white path, marked with oyster shells, which meandered to a small white cottage on the highest bluff on Cape Cod.

Below, the sea shone silver, and overhead a plane droned by through the clear summer sky.

The little girl who stood in the middle of the path scowled and pointed to the easel beneath Peter's arm.

"Mama says she's tired of posing! Mama says why don't we go on a picnic?"

"A picnic, eh?" Peter laughed and patted her hand. He stared up at a wheeling gull. "Mmm . . . yes. A picnic *would* be kind of nice, Carolyn. But it would be a shame to go running off with your mother's picture only nine-tenth done!"

"Mama says it's awful to be a widow," Carolyn said, falling into step at Peter's side.

"Oh?" Peter's blue eyes crinkled beneath his sandy thatch of hair. "Did she say why?"

"I think Mama wants to get married again. But she said it wouldn't be fair to ask a man with an artistic temper—"

"I guess you mean 'temperament,' little lady!"

"I'm just telling you what she said. She said it wouldn't be right to ask him to support the child of another man."

"Your mother's a very wonderful woman, Carolyn," Peter said. "But she can be as stubborn as a Scotchman from Dundee. Come to think of it, though, there's a special kind of stubbornness that's never found in a man. You've got it too."

Carolyn was silent for a moment. Then she made a surprising request.

"I wish you'd ask Mama to marry you right away. *The pirate will carry her off if you don't. He watches her all the time.*"

Carolyn stopped to tie up a dangling shoe-lace; her face flushed.

"He was watching mama on the beach this morning!" she almost shouted. "I told him to go away, but he just laughed. He had a long red beard, and big muddy boots like fishermen wear, and he said Mama was the prettiest woman he'd ever set eyes on!"

"Really?" Peter grinned. "You didn't tell me you knew a pirate."

"Maybe he wasn't a pirate," Carolyn retracted, falling into step again at Peter's side. "He looked like one, all right. He certainly did. But when I asked him he just laughed and said there were no pirates where he came from."

"Well, that ought to settle it!" Peter said. "Come to think of it, there have been no pirates sighted off the New England coast since the middle of the eighteenth century. Now run along, and tell your mother I'm here."

Ten minutes later Peter was setting up the easel in the living room of the cottage. He wanted to be ready and waiting when Carolyn's mother appeared. He had an idea she might refuse to pose for him on a day when the sea beckoned so invitingly. It was a perfect day for a swim, but Barbara Chintook in an oilskin slicker was the most alluring of all fisherman's daughters when posed against a window seat indoors.

He admired the rich blues and ochres on his palette. He arranged the lighting until the almost finished portrait took on the mellow richness of a golden Rembrandt, then he fumbled for his pipe.

He was standing by the window contemplating the portrait through a blue haze of tobacco smoke when she came into the room.

Without a second's delay Peter grew to his full stature as an artist. Something in his mind became brighter, keener, and his heart began to sing.

She was young, willowy, very blond, and her eyes were the deep, unruffled blue of the sea at the base of the cliff. She wore a bright summer dress, and moved with negligent ease, as if she had entered the room to straighten a crumpled curtain, or put a flower into a vase.

"Hello, Peter!" she said.

Peter set down his pipe, went up to her and tilted her chin with his thumb. He looked deep into her eyes. Their lips met in a kiss that would have been long and lingering if he hadn't interrupted it by murmuring: "Carolyn thinks we're stalling. She thinks we should get married before a pirate carries you off."

Barbara's eyes grew troubled. "Peter, it wouldn't work out.

"Try cupping your fingers and standing back and looking at it—us—from a distance, the way art dealers do. You know, like when they're sizing up a painting for its permanent qualities.

"This girl looks at it this way. She knows what marrying an artist could mean. She once imagined she wanted to paint herself, and she lived in New York for one whole year. She even had a roommate who became engaged to an artist!"

"It's nothing to joke about!"

"I'm not joking, Peter. Carolyn would drive you half out of your mind. She'd stand around and ask questions while you were trying to paint. And I won't send her away to school. I'm not that kind of a mother."

"Sure, I know. It's all right with me—"

"It won't be all right. Carolyn is a strange, sensitive child, Peter, in more ways than you dream. For five days now she's been talking about that pirate."

"I know all about the pirate," Peter assured her. "And I'm going to prove to you right now that I really understand Carolyn. She has a fertile mind, and she has conjured up an imaginary companion."

"An imaginary *companion?*"

"Precisely. It's like the case of the little girl who—well, there's a classic example of that sort of thing I remember reading about once. A child of six imagined she was accompanied everywhere by Thumbelisa, the tiny, blue-eyed girl who was born in a tulip. Thumbelisa became so real to her that she thought of herself as tiny too.

"She stood on her toes, and cupped her hands, and shouted up at grownups. She even felt awkward and ill at ease in the presence of other children. You see, the tiny girl was her fantasy self, her subconscious idealization of herself in relation to reality.

"She was a sensitive child, and the harshness and stupidity of the world made her feel fragile, tiny. It didn't hurt her to believe in Thumbelisa, and in a year or two she had outgrown the idea. Only the brightest and most imaginative children get fantasies."

Peter smiled. "You see? If the magazines ever stop buying my streamlined cover illustrations, I might qualify as a child psychologist."

"It doesn't make sense to me," Barbara said. "If the pirate is a subconscious idealization, Carolyn must think of herself as a big swaggering bully."

"Just a tomboy," Peter said cheerfully. "Carolyn can take reality in her stride. That's why her imaginary companion is a pirate. Carolyn won't take hypocritical adult guff from anybody."

For a moment Barbara's lips relaxed in a smile. Then tormented uncertainty returned to her eyes.

"Peter, I don't know. Even if you do like children—even if Carolyn doesn't get on your nerves now—"

"She doesn't, I tell you!"

"She would, Peter. If the three of us were cooped up in a small apartment in Manhattan, you couldn't work at all. She'd wear your nerves ragged."

"You underestimate my powers of concentration. If we could ask Carolyn right now—"

WITH CAROLYN there was a time to be asked and a time to take to her heels. After a session of eavesdropping, it seemed good to her to run along the beach in her bare feet, her hair blowing in the wind.

As she ran she made a wish. She wished that everything could be settled well before lunch time. It would be no fun at all to go back and eat a cold sandwich, with Peter gone and Mama crying again.

The tide was coming in fast, strewing the beach with seaweed and bright, fragile shells. Carolyn bent suddenly, and picked up a gigantic horseshoe crab. There was a live beauty in the creature despite the ugliness of its many squirming legs.

After a moment she set the crab down and stared out over the bay. To her inward vision it wasn't the Atlantic Ocean which stretched out before her. It was the Spanish Main, and a big galleon was coming in with the tide, its red and yellow sails fluttering in the breeze.

That private miracle was quite as beautiful, in her sight, as the horseshoe crab. Quite as beautiful and without the ugly squirming.

The pirate came striding around the breakwater with his brows drawn together in a ferocious scowl, as if he'd just waded ashore and was looking for someone to frighten. When he saw Carolyn his eyes lighted up and he gave a great shout.

Before she could turn and run, he advanced to her side and blocked her path, his ice-blue eyes mildly accusing.

"Child of a barbarous age, where is your mother?" he demanded.

Carolyn blinked furiously. She wanted desperately to believe that the pirate was no more real than the galleon. She shut her eyes and opened them again quickly, hoping he would disappear. It wasn't any use. The pirate was as real as the sand beneath her fingernails and her footsteps in the sand.

"Mama didn't feel like going for a swim today," she said fearfully, backing away. "It isn't my fault. I—I didn't do anything!"

"Be quiet, child!" The pirate's voice grew less harsh. "I didn't mean to shout at you. But when I saw your mother I knew that I could travel back through time to the Wisconsin Glaciation, and not find a woman more to my liking. She is one of those rare and exquisitely beautiful women who would appear civilized even in an age of the rudest barbarism."

He slapped his knee. "When I saw her I knew that while there is such beauty in the world, life cannot take from a man more than it gives!"

The pirate's eyes began to shine. "Her beauty is like a singing flame, warming everything it touches. Warming me even in my loneliness, giving me a strange hope."

"You're not fooling me!" Carolyn said, swallowing hard. "You want to carry Mama off!"

The pirate slapped his knee again, merriment dancing in his eyes. "Carry her off! By heaven, I am just primitive enough to be stirred by such a barbarous form of courtship. If you but knew how life roars within me at times. I am like a hungry lion, stalking the jungle aisles. But I would not so much carry off your mother as win her love with a great show of beauty and wisdom, tenderness and joy. The ages would be ours to explore!"

Carolyn almost decided that he was no more terrifying than a big shaggy dog running and barking at the edge of the surf, a dog you could tame with a few softly spoken words.

"I've got to go now," she said, trying to make her voice sound friendly. "It's way past lunch time and I promised Mama—"

"Child, how would you like to have lunch in the Great Ice Age?" the pirate asked, his eyes dancing with merriment again. "Your mother has never met me, and I might have a hard time persuading her to take the trip. You could be her eyes and ears. When you tell her what you've seen, her natural woman's curiosity will make her eager to travel in time too! She'll have to believe you when you show her ancient arrowheads chipped from the tusks of a woolly mammoth!"

Carolyn never meant to follow the pirate across the beach to the cave, but he kept right on talking and his words held her entranced.

"When you've seen a mammoth, child, you'll never become excited about an elephant again. Oh, it's tremendous back there. Fields of ice glistening in the sunlight, great crags wrapped in a frosty glimmering. It's a stupendous world, child!"

Carolyn never meant to agree. She should have stopped her ears and refused to listen. But there was something about the pirate that was the same kind of something that made you get up before it was light on Christmas morning and creep downstairs in your bare feet.

"A man's world, child! But your mother would like it back there too. We'd be alone together under the stars, your mother and I!"

The tide was still coming in when they reached the cave. There were flat, black rocks by the entrance, all slippery with seaweed, and when they climbed over the rocks there was little to see at first. Just the walls of the cave towering up, covered with barnacles, and a hard-to-find kind of black mussels which gave off a whistling sound when you squeezed them.

The interior of the cave smelled strongly of salt and seaweed.

"You'd better give me your hand, child," the pirate warned. "The ledge is tricky."

The pirate's palm was not all rough as she'd imagined it would be from tugging on ropes at sea. She felt only a light pressure on her hand, guiding her, preventing her from slipping.

Suddenly he stopped and pointed. "Here we are," he said. "Careful now!"

She thought it was a buoy at first—a big metal buoy like the one that flashed in the middle of the channel off Graystone Light. Then she saw the glimmer inside and a door standing open, and a great wonder took hold of her.

"I built that atobile myself!" the pirate said, drawing himself up to his full height; his dark eyes flashed. "No one before me had ever traveled in time. I was the first!"

FROM THE LIVING ROOM window Barbara saw her daughter coming up the bluff, her face flushed with excitement, a small, furry animal in her arms. The animal looked like a little white lamb. It was struggling and kicking, and Carolyn was attempting to pacify it by stroking its back.

Barbara turned from the window, her lips white. "She's all right, Peter," she said, quietly. "You'd better phone the sheriff and tell him."

She swayed, and had to sit down. "I'll never be able to face him. It will be all over town that I'm one of those neurotic mothers who ruin their children's lives. I'm not, Peter. You know I'm not. But when five o'clock came and she didn't return—"

"I was plenty worried myself," Peter acknowledged. "I let myself forget that children have no idea of time. Not when they're playing on a beach at ebb tide. It's my bet she found a cave to explore."

"She might have drowned!"

"She wasn't. That's all that matters."

Peter smiled, patted Barbara's shoulder, and went into the hall.

He was approaching the telephone when a tiny whinny came to his ears, and the front door burst open. He stared, pulled his pipe from his mouth, and blinked furiously.

In the doorway stood Carolyn with the little white animal. Her face was flushed and her eyes were shining.

"*Oh, no!*" Peter breathed. "Am I crazy? An *eohippus?*"

"Isn't he cute?" Carolyn asked.

She set the horse down as she spoke, heeding the furious blows of its three-toed hoofs against the hardwood floor no more than if they were the clatter of grasshoppers leaping about in an empty match-box.

As Peter stared, the tiny animal broke away from her, and raced in furious circles about his legs, its mane standing out on both sides of its straining neck. A horse less than eight inches high, a pygmy horse with flaring nostrils. He seemed to feel an uncontrollable urge to escape.

"The pirate caught it for me," Carolyn said. "It lived a million years ago!"

For a moment Peter stood watching the horse in grim silence. Then he knelt, took Carolyn by the shoulders and looked pleadingly into her eyes.

"We're pals, aren't we?" he asked. "Buddies? Sure we are. Now I want you to tell me the truth. Just where and how did you get that little animal?"

"Peter, you can't believe—" Barbara began.

"Come with me," Carolyn offered eagerly. "And I'll show you!"

AS THEY TRUDGED along the shore toward the cave, Peter said, "Carolyn didn't pull that prehistoric horse out of thin air!" He felt utterly divorced from the familiar world, from reality, as he followed the strange, elfin child.

He wondered where the boundary was, between sanity and insanity.

"There's the cave!" Carolyn's voice cut sharply through his thoughts. "The pirate said he'd wait right here if I brought Mama! He must be away on another trip!"

Peter felt the sea breeze cool on his brow. He moistened his lips and stared at Carolyn, his eyes searching.

"If the pirate's not here," he said, "we won't find the time atobile, as Carolyn calls it. Is that what you're hinting at?"

"Peter, you're wrong," Barbara whispered. "Children brazen out their falsehoods. You can always tell when they're lying."

Her hand tightened on his arm. "Carolyn's acting in a perfectly natural way. Oh, I wish I could understand it."

"That goes double!" Peter muttered, pushing on into the cave.

He clambered over the flat rocks at the entrance, and rose to his full height, his eyes searching the gloom.

The machine towered directly in his path, like a big rusty buoy that had been washed ashore in a storm. How could he accept such a terrifying challenge to his sanity?

The tiny horse had given him an ugly jolt, but yet still the horse was easier to accept than the intricate tangle of shimmering dials and cogs and wheels which were just inside the open door of the machine.

The complexity of the instruments made his head whirl. As he stared, he was aware of Barbara crowding at his back. Like most men who find life pleasant and the odds stacked against disaster, extreme bewilderment made him utterly incapable of speech or action. Barbara's touch gave him a renewed balance. He struggled to remain as calm as possible, to be completely practical and matter of fact.

"It's a very strange object," he said at last, his gaze on Barbara's white face. "I'm going to take a look at the machinery. You'd better wait here."

A moment later he was inside the machine.

Carolyn said: "The pirate sat down first. Then he lifted me up beside him, and started turning that big wheel—"

"Don't touch anything!" whispered Barbara pleadingly. "Peter, be careful!"

"I'll show you what he did!" Carolyn said.

She was through the door and inside the machine at Peter's side before he could protest.

Barbara followed, her lips white. "Carolyn, don't do that! *Carolyn*!"

They were all inside together when the lift came. There was a sudden droning and a whirling, and lights flashed into brightness, and then dimmed, and flashed again. They were hurled forward into darkness and then back into the light. With stiff, frightened movements they struggled to maintain their balance.

Barbara screamed and Carolyn let out a delighted yell. Around and around they went like riders on a seaside merry-go-round, each separate from the other, but joined by a single spinning band.

Around and around and around.

Peter felt light-headed. His body seemed to grow lighter too, pinwheeling into the brightness like a revolving shadow on a screen.

Then with startling abruptness all movement ceased. Peter became aware that he was again a substantial entity, sitting before a luminous dial of mechanical-electronic parts which had suddenly ceased to rotate.

"We're back in the Great Ice Age!" Carolyn said.

Peter stared at her and said nothing. There was a faint hissing sound in his ears as if all the air inside the machine was escaping into a colder outside.

He looked at Barbara, silent and ashen-faced at his side, the knuckles of one tightly clenched hand pressed to her mouth.

Carolyn opened the door, with a little choking cry of pure delight.

Flurries of snow blew into the machine, and Barbara dropped her hand and cried: "It's true, Peter! I'm terribly afraid it's true! Oh, Peter . . ."

"I've got to check this," Peter muttered. "It's crazy."

"I'm going with you," Barbara declared. "Carolyn, you stay here where it's warm."

It was a world of untrammeled snow and frost, with bare patches of earth between, and immense blue-white glaciers looming in the distance, lifting their peaks to flame-tinted skies.

Carolyn was beginning to feel miserable and afraid, when the pirate reappeared, stepping forward out of the shadows.

"I'm glad you didn't give me away, child," he said. I tried to stay out of sight, but my legs cramped and I had to move out from behind the control board once or twice. I saw you staring. Children as a rule have pretty sharp vision."

Carolyn gulped, her eyes wide. "I—I didn't see you!" she stammered. "I didn't know you were hiding from mama and Peter!"

He came closer and towered over her. His eyes grew stern. "Child, do you remember what I told you this morning? The Great Ice Age is a man's world! *He* won't last two days!"

"Who won't?"

The pirate laughed harshly. "Why, that pale, scrawny mockery of a man your mother has taken a fancy to. What does she see in him? Tell me. Would she lose any sleep if she lost him forever?"

"They're in love," Carolyn said. "They're going to get married."

The pirate reached out and took Carolyn's hand. "Come, we'll find them. Then you can ask her what she sees in him. Her answers will enlighten me, and I can set about curing her. Before you can cure a disease, you must understand the symptoms."

It was cold outside, but not freezing cold. The pirate had explained that even in the Great Ice Age the snow sometimes thawed, and the weather became almost warm.

It was like a crisp autumn day with little gusts of snow in the air, whirling Carolyn's hair around as she walked and making her shiver.

She wished the pirate's hand was warmer, firmer. She could hardly feel his fingers when she tugged, and it was hard to believe that he was big and strong until she looked up into his eyes.

They were high on a sloping hill when the ground began to shake and cracks appeared in the snow, making the white surface which stretched out below them look like a jigsaw puzzle. There was nothing to see, but the pirate was quick to sense danger.

He took Carolyn by the shoulder, and guided her to the safety of a big gray rock.

"Keep out of sight," he warned, crouching down at her side. "Keep your head down until I tell you it's safe."

Carolyn peered out through a crevice in the rock, her mouth suddenly dry.

The seventh year of life is a continuous adventure. But the new and the startling sometimes can rush in so suddenly upon a child's mind that the shock is difficult to efface. As Carolyn stared around the base of the hill, came another hill.

It was gray and shaggy, and four long poles jutted out from one end of it. The poles were blue and glistening with ice, and the object seemed to have eyes.

Carolyn suddenly realized that the second hill was a great shaggy beast!

"A mastodon!" the pirate whispered. "They were allied to the elephant, blood-cousins, you might say, but they had four tusks instead of two."

The mastodon seemed to be seeking an outlet for its rage, for it suddenly ceased to move sluggishly and started up the slope like a juggernaut, its massive hoofs shaking the earth.

"Don't move!" the pirate warned, gripping Carolyn's hand. "If it sees us it will head straight for us." They dropped.

Carolyn didn't want to scream. But she thought about it and was afraid that she might.

Thinking about it was as far as she got. As the pirate's hand moved toward her mouth, a long spear whirled through the air and buried itself in the mastodon's flanks.

The charging beast swayed and bellowed in sudden, terrible pain. Its front legs collapsed and it skidded forward through the ice and snow for thirty feet, ploughing a path that stained the ground red.

The pirate rose and swabbed his perspiring brow. "Child, that was close!" he breathed.

He ducked down again just in time. From behind another boulder a tall, bronzed savage emerged and started up the slope, his shoulders held straight. He stopped beside the slain beast and stood for a moment staring down at it, shading his eyes against the glare of sunlight on ice.

"Folsom Man!" the pirate breathed. "This is tremendous. He was a magnificent hunter, a proto-mongoloid with a genius for flint-making. He lived twenty-five thousand years ago. Think of it, child! He was the first man to set foot in the New World!"

"He's alive now, isn't he?" Carolyn whispered.

"Every man who ever lived is still alive, child. In time there is no real death. When a man dies he's still alive ten minutes ago, ten years ago. He's always alive to those who travel back through time to meet him face to face."

"What will we do if he sees us?" Carolyn asked.

"He won't if you keep perfectly still," the pirate warned sternly. "Give him a moment to rejoice in his own strength and skill. Ah, he is truly a man. Not in

"Folsom Man . . . let out a howl of pain."

the least like that scrawny-chested weakling your mother has a fondness for."

"When he stops showing off what will he do?" Carolyn insisted.

"You can't rightly say he's showing off," the pirate said. "He has no audience. I mean—he doesn't know we're watching him. When he's through rejoicing in his strength he'll join his fellow tribesmen, and they'll all come back and skin the beast."

Folsom Man strutted, pounded on his hairy chest, and gave the shaft of the mastodon-buried spear a resounding thump. He grinned at nothing in particular.

"He's sure stuck on himself!" Carolyn said.

"He has a right to be."

Folsom Man turned at last, and went striding down the slope with a swaggering assurance which would not have been tolerated in a man less completely his own master.

The pirate said: "It's a ghastly thing to lay the cloak of civilization on such shoulders. Future ages will tame him. He will help develop the Mayan and Aztec cultures, but he will never know a greater moment than this."

The pirate stooped as he spoke and wrenched the spear from the mastodon's flesh. He wiped it clean by rubbing it on the snow. Then he held it up and studied it.

"Folsom points were surpassed only by Yuma points," he said. "The chipping was done painstakingly by a master craftsman. In the Old World such craftsmanship did not appear until late in the neolithic—in pre-dynastic Egyptian stone daggers and the like."

A SCREAM—IT WASN'T very loud. It came from the opposite side of the hill, and Carolyn scarcely heeded it at first. She was too absorbed, staring down at the enormous bulk of the slain mastodon, to realize that all of the blood had drained from the pirate's face.

"It's your mother," he cried, hurling the spear from him as if it had suddenly turned into a poisonous snake. As the weapon went hurtling down the slope, twisting and leaping about like a live thing, he seized Carolyn's hand, and together they hurried in the direction of the sound.

Barbara was just below the summit of the hill. She was clinging to a narrow ledge of rock overhanging an enormous, scooped-out hollow in the earth. The hollow was a kind of natural amphitheater which a glacier of vast dimensions had left in its wake. Barbara was staring down at a spectacle which froze Carolyn and the pirate in their tracks.

Folsom Man was advancing on Peter Joyce with his great arms spread wide, a killing rage in his stare.

As the savage closed in with a bellow of rage, Peter kicked at him and leapt back. The savage swayed, and bared his teeth, his almond-shaped eyes gleaming blood-red. He moved in close again, and Peter hit him savagely in the face.

Folsom Man grabbed Peter's right ear and started to twist, his lips snagged by his teeth. Peter landed a smashing blow to the big bruiser's stomach, and followed it with a hard right to the jaw.

Folsom Man released his hold on Peter's ear, and let out a howl of pain. He bent, scooped up a handful of earth, and threw it in Peter's face. Then with a hoarse grunt he threw his arms about Peter's legs and dragged him to the ground.

Instantly Peter escaped his grasp and threw his legs around Folsom Man's torso and started exerting skillful technique. He tugged, squeezed and pressed.

There is a particular spot behind the ear which can immobilize an opponent if one is lucky.

Peter was lucky. His thumb reached the spot.

CAROLYN FELT A tugging at her elbow.

"I have been a fool, child!" the pirate whispered. "She could never love me. This Peter is a man of courage. What did I seek in the beginning but to stand shoulder to shoulder with such a man, in some heroic struggle of the barbaric and legendary past!"

He rose suddenly to his full height. "Have no fear, child. If you run now to join your mother and that brave man all will be well. Just give the big wheel one clockwise twist and you'll be carried straight back to your age."

He fell to one knee, and turned Carolyn firmly about until she was facing toward the atobile.

"Remember what I told you, child! Nothing is ever truly lost in space or time. When you return to your home by the sea, you'll continue to grow in wisdome and strength."

As the pirate spoke, the sunlight gilded a distant pinnacle of ice, and flashed for an instant on the wings of a darting sparrow. As his eyes followed the bird he seemed to be gripped by a strange yearning.

"History is like a great river that flows from the mountains to the sea, breaking up into separate channels and curving about islands bright with beauty until it returns in a wide, rushing torrent to the shining source of all life. Individual lives can make bright wonderful little eddies in the current. But they cannot change the course of the river itself."

He paused, then went on with quiet conviction. "History is made by mankind as a whole, marching ever onward with a courage undreamed of. In my own lifetime I can't bring Folsom Man the gifts of civilization. He must work out his own destiny. But I shall stay here where I feel most at home, and help him lay the groundwork for a new way of life."

Carolyn scarcely heard him. She was staring at her mother running toward Peter, and at Peter turning as if he hardly dared believe in the wonder of what he saw. The wind that was blowing down from the big ice mountains was ruffling Barbara Chintook's

hair, dusting it with snowflakes, making it seem as white as the flying birds.

In her pride at having such a beautiful mother, Carolyn forgot to be afraid.

The pirate said, almost gently: "Run to them, child! Quickly now! and when you're all together inside the machine remember my advice about the wheel. *One clockwise turn*! They'll listen to you, because adults take children seriously when they're facing a crisis in a world that's just a little too big for them. Children are so close to elemental reality . . ."

Carolyn looked at the pirate and her eyes began to smart. It was silly, and she was almost instantly ashamed.

"Won't I ever see you again?" she asked.

"Of course you will, child. Even now you can travel back in your mind, and remember things that happened to you when you were much younger. Your memory of me will never fade. Don't you see? The human mind is a time mechanism too—the most tremendous of all time atobiles.

"On wings of memory and imagination man can travel a shining road leading straight back into history—a road as real as the machine I built. Some day that road will guide him to the stars."

Carolyn knew then that the pirate was saying goodbye and that she could please him best by doing as he asked.

Carolyn turned and without a backward glance, ran straight toward her mother and Peter across the gleaming snow. She heard a voice behind her shouting into the wind, and for an instant tears stung her eyes again. Then Peter was coming toward her, and her mother was calling her name with a sudden gladness.

"It's Carolyn! Oh, my darling!"

It didn't seem possible that Peter could be kissing her mother, but he was. Holding her tightly and telling her how brave and beautiful she was, as they waited together for Carolyn to join them on the slope.

WEDDINGS ARE always a surprise. Carolyn wouldn't have missed for the world the fun of racing up and down stairs as each new guest arrived. It was even more exciting to peek in and out of rooms at men in striped pants with flowers in their buttonholes standing about like lead soldiers, and at Mama's bridesmaids giggling and rushing around as if they wanted to get married too.

It was like being caught up inside a big soap bubble, and being whirled around and around and around. Not for the world would she have missed the plum pudding cut up into big slices, and how Freddy and Tommy looked when she blew out all the candles first. And how beautiful Mama looked when it was all over, and everyone was throwing rice at Mama and Peter, only he wasn't Peter anymore, but her new daddy.

She wished she could have it all back again.

Of course, she liked New York City, too. There were no gulls in Central Park, and she couldn't run along the beach in her bare feet, picking up big conch shells and holding them to her ear to hear the roar of the sea.

But she liked the big lake and the swan-boats and the swings in the playground. It was fun to swing high and then low, knowing that Mama and Peter could see her while she played. The wedding had been over for such a long time it was hard to understand how Mama and Peter could sit on a bench looking at each other like they had just met for the first time. How could they be in New York and married and everything, and still act so foolish?

When she saw the pirate again she'd ask him. When she shut her eyes tight it all seemed to be happening over again. Her hand tight in Mama's hand, and Mama and Peter hurrying over the snow and ice to the machine. Then Peter inside the time atobile taking her advice, and giving the big wheel a twist. And the merry-go-round feeling again! Up and down and around, with Peter shouting at the very end: "We were everlastingly right in listening to her! But how did she know that one turn of the wheel would bring us back? I tell you—it's uncanny!"

They had climbed out just in time. She shivered, remembering, and forgot to swing. At the entrance to the cave with the tide coming in, and Mama screaming that the machine was sinking into the mud.

The tide had come rolling right over it!

She could still hear Peter talking about it by the fireplace with the logs in the apartment over Central Park he'd rented for Mama right after the wedding!

"We'll never know where that machine came from, or what would have happened to us if we'd made another trip in it. It's buried so deep in mud and silt that no grapple could ever reach it. There are some things it doesn't pay to dwell on—not when a man values his sanity—"

And Mama saying: "We can accept it, darling, without allowing ourselves to be tormented by it. Every daily experience of our lives is as great a miracle, if you stop to think about it."

There were so many things Carolyn wanted to ask the pirate when she might see him again. It was too bad she could no longer travel in the time atobile and see the big ice mountains and hear him shout loud and clear: "Isn't it tremendous here?"

But if she just sat very quiet and waited for him to come striding toward her along the shining road inside her mind that led straight back into yesterday—who could tell what might happen?

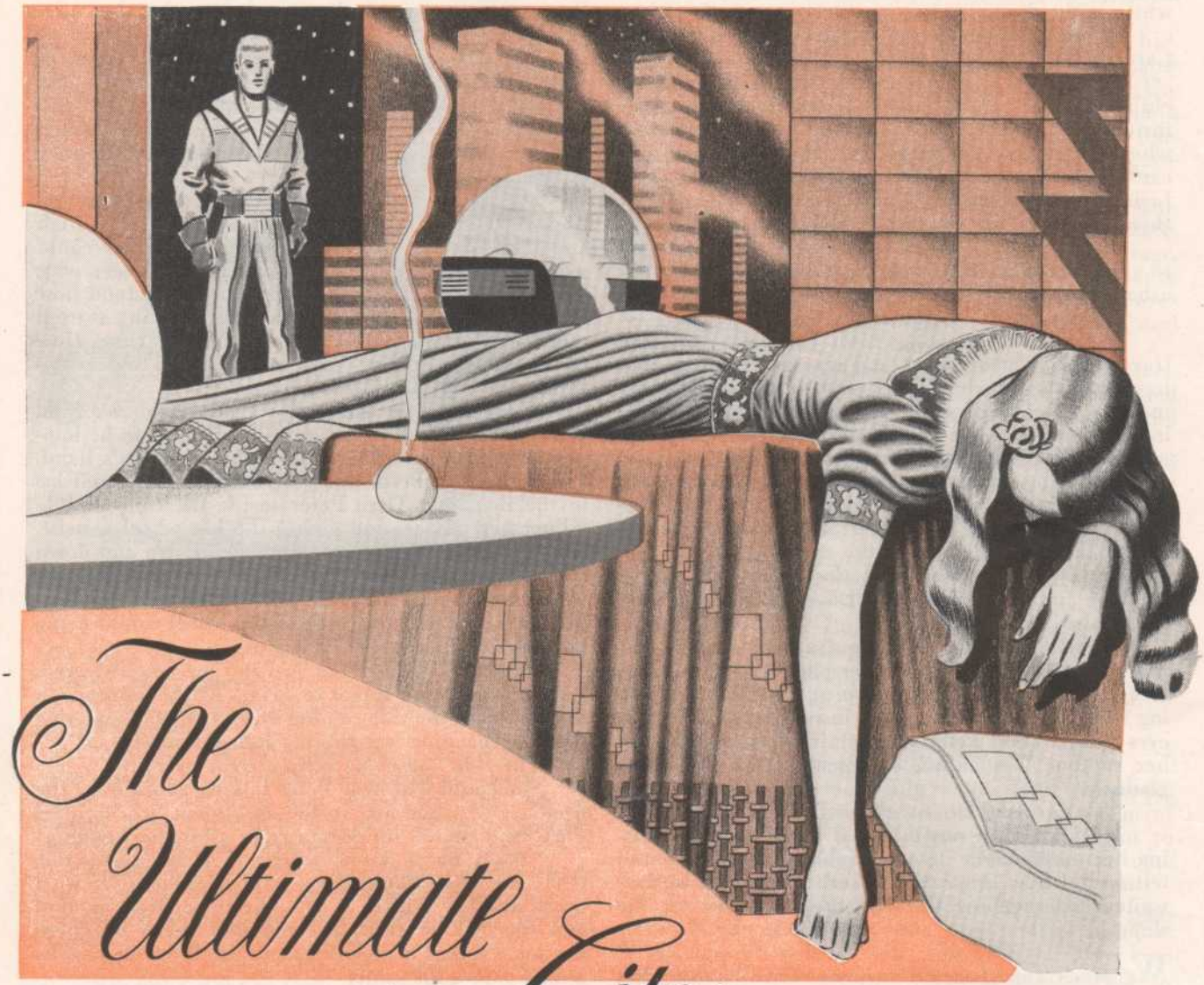
THE BACK COVER

THE EYE-SHAPED NEBULAE on the lower left symbolizes the eye of science-fiction. It watches the creation of new worlds as the forces of nature shape them. At the lowest point we see the simplest atom—with one circling electron, hydrogen. Next, the helium atom, then lithium—on and on, through more and more complex atoms. Vast electrical forces are let loose during the act of creation—symbolized by the flashes and the sinuous electromagnetic waves.

Finally, the new spiral-shaped world grows rapidly in ever-widening circles—the expanding universe now recedes into the infinite void.

The back cover was drawn by Frank R. Paul from an original design by Tina.

——*Editor.*



The Ultimate City

by RICHARD TOOKER

(Illustrations by Thomas O'Reilly)

The world has seen what a terrible weapon of destruction the atom can be. All thinking men tremble at the fate of civilization should the fantastic energies of the atom be released in total war. The menace of such an impending disaster weighs heavily in our thoughts and creates a tension that destroys peace of mind. The great fear is that the atomic age might prove the briefest of all ages. Yet, atomic energy has another aspect—the potentiality for providing cheap and limitless power for every conceivable need. What kind of a world would we have if atomic energy were used exclusively for the good of mankind? Richard Tooker explores this possibility.

THE TOWER CONFERENCE room of the Committee looked out through four transparent walls upon the silent city. Nephert Lak had never seen the landing plazas so bare. The prismed, silvery-white walls and spans and spires of the United Nations capital, Euramasia, gleamed in the atomic-powered lights like a mausoleum of the gods. As he looked Nephert saw a bulb-shaped repulser car bob up from a landing spar and settle with an eery deceleration into a canyon of apartment levels. Mentally, he estimated the interval since such previous appearance of life and movement. Eighteen minutes. One nearby sign of travel in eighteen minutes; yet in 3031 A.D. there were over eighteen million people in Euramasia!

Nephert Lak turned to the other four at the table. Two men and two women, upon whom rested the fate of mankind, with a hopeful quickening that died as his attention came to rest on Lanvia Dulce, who sat at his right. Only in her face did he see a reflection of zest to live, zest that still burned in his own heart like something vestigial from their biological past.

"Am I to conclude that this Committee, chosen by

the popular ballot of world peoples to guide and govern them, has no suggestions in this hour of crisis?"

Teggart Lee raised his dark, heavy, brooding head from contemplation and said, "What is there to say? They die of their own free will and choice. The incentive to live has disappeared with the competitive struggle. Ten years ago we thought suicide was only a passing fad; now we can see it is inevitable. Man has reached perfection. He achieves all his dreams without effort, and he's tired of repeating his conquests." He reached for a beautiful orchid, artificially rooted in a sealed glass bowl of chemicals.

"You see this flower?" He looked around him at the lazy, contemplative eyes of the Committee members —Nephert and Lanvia, only, were alert and interested. "With all our wizardry of chemistry applied to agronomics we can keep this bloom alive only five times as long as it naturally lasts. The moment it reaches perfection it begins to die. Mankind has passed the peak of its bloom. In a million years we achieved what we have. In a few thousand years we wilt and die."

Burg Tun nodded. His deep, luminous eyes under the broad, protruding brow were a product of five centuries of miscegenation, blending the best traits of all the races. His clear voice, carried by the perfect acoustics of the room, penetrated as if microphoned:

"The human species is like an old man who lies down happily to die after a full and successful life. He looks about him with tired, serene eyes for a last gleam of faint pleasure before accepting the eternal rest from boredom."

Nephert looked at Martia La Vere, whose red blond hair shimmered in the discreet atomic light . . . "And you, Martia, with all your genius, perhaps the greatest woman who ever lived—surely you have some suggestion?"

The beautiful lips smiled languidly and the blue eyes looked lazily off into space. "How can I have a suggestion? I, who am far gone with the same malady that afflicts the last and greatest people the world has yet known. We're tired. We've done everything perfectly so many times we have no desire to repeat the sensation." Her eyes lighted a little. "I think we failed when we analyzed ourselves out of a stimulating attitude toward a future. If we could only believe in something beyond all this, mightier and more wonderful than the atom! But it's all hopeless. There's nothing to do but create masterpieces, one after the other, or die of a meteor collision while rocketing through space in search of livelier worlds."

Chairman Nephert Lak drew her attention with the burning of his own intense, soul-seeking gaze. "And—love—you find no place for love, with the finest men the species has ever known at your feet?"

Martia La Vere patted her lips with delicate fingertips. "Nephert," she yawned, "if it weren't for that childish ambition of yours, you wouldn't be chairman of this Committee. What is that love you talk about? A biological spasm employed by nature to propagate the species through periods of evolution when the brain lacked development. Only a moron can find anything worthy in such primitive indulgences. Of course, when I was sixteen it was of curious interest. But now that I'm—let's see—one hundred and eighteen, hormonized, psyched, and streamlined—I'm old enough to know better."

Nephert Lak winced at the mild but thorough rebuke. He could feel Teggart Lee and Burg Tun staring at him with an incredulous humor and tolerance for such a fool as would bring up the subject of sex love at a conference of the governing technologists concerned with rapidly-growing self-extinction tendencies. His telepathic sensitivity deciphered what they were thinking: this throwback idiot thinks he's important; he thinks people are worrying about whether or not they live. Back in the year 2000 it was important who ran a country. Now, when each individual is a law unto himself, and the progress of science gives each of us far more than we can use in a dozen ordinary lifetimes; when every man or woman has his ideal mating complement, and the races of men are happily united in a perfect city—living isn't important. Atomic energy perpetually supplies everything we could dream of, and we don't have a single case of neurosis or maladjustment. With all we have, this ancient romanticist brings up the subject of love as a reason for wanting to live. If nature decides that mankind shall exterminate itself, this young, eighty-year-old upstart can't do a thing about it!

"You, Lanvia Dulce?" He faced the last of the four. His emotions playing like prismed light over his handsome countenance. He might have been an ancient, blond Greek—or an American football athlete in the era of Fascist-Communist world conflict. He watched Lanvia intently. Her hair waved in flames of bronze-red from a placid brow, an oval, artful face. At seventy she was mentally mature, trained thoroughly in the science of psychic adjustment and supreme development. As Nephert's mate-complement she easily won membership on the Committee. As the others implied, it was no longer considered important who was on the Committee. The Euramasians actually ruled themselves. No one had looked at a law for two centuries. The last war was three centuries ago, and the last crime was not more than fifty years later.

"I hardly know what to say," Lanvia spoke at last in a high, sweet voice. "It seems the people wish to die. We have nothing to discover, apparently. We found nothing worthwhile on the other planets, and the star systems are beyond reach. We can no longer write a poem, or paint a picture, that hasn't been done in a thousand ways before. We find our perfect mate-complement by a perforated card system. Without the need of struggle for anything important, we have lost the incentive to live. It's as Teggart illustrates with the orchid there—mankind has passed the stage of bloom. We've gone to seed. We're doomed to wither and die and go back to the primal chemistry of the soil, the air, and the water."

Aside to her, with the telepathic sensitivity that had almost become a sixth sense, Nephert Lak said, "You lie, Lanvia Dulce! You know we haven't gone to seed, not you and I, Lanvia. We can still dream. You know our hours together, and we still have the dream of the little one to come. We have not yet replaced ourselves in the registers of Euramasia. Ours is the ultimate of pleasure, deferred by free will and self-mastery undreamed of in the day of sex worship."

And her eyes returned his gaze. Silently, she answered, "I know what you mean, Nephert, but we are so alone. They will only amuse themselves, ridiculing us in their mild, humorous way. Don't you see, Nephert, we are throwbacks, we are the only people left

Richard Tooker

Although he has been writing and selling science-fiction since 1923, and, although he established a literary splash with his famous novel, *The Day of the Brown Horde*, published in 1929, Richard Tooker enjoys the unique reputation of being the best-known ghost-writer in the country. His work has appeared in the nation's leading magazines under the names of his clients.

in the world who have something to live for—each other, and the dream of children."

"I HAD HOPED for a little faith from this assembly," Nephert Lak spoke aloud as his manner told Lanvia to wait. "I may be a throwback infant in our evolution, but I find myself completely disgusted with the spiritual inertia of people who can't find anything to live for. They actually have everything to live for! Your children are perfect, you have perfect lives for them to live, but you refuse to go on. You're tired. You yawn and say, 'What's the use? Mankind is just another flower that has reached its bloom and now it's ready for reassimilation.'"

He reached for the speaker on a folding extension beside him. "I shall now announce the results of this conference." He pressed one of the plastic-topped buttons inlaid along the edge of the long directory table. A red light flashed on, and across the city, from a tower of compact antennae, another red light flashed on, the signal of emergency control of communication. At that instant every speaker in every apartment sector of the dying city switched to the controlling station. . . .

"Euramasians, I, Nephert Lak, Chairman of your Central Committee of Technological Control, address you after a conference of the committee members. We have discussed the alarming prevalence of suicide in this city, the last city-nation of mankind. I regret to announce that the Committee agrees that the suicidal tendency is a psychic malady. It grew out of the nature of our biological evolution itself. We have mastered all material obstacles, and found none in outer space to challenge us. We can die only by our own hand. I personally deplore this. With my mate-complement, Lanvia Dulce, I plead with you. Find a new incentive for living and continuing the marvelous perfection of our social organization!

"They looked off . . . over the city."

"In the dark days of capitalist and communist overlords, when men lived in fear of ruin and starvation and annihilation by the atom bomb, our civilization appeared nothing less than heaven fulfilling the dreams of sensualists and esthetes alike. My appeal, as a man and as chairman of the Committee, goes out to each of you. Rise and cry out. Let there be a future! Let us be thankful for the munificent gifts bestowed on us!"

He pressed the cut-off button and switched on the reception. The Committee members waited in bored silence, with the exception of Lanvia. Scattered comments began to come in from the Euramasians in their palatial compartments. . . . "Shades of Abraham and Isaac, we have a new prophet in the Committee! Nephert the High Priest of blah!" . . . "Say, Nephert, I have a record made during the First Revolution after Eisenhower that sounds just like you." . . . "On, Oxford, on Yale, who are we for, Nephert, Nephert, Nephert and humanity forever." . . . "Ho, hum, as if life or death were important anymore. Who's to say what is important?"

Nephert's pained glance sought Lanvia's for comfort. He was a revolutionary of the era, and he was her man. The index cards from the eugenics bureau pointed out their precise complements, mental, emotional, physical, which meant that she, too, shared his revolutionary tendency. Nonconformity had become practically meaningless, for there was no reason not to conform, until the popular obsession became suicide.

Nephert shut off the scattered comment, a superrapid press reaction of the masses. Teggart Lee smiled consolingly, said in good humor and with perfect tolerance, "You made a good try, Nephert. No one can say you did not do your duty. You might have become a hero, that is, if anyone will be left to evaluate history. What's the latest figure on suicides today?"

With a slow sigh the chairman switched to the Vital Statistics department, from which all difficult computations and facts were obtained. . . . "5,061 suicides today," the speaker answered from the records room.

"Must be overworking our mortuary incinerators," Nephert rasped back into the speaker, with the intentional coldness of a scientist.

"No," was the instant reply. "Most of the suicides operate their own atomic incinerators by timed control. They use psychometer units to create the state of dreaming sleep until the incinerator time switch goes on. They never know what killed them. In a second they are reduced to elemental chemicals."

"It's horrible!" Lanvia said, and her hand went out to Nephert's as he turned off the speaker.

"I'm glad *you* are able to *feel*," Nephert said softly.

"I move we adjourn," Burg Tun announced with a yawn.

"I second the motion," Teggart Lee said, rising.

"Aye, aye," Martia La Vere sanctioned superfluously. "And, Nephert dear," she cooed mockingly, "please don't hesitate to call another session when you have another brain child."

Teggart Lee laughed. "All that's wrong with Nephert is that he and Lanvia haven't given in to the biological impulse. After the first child they'll be as sick as the rest of us of perfection, nothing but perfection, and the whole universe weeps about vanishing man. Ha, ha!"

The committee members left out of noiselessly sliding doors, leading through shady, verdant arcades to the open-air landing plazas where the repulsion cars awaited them. Everyone had come in separate cars, save Lanvia and Nephert. The three Committee members stepped into their cars, and the doors, contoured with the walls of the opaque spheres, closed automatically after them. The spheres awoke with a low humming of atomic motors, generating the control of gravitational magnetism at the fingertips of the operator-passenger. The cars bounded up in slow motion, like immense bubbles drifting on guided air currents. In an instant the members were speeding away to their compartments or pleasure palaces.

LANVIA AND NEPHERT were slower to enter their car. Nephert closed the outer door of the conference room before he joined Lanvia on the shrub-bordered plaza beside the repulser car. They looked off together over the city, their hands instinctively clasped.

"We're babes in the woods, Lanvia," Nephert said. "But the woods are civilization this time. It's all new to us, Lanvia. If only it could always be that way? Maybe we'll be like the others after we fall, just as Teggart said."

"We'll find a way, Nephert," she answered with her glowing eyes lifted to his.

"Damn them!" he groaned.

She looked up at him in astonishment.

"Nephert, you swore, you actually used a profane word!" she exclaimed.

He laughed as he pushed her into the repulser car. "I'm a throwback," he said bitterly. "Don't forget, it was through childish ambition that I was elected as Chairman of the Central Committee on Technological Control. It's also my childish idea of romantic love that gives you and me a little happiness."

He pressed the control as they settled back in the airfoam cushions in front of the semi-circular windshield. The car leaped up elevator-like to his manipulation of the instrument panel, which was simplified to a tiny lever for descent and ascent, and another for ahead and back. They hopped with breathtaking celerity over a terrace of apartment buildings, until a number glowed below them on an aerial landing plaza. It was their own house number.

The repulser car bumped ever so gently on the tiled surface. The two lovers stepped out with an agility that revealed their perfect health and preserved youth. Chemically grown verdure banked about them in more than common profusion. The Nephert Laks, more than most Euramasians, preferred the lushness of the primitive. The beauty and freshness of plants and flowers was still appreciated by a super-developed man, but in most instances the decorations were confined to enclosures in plastic glass walls, which could be filigreed with leafy designs and beautiful blooms, for the very practical purpose of preventing people from mashing their noses against what appeared to be thin air.

Nephert and Lanvia entered the perfectly air-conditioned apartment, which opened before them like a dream. Their own particular idea of a house had been accurately realized by the last word in architecture and building efficiency. Although their house was part of a vast honeycomb of similar houses, they felt as if they lived alone in a country estate. They could call friends by television and radiophone. Atomic powered lights could be switched from one color tone to another. They could even create a revolving jungle picture in the walls of a room or a motion picture projection of the solar system.

"I'm hungry," Nephert said as they flung themselves on an airfoam davenport. "I suppose that's primitively crude, like the rest of my ideas."

"Well, I'm hungry, too, I match you. A good Cromagnon housewife! What shall it be?—and one thing I'll guarantee, Nephert dear, the meat will not be burned as it quite likely would have been in the day of the real Cromagnon."

"Or even New England days, for that matter," he sniffed. "It'll be good hot roast turkey with pumpkin pie and tender asparagus drenched in melted cow butter."

"Okay, we'll have it, though the turkeys are grown in one week to plump perfection in our radium-stimulated hatcheries at the edge of the city, and the pumpkin pie comes from a laboratory and the asparagus is just one day old from the hot-house."

"Fortunately, our forefathers didn't lose their appetites or their zest for enjoying them," he said as he turned on the television, dialing to the projection of a motion picture over a thousand years old.

He fell to chuckling over the ancient scenes, people chewing each other in love, and the dancing girls wrenching their buttocks about in rhythmic motions calculated to stimulate the male. "Say, Lanvia!" he called out through the quiet house, "if we were these people, we'd be young enough to start the species all over again."

Quite suddenly he shut off the television and lapsed into such meditative silence that Lanvia came to the kitchen door and looked in at him anxiously.

"I'm all right," he waved to her. "Just keep that roast turkey smell coming this way."

Lanvia turned back leisurely to her cooking. The turkey had come by dumb-waiter from the elaborate food stores at the base of the great apartment building, where robot devices responded to spoken words and filled orders. Popped into an automatically operated oven, the turkey was perfectly browned in a few minutes, timed to the asparagus and other essentials. Lanvia's only labor was carrying the food to the table, which opened, spotlessly sterilized, out of the dining-nook wall, and applying the robot carver to the bird. The machine precisely sliced the turkey, separating the dark meat from the white.

In a few minutes they were eating their dinner. Without excessive appetites, a boon of their perfectly co-ordinated nervous systems, and with perfect digestion, they ate with the fullest enjoyment. Lanvia pressed a wall switch. The table disappeared with all its litter, to be cleaned invisibly and almost soundlessly, and the dishes returned to their compartments, all behind the wall.

Nephert and Lanvia washed their hands by thrusting them into a whirling, heated fountain of detergent, which dried properly at the flipping of a small lever, all concealed in a configuration of the dining nook wall when not in use, and a moment later they were entering their repulser car for a joy-ride out of the city.

As they soared high over the plaza-numbers of their neighbors, many of which were blacked out in the sign of mourning, Lanvia turned on their receiving set to hear the comments of the radio press. Wits of the city were still making great sport of Nephert Lak's heroics. "Save the dying old monster, he's Jehovah's anointed," or Keep the home-fires incinerating, Nephert," were the comments, bandied about in the mild sort of humor characteristic of the times. Lanvia turned off the speaker impatiently, while Nephert piloted the car at top speed and with a grim, set look on his face.

They passed the living center of the city in a few minutes, and into the deodorized departments of food production and manufacturing, all super-concentrated by technological advancement. Long, transport repulsion planes were docked here and there, to be used at intervals to freight to the city raw materials from various outlying portions of the planet. These areas were now practically uninhabited, although now and then a wild form of hybrid man was located and mercilessly shot down by atomizers to prevent mongrelization of the species.

The entire roster of racially blended inhabitants and citizens of the city-nation of Euramasia were rotated for the occasional unpleasant duties of manufacturing repairs and replacements needed for the atomic machinery, and artificially maturing meat stock, fruits, and vegetables for tasty nutrition. Man had remained a hedonist as regarded the actual indulgence of the senses, but with the perfect neuro-balance that prevented excesses and the diseases of excess.

As intelligence increased with the perfection of technological organization, voluntary caution as regarded progenitation had become international. Unhappy, imperfect children were a curse to themselves as well as civilization. "Let only the best be born" was the slogan of the eugenics-minded survivors of the ancient revolutions, following the fear of atomic war, which never had come because nations were too smart to risk mutual extermination. But ignorant revolutionists had not been so squeamish. Atomic explosions, induced by secret societies and anarchists, had laid waste millions of square miles of the fertile earth. Almost all of India had been left a charred, radioactive desert. All of Central Africa had suffered from chain-reaction fission. Some of the largest cities on the face of the planet had been blown to atoms in catastrophes more violent than Krakatoa, all caused by revolutionists, the mad orgy of the self-destructive mind, the same mind that had been behind the years of the guillotine in Madame Roland's France. Yet the last revolution had surpassed all revolutions in violence and world-wide scope, with whole cities and even nations beheaded at one earth-shaking stroke of chain-reaction destruction, far mightier than ever had been dreamed at Bikini Atoll or Hiroshima or the proving grounds of Nevada.

Nephert and Lanvia looked down from their view-panels upon the lush jungles of the Sonora Desert, once a part of Arizona. This semi-arid land had been reclaimed by the great Colorado River project of the year 2000. All the West Coast had been laid waste by secret society bombing, but this interior desert had remained untouched. With a little encouragement from agronomists, an artificial jungle had been created, yet properly drained and with wild life controlled by periodic patrols.

Euramasia was built by the combined races of man after a world meeting and the abandonment of all the areas of ancient civilization, most of which were dangerously radioactive. Only a few million people remained at the time. Only a few of these survived to progenitate the super-blend of the best of all the colors and ancestries of man. Gradually, so careful was the balancing of births to food supply, and so voluntary the common concentration on the perfect baby, the population became choice individuals, kings and gods by right of individual merit.

"What does that mean to you?" Nephert asked Lanvia, as he watched the green and scarlet masses drifting past below, between the convolutions of the canals and locked lakes.

She looked down a moment and her handclasp tightened on his arm. Finally she spoke in a low, tense voice, her eyes fired with imagination, "It means fear of the dark. Hunger—times when the fruit and nuts were green and the roots poisonous and the berries eaten by worms. It means fang and claw and snake bite. It means the terror of thunder crashing, and lightning setting the jungle on fire. It—it—"

"Go on," he said hoarsely. "Go on, I'm listening."

He dipped the repulser car lower, until the oozy odors of the wet jungle floated up to them and were sucked in by the air ducts of the car.

She turned and buried her head in his breast. "It means love," she said in a smothered voice. "Wild, sweet, mad love such as mankind no longer knows. The kind of love we dream of, Nephert." She jerked away from him and looked down. An elephant, brought from the Congo, blew a tower of spray from his trunk as he bathed at the edge of a lake. The spray glittered in a rainbow prism under the rays of the afternoon sun.

"You *are* dreaming," he said, in a low, husky voice.

She buried her face in his shoulder again, as if to hide her eyes from the vision in her acute imagination.

They peered down again into the wild, strange land. A long, slick tiger moved across a small clearing, crouching slightly as he walked.

The repulser car soon exceeded the outer fringes of the two-hundred-mile stretch of jungle. Red and adobe brown, the parched hills and canyons of the desert flashed beneath them. Torrid air swept into the car vents. They smelled the acrid stench of the creosote bush.

Nephert dialed the repulser car around in a swift circle that brought them back into the cool breeze of the high jungle area. His face was flushed, his eyes feverish. They said nothing until they could again see the banking terraces of the watered tract. A condor circled them, and they played tag with the monster bird. Lanvia had a short but effective detonator ready in case the bird got too familiar. Presently, they flew on again, leaving their puzzled playmate behind.

"And to think we're dreaming of that," Nephert exploded spontaneously, "with everything that we know."

"It's *struggle* that we have lost. Struggle is like a cord for a vine to climb on. Without struggle life becomes flat. No thrill of transition when we have everything. Only the firsts of psychic youth. After we repeat a while, we are old, no matter how healthy we are, and no person young in years can master the science we must know today just to operate our nutrition plants."

Nephert turned on the radio and dialed the Vital Statistics Bureau. Twilight was creeping around them. Over the eastern sky, the atomic glow of the city arched like motionless northern lights.

"How many suicides today?" he asked the robot.

"Eighty-nine thousand, seven hundred and nine . . ."

"Repeat that!" Nephert commanded sharply as he met Lanvia's startled eyes.

Sonorously clear, the robot repeated, "eighty-nine thousand, seven hundred and nine—ten—another just flashed in . . . presumed cause of sudden increase, depression after fiasco of Committee conference. . . ."

"Eighty-nine thousand—my God!"

The repulser reeled to his fumbling clutch on the controls, and Lanvia caught at his hand to steady him.

"What do you expect?" She was the cooler of the

two. "Didn't we admit that it was an inevitable disease?"

His hand steadied on the controls. The repulser car soared as he accelerated straight toward the city.

"We must do *something*, Lanvia, and do it immediately."

"You mean, save the people?"

"I mean save ourselves—our children—and those few people who want to live. Suicides are too sick to live. I have emergency authority as Chairman of the Committee," he now talked half to himself. "Especially under the circumstances—I can commandeer a freighter from the docks of the nutrition plant. I'll load it with medical robots—everything necessary for our health, comfort and life for years to come."

"Why leave the city?" Still her voice was cold and steady, as if she had passed beyond emotion through this crisis. "We could live here for a century even with no further knowledge than we have now. A few machines might break down, but we could repair them with research."

"Live in this city until we succumb to the psychic plague of race suicide?" he said as the unearthly light of the apartment banks and spires rose on the horizon in the evening dusk. "I have other plans."

THEY DROVE SILENTLY toward the city lights, aware of a few repulser cars aloft, a bare few, for at that hour joy-rides over the canals and lock-lakes were common. As they neared the apartment banks, where the plaza numbers glowed brightly for home-comer's guidance, artfully placed so as not to interfere with one another's sky view, Nephert cried out suddenly:

"Look at that!" At the same instant he braked the car and slowed it to a stop in mid-air. The repulser continued drumming steadily.

Lanvia caught her breath as she clutched his arm. Bank after bank of apartment lights were going out as they watched. Patches and tiers—or singly, here and there, like the winking out of stars. Atomic-powered light was practically costless. There was only one reason why a Euramasian would put out his lights. *The last of his house had chosen death.*

"We'll soon be the only ones left," Nephert spoke in a voice of steeled will, as he pressed on the accelerator, darting toward their number series to their own apartment. As they climbed out of the car in the light of the plaza tubes, Lanvia called to him:

"What are you going to do?"

"First, I shall call a meeting of the Committee, if there are any of the members left. It won't do any good, but it's my duty. Next, I'll start to equip the freighter at the nutrition plant." He turned to her suddenly and gripped her shoulders. "Don't ask questions, do as I tell you."

"Yes," she said, surprised.

"All right. I want you to write down everything we'll need for having and raising children. We must take the essentials with us in the freighter. The suicides will not take the trouble of crawling into their own incinerators, and in a few days this place will stink like a charnel house. There won't be enough people left to send robots for the dead. You and I must be absolutely heartless, as behooves sophisticated people regarding suicides." He kissed her brutally. "Remember the jungle!"

She smiled, slightly. "But stop kissing me like a bull ape. I'm not yet acclimated to anything that torrid."

He swept her along with him into the house, where the soft white glow of the atomic lights perpetuated the light of day. Teggart Lee was dead, the radiophone reported. Martia La Vere, dead. Burg Tun answered languidly, "I think a conference is futile, Nephert. There's nothing we can do but ride with the tide. Who wants to be on a Committee at a time like this?"

"You mean you will follow these insane faddists?" Nephert watched Burg Tun's expression on the television view.

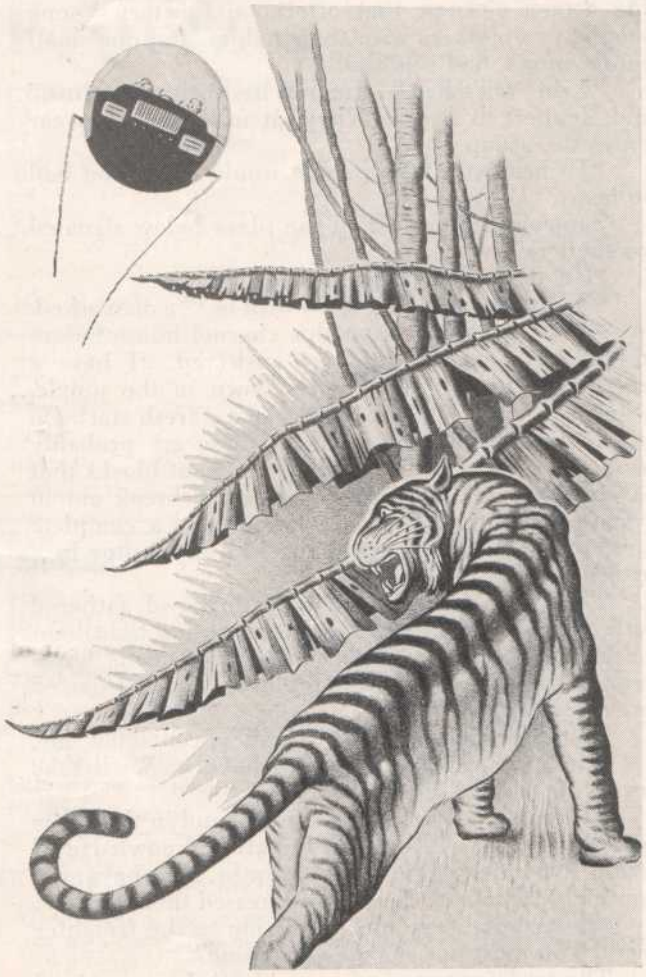
"I suppose so. I thought about it all day, and I can see no reason why mankind should not perish. Do you realize how many of our friends are already dead?"

Nephert's voice broke and he breathed a shuddering sob. "I know. I'm trying to steel myself, trying to be hard. The fools, the poor diseased idiots, why—"

"That's what they are calling you, *a poor, diseased idiot*," Burg Tun reminded him, pleasantly. "Now, please, Nephert, no adolescent emotions. If you want to be Moses (or is it Noah?), then, God bless you. Meanwhile, I think I'll prepare myself for a long, dreamless sleep—sweet, restful oblivion."

Nephert clicked off the connection with an exclamation of disgust that was half a sob of anguish. For the next hour he worked on departments by radiophone. The underground pressure tubes hummed with activity as the airtight capsules containing a wide variety of items shot toward a freighter berth on the outskirts of the city. As each capsule popped out of the vacuum delivery tube, it was picked up by a loading robot and tracked into the cavernous body of the repulser ship.

It was late that night before Lanvia's list received attention. Nephert had to make a few personal calls



"A . . . tiger moved across a . . . clearing . . ."

to various supply departments, and twice he flew to the freighter to disentangle the loading robots.

By morning the task was finished. He and Lanvia slept a few hours with the help of the psychometer. He then spoke to the city for fifteen minutes, pleading with the remaining people to save themselves while still there were enough beings to maintain culture. Response was slow but appreciative and tolerant. . . . "Vital technicians are already missing," one said. "The smartest ones go first. It's too late now. If the base power goes off, I doubt if anyone can start the motors. Correg Olds died last night. . . ." Another, "Why should we wait? We've done everything, seen everything; our relatives and friends are dead—it's our time, it's the greatest finish any species has ever seen. We've beaten nature! We chose our end like the lemmings who ran into the sea."

"But you're not lemmings, you're men!" he exhorted them.

He called personally on many of his friends and Lanvia's. Only a few remained. House after house was dark. Some lights had not been turned off, but the families lay in the last sleep on their airform davenports.

Nephert had hopes for the few remaining children. He called upon them to live on, to make a better, wiser world for themselves, to ignore the dread malady of boredom and fatalism that had afflicted their parents . . . "All young people who want to survive and build a new nation please report to me in the plaza of the Central Square. Your parents have no rights over your separate futures. I as the chairman of the Committee beseech you to report to me as directed."

By THREE O'CLOCK that afternoon fourteen young people, two mothers with their babies, and one small family intact, had reported.

"Cain won't have to marry his sister this time," said Nephert to Lanvia. They sat in the repulser car above the group.

"To hear you talk, people would think you had no heart," Lanvia said.

Someone from a car in the plaza below signaled for their receiver.

"Go ahead," Nephert directed.

"What are you going to do with us?" a man asked.

"Take you away from this charnel house before it begins to smell," Nephert answered. "I have a freighter outfitted. We'll settle down in the jungle, near one of the lock-lakes, and make a fresh start. Do you realize that at this moment there are probably two million dead bodies in the apartment blocks that haven't been incinerated? Disease may break out in a matter of hours. We can't function as a complete unit; our technicians are dying like mosquitos in a frost."

The man below spoke to the little crowd, gathered with a woe-begone air of displacement in a tight knot for mutual comfort. Some shook their heads hopelessly. Several entered their repulser cars and darted away.

"Why are you leaving?" Nephert contacted one.

"No jungle for us. You can have it. We'll take ours with the rest."

The one family remained, a husband in the lower brackets of age, with but an imperfect knowledge of fission dynamics. Nine of the youths, five boys and four girls, remained. Nephert addressed them hastily:

"Enter your cars and follow me to the freighter berth. You must not change your minds."

The transfer was made quickly. A few remained to give moral support to any new arrivals who might decide in favor of the new start. By twilight the last of them had been transferred to the freighter. Nephert and Lanvia made them as comfortable as possible. A few wept. Most maintained a Spartan calm. Three changed their minds and went back to the psychometers for the everlasting dream-sleep.

At nine o'clock Nephert's preparations were complete, and at intervals of twenty minutes he broadcast to the city, seeking more volunteers for evacuation. Two more came—and three more left never to return.

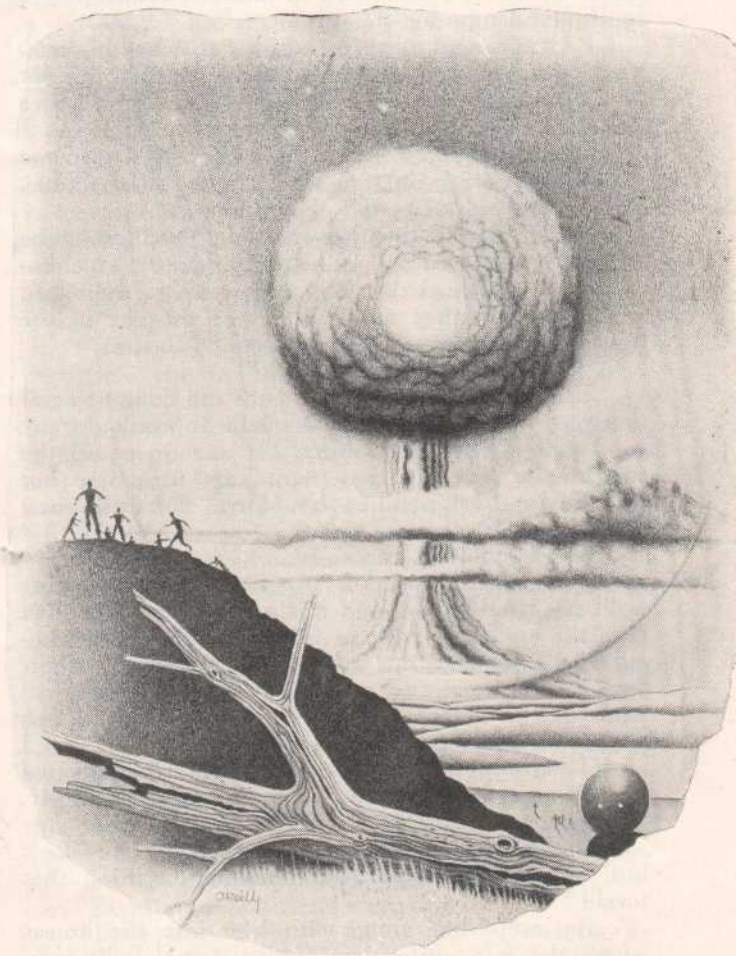
By midnight there was scarcely any response to his broadcast. "We are leaving one hour after the last living response from Euramasia. Report to Berth 906 immediately, or forever hold your peace in this doomed city. Without the equipment I have, not one of you could live a week in the jungle. You can't escape in a repulser car or man a freighter at the last minute. It takes planning and I've done the planning."

At two in the morning all response ceased. Climbing to a high altitude in the repulser car, Nephert looked for lights. Very few residence lights still were on. Deep in the heart of the city the glow of the great energizing unit warmed the sky. He descended to one or two lighted plazas. The occupants were all dead. At three he closed the hatches over the precious cargo of the freighter. He pressed his fingertip on the instrument board. The repulser unit hummed, then lifted them into the mystery of the starry sky.

"Where are we going?" Lanvia asked in a low voice.

"I don't know, but don't tell anyone. I couldn't think of that till now. Does it matter where? We have everything with us that we need."

Tears streamed unashamed down his cheeks, as



"Someone cried out from the hill above, 'Look?'"

of a dying monster. Lanvia was crying, too, but she stifled her sobs as she saw that two of the girls needed comforting.

One of them jumped up as Lanvia approached along the narrow passage between the berths and the store-rooms. "Let me jump; I want to die!" she cried.

A boy ran after her. "If she goes, I go, too. She's why I came. I'd have died with my parents, if it hadn't been for Tania."

The girl relaxed against him, subsided to the comforting of his arms. "I'll stay, I'll stay," she murmured as Lanvia helped her to a seat, the boy dropping on a chair beside her.

In the gray gleam of the dawn Nephert landed in a cleft just above one of the larger artificial lakes. They were a hundred miles or more from Euramasia. He still called to the city at frequent intervals, hoping for some response. But the radio receiver was as dead as the totality of mankind who had remained to die by their own hands.

"We'll stay here a while," Nephert addressed his wan-faced passengers. "We must try to get used to it. For a million years or so, your ancestors knew nothing better than this. Quite frequently, a lot worse."

They climbed out of the ship without much urging and looked around. All of them mourned for loved ones, with their customary hyper-refinement of emotion.

When they were all out, Nephert turned to Lanvia. His face was white, his eyes abnormally bright. "Now I shall tell you a little secret. I haven't told you, because I didn't want anyone, not even you, to know."

He could see her stiffen, raising her proud head. Never had he seen a woman so beautiful, so strong. The mating cards hadn't failed in this choice for him.

"Our freighter is equipped with remote control, synchronized with detonators in the base energy unit of Euramasia." He drew Lanvia back into the cabin, out of hearing from the rest, who were scattering along a little hill overlooking the lake. "When I dial the right calibration on this control unit, the greatest city in the history of the planet will explode in a cloud of mushrooming smoke and flame. Chain reaction of stored plutonium."

Tiny beads of perspiration glistened on his forehead. "You must decide. Shall your children and mine know the past? Or shall we return to hardship and struggle, to make life worth living?" He gestured towards the cabin window. "What our people here remember will be only a pipe dream even before our supplies are gone."

Her eyes sought his with flaming intensity. For an instant they looked deeply into the mysteries of their mutual being. Then she said in throaty exaltation, "Send our past to hell where it belongs!"

His hand slipped to hers. He put her fingers with his on the dial, and together they turned the knob.

The earth shook. A great blast of wind swept over them. Someone cried out from the hill above, "Look! It's the cloud of an atomic explosion, right over the city!"

Nephert and Lanvia were in each other's arms. They saw nothing, heard nothing. Tomorrow the tiger might spring, but today the enchantment of replenishing the earth drew a veil of delight over the stark past. +

SCIENCE QUIZ

Test your scientific knowledge with this questionnaire. The answers are in the fiction stories on the pages listed.

STRANGER THAN SCIENCE-FICTION

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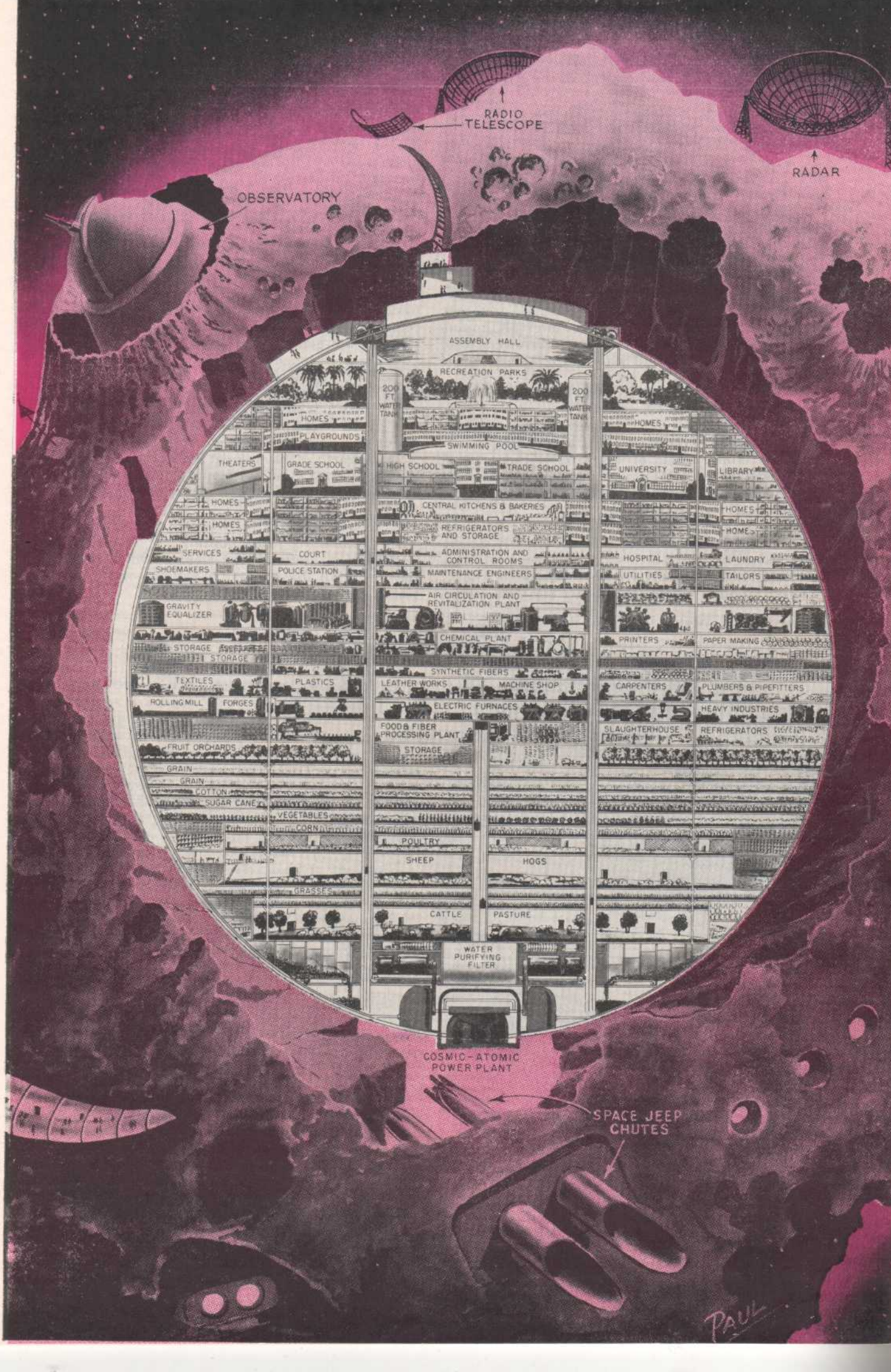
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WATER PURIFYING FILTER
COSMIC-ATOMIC POWER PLANT
SPACE JEEP CHUTES
PAUL

INTERSTELLAR FLIGHT

By LESLIE R. SHEPHERD, Ph.D.

(Illustrations by Frank R. Paul)

After man has explored the solar system, he will not be content until he has reached the stars. Time and distance conspire to thwart all but Methuselahs. Science-fiction has investigated various means of bridging the gap to the stars. Here Leslie R. Shepherd, Ph.D., scientific advisor to **The British Interplanetary Society,** ***examines two of the most dramatic possibilities: first, of sending colonists on a 1,000-year voyage—a voyage whose end would be seen only by generations yet unborn; second, the utilization of the*** **time-dilatation** ***effect, where, at speeds near that of light, time would pass more slowly for the space voyager than for people back on earth. Dr. Shepherd supports his arguments with solid science and accepted theory. This is a revised and modified version of an article that appeared in*** **The Journal of the British Interplanetary Society.**

Leslie R. Shepherd, Ph.D. Dr. Shepherd is the Technical Director of The British Interplanetary Society and an outstanding British authority on space travel.

Introduction

SOMETIME IN THE near future, perhaps before the turn of the century, man will take his first step into space. He will do so in all probability without being unduly concerned about the chain of events which he will be setting into motion. The significance of the act may not have escaped him entirely, but he is not likely to be influenced by considerations of the ultimate importance of interplanetary travel upon human affairs. Scientific curiosity and the love of adventure for its own sake will be sufficient motives for the first exploratory voyages.

Nevertheless there must be many apostles of space flight to whom these two motives are only a small proportion of the whole purpose. There must be many who cannot derive complete spiritual satisfaction from the picture of mankind spending its whole existence in one single infinitesimal planet with no contact with other species who may people countless other worlds of the universe. Many who hold to a more materialistic outlook may see in man's confinement to a single planet a factor reducing his probability of survival. Humanity dispersed over many worlds would appear more secure than humanity crowded on one single planet.

We are going to examine the possibilities of interstellar flight mainly from the latter viewpoint, viz., the possibilities of the human race establishing colonies in other stellar systems, always assuming that there are worlds suitable for mankind to be found in such systems. We are concerned with the problem of getting small colonies across the almost endless interstellar gulfs, safely, but ultimately, no matter how or in what time. It is not necessarily a question of getting an individual from one stellar system to another, but rather a question of getting an adequate *community* to another system. It is important to stress this point because this profoundly affects our interpretation of what is possible and what is impossible. For if we interpret the problem of instellar flight as the problem of transporting a man from one system to another during his lifetime, then it is a much more difficult problem.

The problem of interstellar flight is one of vast distances and interminable transits which may demand a completely new philosophy of exploration. If we accept the more general interpretation of interstellar travel then the *explorer or colonist setting out for some distant system may do so in the knowledge, not only that he will never again see his native planet, but that he will not even see the planet of his destination*—a privilege reserved for his descendants. Thus the philosophy of the explorer may be that of the soldier or airman setting out on a suicide raid, doing so in the knowledge that for him there can be no personal gain, only the dying knowledge that some will survive to benefit from his action. Indeed, interstellar colonization may call for *the sacrifice of whole generations* in the lonely reaches of space. Colonies once established may have to exist for generations in a state of complete isolation, and such communication as may exist between systems may be a very tenuous and precarious matter.

Thus interstellar exploration and colonization may be vastly different from the exploration and colonization of our own world or even of our own system. It may require a revolution in our way of life not only socially but biologically if we are ever to become a galactic people.

Distance, Time, and Energy

We have already indicated that the dominating factor of interstellar flight is distance, vast unimaginable distance. When we discuss the achievement of space flight, of journeys to the Moon and our solar neighbours, we talk of velocities of the order of 6 miles per second. Such velocities are insignificant on the interstellar scale of magnitudes. A vehicle leaving our system for the binary Alpha-Centauri (at 4.3 light years distance,* our second nearest neighbor), would take about 130,000 years to reach that destination if it travelled at such a low velocity as 6 miles per second. Thus the statement that vehicles capable of achieving interplanetary flight could also fly to other stars, while it may be true, is nevertheless completely academic.

It is probably true to say that interstellar flight will be considered possible when transit times of 100 to 1,000 years can be realized, and not before then. In the case of a flight to Alpha-Centauri or other neighboring stars this involves mean velocities up to 6,000 miles per second. Let us see what such velocities imply in terms of known energy sources.

A rocket is propelled forward by the ejection from its rear of a stream of matter moving at a high velocity. The velocity attained by the rocket is proportional to the velocity of this stream or jet (the so-called exhaust velocity) and also depends upon the amount of matter ejected. A high exhaust velocity pays off a considerable bonus in rocket performance.

In the present-day chemical rocket, the exhaust velocity is determined by the available chemical energy of the propellants and the efficiency of the motor in converting this chemical energy into kinetic energy (the word "kinetic" means "matter in motion") of the gases ejected from the nozzle. The most favorable estimate of the exhaust velocity attainable with known chemical propellants, is about 2.5 miles per second.

Many nuclear reactions are millions of times more energetic than the most powerful chemical reactions. If nuclear fuels were employed in a manner analogous to chemical rocket propellants, i.e. if the energy of the nuclear reaction were concen-

* A "light year" is the distance light travels at 186,000 miles per second in one year's time.

◀— CROSS-SECTION THOUSAND-YEAR SPACE ARK

trated entirely in the reaction products, then the exhaust velocities attained would be a thousand times, or more, greater than those attainable with chemical propellants.

It can be shown that so long as the mass of nuclear fuel carried by the rocket is less than four times the empty weight of the rocket, it would be better to dilute this fuel to such a degree that the mass ratio (the relationship of the mass of the fuel to the mass of the empty rocket) is made equal to 5. This procedure leads to the maximum rocket performance with the minimum fuel consumption.

Suppose that it was required to make a one-way transit to Alpha-Centauri—which is the nearest fixed star at about four light years distance—taking 250 years and using a fissionable material as our nuclear fuel. To do this in the most economical manner, we would need a mass of nuclear fuel equal to 2.4 times the mass of the empty rocket and sufficient inert propellant material to raise the mass ratio to the most efficient value. Under these conditions the exhaust velocity would be 3,780 miles per second and the rocket would be capable of accelerating to 6,000 miles per second, or alternatively (as would be required in this case) accelerating to 3,000 miles per second and braking down again to zero velocity. If it were possible to employ the lithium-hydrogen reaction, the same ratio of masses would lead to a transit time of 140 years in the voyage to Alpha-Centauri.

Since this necessitates a prodigious expenditure of what, in the fission case at least, would be valuable material, it is of interest to note that the exhaust velocity varies only as the square root of the proportion of nuclear fuel. In other words if a tenfold increase in transit time could be accepted, a hundredfold reduction in the proportion of nuclear fuel would be possible.

BEFORE PROCEEDING FURTHER, it is worth pausing to consider the nature of the propulsion unit which would raise the interstellar vehicle to the considerable velocities which we have been contemplating. Referring again to the example of a rocket going to Alpha-Centauri in 250 years transit time, we note that at the expense of increasing this to 350 years we could spend a 100 years in accelerating and decelerating. This corresponds to an acceleration of 60 miles per second for one year or about one three-thousandth of the acceleration due to gravity at the earth's surface. The useful power output of the propulsion system is proportional to this acceleration and also to the exhaust velocity (3,780 miles per second). In this example the power output would have to be 10 megawatts (the prefix "mega" represents one million) per ton of rocket (specific exhaust power); in other words, if the rocket weighed 10,000 tons, the power output would be 100,000 megawatts.

This represents a very severe power requirement and is certainly not one which could be met by present-day engineering technology. It is difficult to visualize engines running at such a high power level for 50 years continuously. However, it is to be expected that interplanetary flight techniques will have reached a very advanced state before man will be ready to embark upon deeper space flight, and low thrust/high exhaust velocity vehicles may have had several hundred years of development before called upon to play this exacting role.

The Ion-Rocket Principle

In all probability the vehicle which will carry our descendants on their first mission to the stars will use the *ion-rocket principle*, unless, of course, some entirely new method of propulsion is forthcoming by that time. In the ion rocket, the high-velocity exhaust jet is produced by accelerating electrically charged atoms (ions) in an electric field.

High velocities are attainable with accelerating voltages that are not outside the range commonly encountered today. Thus a velocity of 3,780 miles per second could be obtained with singly charged carbon atoms by means of an accelerating potential of 2,500,000 volts.

It is quite possible, in view of the high specific exhaust power required, that a great deal of the inert propellant carried by the interstellar vehicle would consist of power plant and propulsion unit replacements. From time to time during the acceleration program, the old worn-out (and probably burned-out) plant could be stripped out and consigned to the ion sources. As the voyage neared its termination and the all-up mass was reduced, the number of propulsion units might be reduced by a similar process. In this way nearly all of the initial dead weight of the vehicle would serve some useful purpose in addition to its use as propellant.

The facts show that flight to the nearest stars appears to be possible in principle provided we are willing to accept transit times greater than 100 years, and possibly 1,000 years.

AT FIRST SIGHT the idea of advancing mankind's frontiers to points requiring hundreds or even thousands of years to reach, might seem hopeless. It cannot indeed be regarded as a particularly satisfactory picture of interstellar exploration. However, regarded in terms of geological eras, centuries or millennia are small intervals, and provided that human life can be sustained in exploring vehicles for long periods, there is no reason why interstellar expansion should not proceed on this basis.

An important factor in determining whether this state of affairs was adequate would be the frequency of occurrence of planets suitable for human habitation. Many theories of planetary origin suggest that only a comparatively infinitesimal proportion of the stars are blessed with planets. This being the case we might have to go much further afield than Alpha-Centauri to find alternative accommodation for mankind. However, no theory of the formation of planets, so far advanced, can be regarded as satisfactory and for all we know planets may be the rule rather than the exception.

Recent observations on the binary stars 61 Cygni (10.7 light years) and 70 Ophiuchi (12 light years) have indicated that nonluminous bodies of almost planetary dimensions are associated with both systems. If indeed two such close stars have planets it might well indicate that planetary systems are by no means rare phenomena and among the score or so stars which lie within about a dozen light years of our own Sun there may be many planets. One thing is certain, namely that an expensive expedition taking a small community on a thousand-year voyage to another star, would not start unless it was certain that the star possessed planets of more or less terrestrial characteristics. Thus the era of astral exploration must be preceded by a period of observational astronomy the like of which we could not contemplate today.

Instruments of performance vastly superior to those known at present would be required to survey the neighborhood of the nearest stars. The problem would be to resolve planetary images by perhaps no more than 0.5 second of arc, the planetary image having perhaps a strength of less than one billionth of the primary image. No telescope in existence today could give this performance or anything remotely approaching it, for although a moderate telescope of about 12 inches aperture could resolve two stars with this separation, the resolution of two fringe systems (the Airy Diffraction patterns, which represent the two images) when the central maximum of the one has an intensity of one billion times that of the other is quite a different matter.

However, the eventual construction of giant telescopes on the Moon or other comparatively airless bodies might make such observations possible. Even so, it might not prove possible to do any more than measure the orbits of planets detected in this manner, observe their spectra and obtain rough values of size on the basis of reflected light intensities. A more detailed survey might require an expedition to the system in question with provision for return unless the exploring party was provided with means of signalling its findings over the vast distance separating it from the home planets. This would be possible with existing radio techniques.

The 1,000-Year Voyage

The author is not competent to deal with the biological problems of life on an interstellar vehicle undertaking a voyage lasting for a millennium. Obviously they would assume a magnitude quite as great as the engineering problems involved. In the normal way, *some thirty generations would be born and would die upon the ship*. It would be as though the vessel had set out for its destination under the command of King Canute and arrived with President Truman in control. The original crew would be legendary figures in the minds of those who finally came to the new world. *Between them would lie the drama of perhaps ten thousand souls who had been born and had lived and died in an alien world without knowing a natural home.*

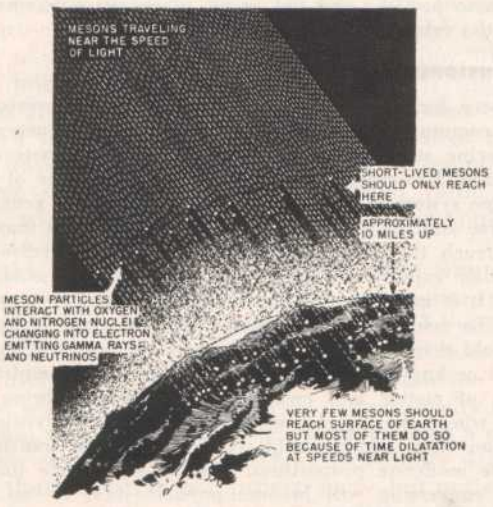
Perhaps this picture might change as a result of advances in medical science which are not yet visualized. It would be idle for a physicist to speculate upon possibilities which might

exist in this field and it is no purpose of mine to do so.

It is obvious that a vehicle carrying a colony of men to a new system should be a veritable Noah's Ark. Many other creatures beside man might be needed to colonize the other world. Similarly, a wide range of flora would need to be carried. A very careful control of population would be required, particularly in view of the large number of generations involved. This would apply alike to humankind and all creatures transported. Life would go on in the vehicle in a closed cycle; it would be a completely self-contained world. For this and many other obvious reasons the vehicle would assume huge proportions; it would, in fact, be a very small planetoid, weighing perhaps a million tons excluding the dead weight of propellants and fuel. Even this would be pitifully small, but clever design might make it a sufficiently varied world to make living bearable.

The passage of perhaps thirty generations would pose major problems of a sociological nature. The control of population would be only one of many. Children could only be born according to some prearranged plan, since overpopulation or underpopulation would be disastrous. The community would be subjected to a degree of discipline not maintained in any existing community. This isolated group would need to preserve its civilization, and hand on precious knowledge and culture from generation to generation and even add to the store of science and art, since stagnation would probably be the first step to degradation.

On the technical side one would list the conservation of habitability as one of the major undertakings. Maintaining a reasonable atmosphere over the long period of space flight would be no small matter. Loss of air from the vehicle, and of other volatile materials for that matter, could be very serious when integrated over a thousand years. A hundred milligrams of air leaking out of a million-ton vessel in one second sounds insignificant, but in 1,000 years it would amount to a loss of 3,000 tons of material. Artificial gravity would need to be provided by rotation, and one might visualize the vessel as a huge oblate spheroid. The list of problems could be increased endlessly, but they would all add up to the fact that an interstellar expedition under such circumstances would be formidable.



Flight at Near-Optic Velocity

Thus far we have confined our attention to a conception of interstellar flight based upon known principles, although involving considerable extrapolation from present technical capabilities. This has been characterized by a picture of voyages taking centuries or millennia to complete, entailing a strangely planetless existence for the travellers. This is not the notion of interstellar travel envisaged by many people to whom even the speed of light would be an irksome crawl. Since we are in no position to judge what sources of energy will be exploited in the remote future it is essential that we should investigate some of the features of flight at velocities approaching that of light itself.

It is an observed fact in our physical world that the speed of light in empty space is a constant and that no change in the motion of the Earth relative to other heavenly bodies results in any measurable change in this velocity. This fact led Lorentz, Fitzgerald, and others to formulate new equations of motion, kindred to the theory of relativity by Einstein.

A consequence of these relativistic laws of dynamics which is usually regarded as setting a limitation upon flight to the stars is the limiting nature of the velocity of light. *According to these laws a material body can never attain the velocity of light.* The simple rules which govern the addition of velocities in the old Newtonian dynamics do not apply to very high velocities. To illustrate this let us consider a vehicle moving at a velocity of 0.9 c. It is convenient to measure very high velocities in terms of the velocity of light using c. as the symbol for velocity of light; *thus 0.9 c. means nine-tenths of the velocity of light*). This velocity of 0.9 c. is the value measured by some observer at rest (with respect to the surrounding stars) who is watching the vehicle. Suppose that there is a super-gun on the vehicle capable of projecting a missile with a muzzle velocity of 0.1 c. If this gun is fired in the *forward* direction of the vehicle's motion, then according to the old Newtonian dynamics the observer should find that missile is moving with the velocity of light. But, according to the Einstein theory of relativity the observer will find that the velocity of the missile is 0.918 c.

Two further interesting facts are apparent from the relativistic theory. The first is, that an observer watching a vehicle which is moving relative to himself will find that the length of the vehicle appears to be reduced along the direction of motion. *This effect is known as the Fitzgerald-contraction.*

The second effect of importance is the *time-dilatation.* According to the theory of special relativity, the clocks on the moving vehicle will appear to the observer to be running slow. That is, the frequency of events which occur on the vehicle will appear to him to be reduced. In fact, the frequency of events appears to be reduced in exactly the same proportion as the length of the vehicle appears to be reduced in the direction of motion. We shall call this reduction the y-ratio.

Thus an observer, watching a vehicle moving relative to himself at the velocity 0.990 c., will find that its length along the direction of motion appears to be only 0.142 of its length when at rest with respect to him, and the frequency of events which occur on the vehicle will appear to be only 0.142 or one-seventh of their normal rate.

The time-dilatation effect has been checked experimentally by observations of electrically charged particles called mesons passing through the Earth's atmosphere. These particles interact with the oxygen and nitrogen nuclei after entering the Earth's atmosphere and undergo a change, which resolves them into an electron emitting gamma rays and neutrinos. The height at which this change is made is known, as is the life of the meson. According to these factors and despite the fact that they may be traveling at the speed of light, only an immeasurably few mesons should ever reach the surface of the earth. *In point of fact, a large proportion do reach the surface, a fact which can be explained only on the basis of the time-dilatation effect.*

The slowing down of the tempo of events upon the moving vehicle relative to the tempo of the same events for the observer at rest, has an important bearing upon interstellar flight. If X is a traveler on an interstellar rocket which leaves the earth at near-optic velocity and returns with the same speed, then the time which he records for the voyage does not agree with that of an observer whom we shall call Y, and who remains on the home planet.

To take an example, suppose X goes from our system to Procyon (10.4 light years) and back with a velocity 0.990 c. The result is that, while the observer Y records X's return 21 years later, X is aware only of a passage of *3 years.* Indeed if X could get close enough to the speed of light he could circumnavigate the universe in his life-time, though he would find on returning that perhaps 10 billion years had elapsed and the solar system and stars that he knew had changed beyond recognition. This would in fact be one-way time travel.

CLEARLY, the attainment of velocities close to that of light would make interstellar travel a much more promising proposition than would the speeds which we have considered in the first part of this discussion. It would become possible for a man to leave his native system, journey to a star—even fairly distant ones would be within reach—and return within a few years *of his time.* The only shortcoming would be the fact that a long time would actually have elapsed *at home* during

his seemingly short voyage, and friends whom he left in the bloom of their youth would be found in their dotage. It is possible that human society, with the help of medical science, could adapt itself to such a state of affairs, but it is no purpose of mine to speculate on such matters here.

The first requirement of a vehicle designed to reach velocities close to that of light would be a source of energy far more potent than anything known today. The best that we could imagine in terms of our present-day knowledge would be the *wholesale conversion of mass into energy*. In modern nuclear and cosmic ray physics we know of a small number of processes whereby particles are completely converted into radiation, the oldest known process being the mutual annihilation of the electron and positron, with the complete conversion of their mass into electromagnetic energy in the form of two equally energetic photons. It is not known whether nucleons (i.e., protons and neutrons) can undergo similar processes; searches for the negative proton have so far proved fruitless. However, it is possible that such a particle can exist, if only for a short time, in which case the complete conversion of nuclear matter into energy is possible at least in principle. It would be quite pointless to speculate upon the possibilities of releasing energy in useful amounts by annihilation, since there is no process known to us today which might produce such an effect. However, it is interesting to investigate the behavior of a rocket making use of such powerful energy sources. In a conventional rocket, decrease of mass occurs by virtue of the fact that matter is ejected in the exhaust jet. On the other hand, in the super-rocket utilizing the wholesale conversion of matter into energy, mass is lost both through the expulsion of material in the jet and also the disappearance of matter which is converted into energy. If the full cycle of energy conversion is 100% efficient, however, it can be shown that the rocket behaves as though all the matter is expelled in the jet.

A case of particular interest is a rocket propelled by photons, i.e. by electromagnetic radiation. In such a rocket the available matter would be converted into radiation, which would then be directed into a beam leaving the tail of the rocket. This would be, in fact, a propulsive jet with an exhaust velocity c. The energy conversion would be 100% efficient, if all the radiation was beamed in the same direction.

A comparison of the classical and relativistic equations of motion shows that, while the latter places restrictions upon interstellar flight from the point of view of the stationary observer, it actually favors the traveler because of the time-dilatation effect. To illustrate this, let us consider a rocket with a mass ratio of 7.4, 100% efficient energy conversion, and a photon drive with exhaust velocity c. According to classic theory, such a rocket could attain a velocity 2c., or alternatively accelerate up to a velocity c. and then retard to zero. Thus on the classical theory, neglecting periods of acceleration and retardation, a rocket would reach Alpha-Centauri in 4.3 years.

In the relativistic theory, however, the actual velocity reached by the rocket will be 0.76 c., whence in the rest system the transit time would be 5.64 years. On the other hand the transit time in the traveler's frame of reference is only 3.67 years. Thus when we speak of the principles of relativistic mechanics being a barrier to interstellar flight, we are not being strictly correct. The most serious factor restricting journeys to the stars, indeed, is not likely to be the limitation on velocity but rather limitation on acceleration.

It is clear, therefore, that the limiting nature of the velocity of light is not necessarily the most serious barrier in the attainment of interstellar flight. In fact in most respects it is no barrier at all. The real difficulty, always assuming that we can find suitable energy sources for the job, lies in the unfavorable ratio of power dissipation to acceleration as soon as we become involved with high relative velocities. The problem is fundamental to any form of propulsion which involves nonconservative forces (e.g., the thrust of a rocket jet) to produce the necessary acceleration. The only method of acceleration conceivable that would not be subject to this difficulty would be that caused by an external field of force.

It might be argued of course that emitters at a temperature of 100,000° Kelvin are not fundamentally impossible and that such temperatures are not even outside the range of our experiences today. However, the fact is that the utilization of radiators at this temperature is quite inconceivable in terms of existing techniques and we are therefore in no position to speculate profitably.

The Effect of Interstellar Matter

As soon as we consider motion through space at velocities comparable to that of light, we can no longer regard interstellar space as a complete vacuum. Interstellar matter is known to exist with an average density equivalent to about 1 hydrogen atom per cm^3, though with variations of up to 1,000 between regions of lowest and highest densities. This matter occurs in two forms, (*a*) the interstellar gas, and (*b*) interstellar dust, it being probable that the latter accounts for approximately 1% of the total interstellar matter which consists mainly of gaseous hydrogen and helium.

M. W. Ovenden has examined the possibilities of collisions between an interstellar vehicle and the dust particles. He has found, on the basis of the available evidence, that the probability of collision is so low as to be no risk at all. We shall confine our attention to encounters between the vehicle and the interstellar gas.

At a speed of 8,400 miles per second a proton striking the vehicle would penetrate only a few microns into the hull of a ship. A small amount of radioactivity would be produced as a result of nuclear disintegrations caused by the bombardment, but this would be of no consequence. We see that a hull 1 cm thick of some material such as aluminum would be effective protection even at velocities up to 60,000 miles per second.

The problem becomes serious at velocities of 120,000 miles per second or more, when the oncoming particles represent a flux of "cosmic radiation" of great intensity. It would prove necessary to dispose a considerable mass of material in front of the living quarters of any vehicle traveling at near-optic velocities. This material could of course be used up in the closing stages of the retardation program when the velocity had been reduced to a safe level.

It is evident from the above considerations that the existence of interstellar matter could not be ignored in vehicles traveling near the speed of light. Precautions would have to be taken to ensure that the interstellar particles or any of the secondary radiations (mesons, etc.) produced by them could not penetrate to the living quarters, and that the heat produced from these particles did not result in excessive temperatures within the vehicle.

Conclusions

There does not appear to be any fundamental reason why human communities should not be transported to planets around neighboring stars, always assuming that such planets can be discovered. However, it may transpire that the time of transit from one system to another is so great that many generations must live and die in space, in order that a group may eventually reach the given destination. There is no reason why interstellar exploration should not proceed along such lines, though it is quite natural that we should hope for something better. To achieve a more satisfactory performance, however, we should need sources of energy far more powerful than any utilized or known today. Nothing less than the complete conversion of matter into energy would suffice to bring about speeds where the traveler could exploit the relativistic time-dilatation effect which would reduce interstellar transit times to quite moderate proportions. Even if we assume that such energy conversion will become possible it is by no means certain that we should be able to make effective use of it. A probable stumbling block in this direction is the extremely unfavorable ratio of power to acceleration which results from the use of exhaust velocities approaching the speed of light. It is quite impossible at the present time to come to any conclusion regarding the possibility of interstellar flight along these more ambitious lines.

The notion that the impossibility of velocities greater than c. places any serious restriction upon interstellar communication is based upon a rather narrow outlook. It is true that if we think in terms of interstellar vacations, business trips to Capella and interstellar warfare, a certain inconvenience would be encountered. But these are minor features, and taking the broad view of things, the fact that it may take many years to go from one system to another is no great restriction. Indeed, so far as the traveler is concerned the limiting nature of the speed of light is more than offset by the time-dilatation effect; *from his viewpoint the speed of light is infinite.* And, though man can never travel faster than light, his frontiers will be limitless if he can approach it ever closer. +

the radio brain

A Short-Short ✚

"A silicon crystal . . . lightly touched the tantalum plate."

by GUS N. HABERGOCK

(Illustration by Jay Landau)

When Technical Sergeant Ilya Personne was sitting in his radio truck, working the SCR-399 in the push around St. Lô during the spring of '44, there was an incredibly loud "boom"! nearby. He woke up in a base emergency hospital next morning with his head neatly bandaged. He was conscious of a sharp and searing headache. A shell splinter had sliced off an egg-shaped piece from the left side of his skull. At the base hospital to which he was flown, the surgeons closed the hole with a piece of tantalum metal, and, in due time, he was back in the U. S., recuperating. He wasn't much the worse for his experience since the brain itself was not affected, only the bony part of the cranium.

Discharged a year later, Personne went back to his radio business. One evening he and his buddy, Eddie Ryan, were talking shop. Ilya pointed to a passage in an old copy of *Radio-Electronics* magazine where curious broadcasting effects were described. It seems that in Boston, a block away from a radio broadcast transmitter, a cold-water faucet when turned on proceeded to give out music or speech. A few blocks away a housewife almost fainted when a frying pan on a gas stove emitted music and lectures that could be heard throughout the flat. Similar strange radio sounds have been reported in the press for years. The magazine explained that these unusual radio "receivers" work on the principle of imperfect contacts, similar to a crystal detector.

"All this may be true," mused Ilya, "but why can't we improve upon it? Why do we need vacuum tubes, condensers, and a whole box full of radio junk in building a 'modern' radio set? Ants and bees and other insects seem to be able to communicate at a distance without a bunch of radio gadgets—why can't we? What we need is something *simpler* than a radio set. Professor J. B. Rhine of Duke University demonstrated that telepathy is a proven fact—but not every subject is sensitive to telepathic impulses or waves, or whatever it is that makes it work. Rhine doesn't require any radio stuff either. Besides, I have a new approach to the problem.

"The metal plate in my skull, as you know, touches the outer layer of my brain. It is therefore an easy matter to *contact* my brain, in order to make a good direct connection with it. That ought to help in our preliminary experiments. Will you help me?"

Eddie would—and did. During the next few weeks they tried a number of things, but the most promising was a silicon crystal which lightly touched the tantalum plate of Ilya's cranium. With an aerial and ground connection, Ilya was certain that at times he heard music inside his head.

Ilya next tried other crystals, interconnected with a battery. Now he was certain that the music became audible, but it was still *very* faint.

The next night, alone in his radio den, he tried a new carborundum-germanium crystal combination and a 90-volt B-battery. Then he connected these to his brain plate. Ilya suddenly heard a loud burst of music. It filled his whole head with such resonance that it permeated his whole being.

There never was such entrancing music! No tinny loudspeaker sounds from a squeaky radio—this was *DIRECT* pure radio transmission to the brain. *Personalized* radio reception, without the interposition of a cumbersome radio receiver. *This was it.* He next took off the aerial and ground connection. Surprisingly, it made little difference—the sound was not quite as loud, but sufficient for excellent reception.

Then he had an inspiration: Why not try to tune in other stations? If the ants and bees can, why couldn't he? All he had to do was to vary the "capacity" of his brain—like one does with a radio condenser. He quickly found the solution. He "moved" his brain a bit by wriggling his ears—a trick he knew from childhood.

Astoundingly it worked! He then found he could tune in dozens of stations merely by frowning hard or moving his neck muscles. Coughing or deep breathing produced identical results. Enraptured he listened to a Toscanini jazz concert, then to a Boston symphony of 60 locomotive whistles interspersed with 25 transatlantic ocean ship horns in different pitches. Then came a political talk by Winston Churchill set to Gilbert and Sullivan music—surely an innovation. Tuning in WNBC, he listened thunderstruck to the President of the United States in an amazing rendition of "Hamlet." This was followed by a chorus of "Mammy" by the entire Congress—the Senators singing in a high key, the Representatives in a low bass.

Quickly turning to WJZ, he listened to a prizefight aria between Marciano and Jack Dempsey—the latter trying to regain the heavyweight title. They were both loudly singing the "Anvil Chorus" between blows—it seemed excellently timed too. Then Dempsey landed a terrific uppercut on Rocky's chin. It sounded like an anvil hit by a cannon ball. It was so loud that it jarred Ilya badly . . .

Mrs. Personne found Ilya unconscious on the floor. She called the doctor from next door.

"God!" Ilya exclaimed as he recovered his senses. "Have I got a headache! I must have fainted for a moment and during the blackout, certainly heard a lot of strange broadcasts."

"Small wonder", the doctor said, as he removed the wires. "You connected the 90-volt B-battery *directly* to your skull-plate!" ✚

science news shorts

astrophysics

Cosmic "Hisses"

WHAT causes a cosmic *hiss?* That is what scientists are trying to find out with the improved radio-telescope at Ohio State University. Hisses from stars may be heard on earth by a radio-telescope 160 feet long and 12 feet across. It is being constructed under the direction of Prof. John D. Kraus and will operate on the ultra-high-frequency of 250 megacycles. It will present an array of 48 helical-beam antennas mounted on a movable cradle. Various star clusters will be scanned with the new radio-telescope, and the results will be coordinated with the findings of regular optical telescopes trained on the same part of the heavens. At present over a hundred stars are known to hiss, i.e., to broadcast cosmic static, at the earth, but what the stars look like astronomers are not certain. Before long we may know more about these hissing stars.—*Chemistry.*

Cosmic Ray Research

COSMIC rays—about which we still know very little—have been recorded on sensitive instruments and photographic plates located in the noses of high-altitude rockets. Such rockets have been sent up to great heights in the far north. A group of scientists, sponsored by the Office of Naval Research and the Atomic Energy Commission, performed the research. The mysterious particles that continually bombard the earth from outer space collide with Geiger counters or ionization chambers mounted in the rocket war-heads. The rockets are lifted to a great height by skyhook balloons and then fired to an altitude of about 40 miles. Primary cosmic rays are the original nuclear particles from outer space. The majority of these particles collide with atmospheric elements, shatter the atoms and create *secondary* cosmic rays. These are the cosmic rays we frequently detect on the surface of the Earth.—*Science News Letter.*

astronomy

Technetium in Stars and Sun

THE first chemical element discovered through atomic bombardment—technetium (element 43) has been found in the spectra of red S-type stars and also in that of the sun. It is surprising to find such an unstable element as technetium, an explosion product of the atomic bomb, in the stars. Using the 100-inch telescope, Dr. Paul W. Merrill, of the Mt. Wilson and Palomar Observatories, found several technetium lines in the spectra of S-type stars. Dr. I. S. Bowen found similar lines in photos taken with the 200-inch telescope. Technetium lines in star spectra appear particularly strong in the case of certain variable stars, which take about a year to pass through the brightness increase and decrease cycle.—*Chemistry.*

Life on Other Worlds

ONE quadrillion worlds may originate and sustain life, according to an estimate made by Dr. Harold C. Urey, Nobel-prize winning atomic scientist of the Institute for Nuclear Studies of the University of Chicago. Dr. Urey emphasized that he was not claiming that even one out of every thousand bodies in space are inhabited or habitable. This leading scientist on the wonders of the universe expressed this view in a lecture before a joint meeting, in New York, of the American Society of European Chemists and Pharmacists, and the Rudolf Virchow Medical Society. Early in the two- or three-billion-year history of the earth there was no oxygen. The atmosphere surrounding the earth was mostly composed of hydrogen, methane, and ammonia. When the sun's powerful ultra-violet rays struck the atmosphere it changed the gaseous methane, ammonia, and water into more complex chemical compounds. Oxygen was liberated by the dissociation of water and began to accumulate in the atmosphere; the sea level therefore subsided, leaving a concentration of chemical "building blocks" in the oceans, including organic acids, aldehydes, etc. In remote ages, the Earth's oceans comprised a gigantic pool containing complex mixtures of the half-a-million chemical compounds modern chemists know today, and many more besides. Through chemical transformations, protein molecules possibly developed. Finally, the first bacterium evolved—the simplest forms of life. After a while the seas contained a concentration of various forms of bacteria—from which plant and animal life later evolved.—*The New York Times.*

atomics

Mesons, Key to Heart of Atom

THE forces that hold the nuclei or hearts of atoms together apparently are linked with the rôle played by the tiny particles of matter known as pi-mesons. The mesons are particles having masses intermediate between those of the electron and the proton. Mesons are unstable and they decay spontaneously, in a similar manner to radioactive atoms. These elementary particles, the pi-mesons, bear the same relation to nuclear forces as the photons (light particles) bear to the electronic and magnetic forces acting between charged particles. This was suggested by Prof. Bruno Rossi, noted cosmic-ray physicist of the Massachusetts Institute of Technology, in his book, *High-Energy Particles,* (Prentice Hall, New York, 1952.)—*Science News Letter.*

Atom-Smashers of Tomorrow

THE secret of tomorrow's atom-smashers (particle accelerators) will lie in intense focusing of high-speed atomic particles. Scientists at the Brookhaven National Laboratory, Upton, N. Y., have developed a new theory on how to build an accelerator which may deliver "atomic bullets" with energies of 100 billion electron volts, or more than 30 times greater than those produced by present-day accelerators. Possibly they will be built in underground tunnels. The focusing will be done with small magnet sections. After the proton beam has passed through 480 magnet sections (for a 100-billion-volt accelerator) a finely focused particle beam would result. A 30-billion volt machine would have much smaller magnets than the 3-billion-volt accelerator in current use. The space required for the "race-track" of the 30-billion-volt machine, however, would be 10 times that necessary for the 3-billion-volt cosmotron, 60 feet in diameter. A 100-billion-volt machine would require a diameter of 2,060 feet (nearly half a mile). Through experience gained with the cosmotron which produced the first billion-volt atomic particles on May 20, 1952, the new focusing theory has been developed. Scientists hope that by utilizing multi-billion-volt particles they will be able to penetrate the neutrons and protons, basic "building-blocks" of the atomic nucleus. If this can be accomplished, it may become possible to change one type of particle into another, or to convert energy into nuclear particles.—*Science News Letter.*

Natural Neptunium Ore

NEPTUNIUM 237 has been found in African pitchblende ore (from the Belgian Congo). Dr. Glenn T. Seaborg predicted that it would be eventually found, although perhaps only in small quantities. True, the amount isolated from the ore is minute—only three ten-billionths of an ounce—but it marks another milestone along the pathway of atomic discovery. It seems that scientists nevertheless will have to rely on synthetic material produced by cyclotron bombardment of uranium (or from uranium piles) for the quantity needed for experiments or industrial use. The discovery of neptunium 237, however, may be of great theoretical value, according to a report by Dr. Donald F. Peppard of the Argonne National Laboratory. The substance is valuable in radiation studies, as the amount of its alpha radiation is low.

The Congo ore yields about one-tenth as much neptunium as it does plutonium. The plutonium content amounts to about 1 ounce per 4,000,000 tons of ore.—*Chemistry.*

New Atom Probe

TO ANALYZE the region of the spectrum lying between .0035 and 1 centimeter in wavelength, a new probe, or extra delicate instrument, was needed.

Dr. Kenneth Pitzer, dean of the University of California's College of Chemistry, described such a device—a grating spectrometer. Collaborating with Dr. Pitzer in perfecting the instrument were Dr. W. D. Gwinn, associate professor of chemistry, and J. L. Hollenberg and C. R. Bohn, graduate students. The new grating spectrometer permits investigation of electromagnetic wavelengths in the far infra-red, which region cannot be analyzed by either radar techniques or prism spectrometers. The forces acting between atoms and particularly the effect of heat on these forces can be more closely studied with this new instrument. This study is essential to the prediction of chemical reactions.—*University of California Release.*

The Antineutrino

PROF. H. PRIMAKOFF of Washington University recently startled the members of the National Academy of Sciences at a meeting in St. Louis, Mo., by stating that the neutrino, postulated for some time as necessary, though not yet detected physically, is, according to present evidence, accompanied by an *opposite* particle—the *antineutrino.* When the nucleus of an atom disintegrates, it emits two electrons, which are accompanied by two antineutrinos, unless the decay lasts for a longer time than appears probable. Scientists have yet to discover the physical neutrino and the antineutrino.—*Science Service.*

aviation

High-Altitude Flying

IF THE pressurization fails in a plane, (or if the pilot is ejected) at 52,000 feet, unconsciousness comes in 10 to 15 seconds. Even the addition of pure oxygen at altitudes greater than 40,000 feet does not prevent unconsciousness. These effects on pilots or crew at high altitudes were described by Air Group Captain W. K. Stewart of the R.A.F. Institute of Medicine. At 10,000 feet altitude (without pressurization) the saturation of arterial blood never rises above 89 percent of the maximum. The lack of oxygen in the body causes fatigue, weakening of judgment, and a loss of discrimination, followed by a feeling of irresponsibility, and finally death. Crews of planes, therefore, should never be exposed to cabin altitudes greater than 8,000 feet. Since a man cannot climb out of a plane flying at speeds above 180 miles per hour, for emergencies an automatic ejector should be provided. As parachutes are subject to unusual strain and pressure at altitudes above 20,000 feet, the pilot should be ejected and attached to a parachute fitted with a self-opening device preset to open at a certain barometric pressure.—*Discovery.*

biology

Rabbit Embryos Transplanted

FERTILIZED eggs were removed, 24 hours after insemination, from artificially inseminated American female rabbits, and were packed in a vacuum flask containing ice. They were then flown to England, where they were transplanted into female rabbits. Dr. M. C. Chang, of Boston University, prepared the fertilized ova for shipment; in England at Cambridge University, W. G. R. Marden transplanted 10 of the fertilized eggs from the white California doe rabbits into the fallopian tubes of two black English does. One of the English does gave birth to two white offspring 32 days later. Since there was no blood relationship between the doe (foster mother) and the baby rabbits, all of the features inherited by the babies were derived from true American parents.—*Discovery.*

Fungus Food Trap

PLANT pathologists at the University of California College of Agriculture have discovered that *animal-trappers* exist even among the fungi. Microscopic roundworms—known as *nematodes*—are snared by several soil-inhabiting fungi. When the fungus grows through the soil, its thread-like strands form lasso-shaped loops, covered with a sticky secretion. Nematodes looking around for food are frequently trapped in these loops, which hold them while the fungus grows and slowly devours the tiny worms. Efforts have been made to increase the activity of the fungi so that they may clean up nematode infestation in soils, but so far without evident success.—*University of California Release.*

"Power-plant" of Living Cells

THE tiny *power-plant* buried within every living cell is somewhat better understood today, according to a report made before a meeting of the National Academy of Sciences, Washington University, St. Louis, Mo. Among others, Prof. Albert L. Lehninger of the Johns Hopkins University Medical School, expressed his views on the mystery of the living cell's source of power. One of the principal constituents of the cytoplasm (the protoplasmic envelope surrounding the yolk or nucleus of the cell) is a minute body—the *mitochondria.* These minute particles form the power-plant or source of energy for the muscles, brain, and nervous system. The mitochondria manufacture the basic substance involved in reactions wherever energy is transmitted—a chemical called adenosine-triphosphate (ATP).—*The New York Times.*

Scientific Growth Regulation

FOR many years scientists have been studying methods of increasing growth and weight. A London University professor has found a formula for making a chocolate which will boost a child's growth. The chocolate is 90 percent chocolate and 10 percent a powder made from beef liver, with its taste disguised by orange flavor. Tests showed that children who ate one bar of this chocolate every day for 13 weeks gained a quarter of an inch more than they would normally gain. When compared to a group of other children who had received a bar of *ordinary* chocolate every day, they gained comparatively 20 percent more in weight and 40 percent more in height.

Fattening of pigs and chickens is accomplished in a shorter time, simply by adding aureomycin to their food. The final weight of a pig or chicken is not increased but—most important to those raising them for the market—the rate at which they grow and fatten is greatly increased. A fowl which formerly took 12 weeks to reach 3 pounds weight, now attains this weight in nine weeks, at remarkably low cost. The same effect has been obtained with pigs fed a small quantity of aureomycin mold (powdered) with their food.—*The English Digest.*

Hormones and Growth

WOMEN in general are smaller than men owing to the growth-suppressing action of the female (estrogenic) hormone. Studies leading to this conclusion were reported by Prof. W. S. Bullough, of Sheffield University, at a meeting of the British Association for the Advancement of Science. This growth-suppressing action of the female hormone is exerted through its stimulation of the adrenal gland, which produces hormones similar to cortisone. The effect of these hormones is to reduce the rate of energy production; they also retard the replacement of skin cells, besides suppressing growth in general. Men and other male mammals do not experience such a repression of growth, as the male hormones apparently do not cause this extra production of cortisone-like hormones.—*Science News Letter.*

cybernetics

A Robot That "Feels"

A ROBOT that not only can manipulate mechanical objects at a distance, but actually can *feel* the work at hand, is predicted by *Nucleonics* magazine. This super robot will be able to perform the work of the human hands and fingers—all by remote control from a console set up at a safe distance. Such a robot could, for instance, be dispatched to dismantle a bomb, or clean up radioactive débris. At the control console, the human operator will be able to see just what the mechanical fingers are doing, thanks to a binocular television camera. This camera will provide a three-dimensional view of the distant operation being performed by the robot. The electrically controlled hands and fingers close onto an object following the action of the operator's hand at the console. The operator will, in effect, sense the pressure exerted by the robot hands on the distant object.—*The New York Times.*

"Thinking" Machine

ELECTRIC computing machines of weird and marvelous patterns have been built thus far, but an electronic machine that can actually *think* is actually possible in the far future, according to *The York Report* (York Engineering & Construction Co.; York-Gillespie Mfg. Co., of Pittsburgh). The machine that can *think* is predicted on the assumption that all of man's new ideas and inventions are based on our previous experience and the application of known facts. If sufficient knowledge and experience can be reduced to basic figures and fed into a suitable machine, simply pressing a button may automatically develop a brand-new idea or invention.

Push-button factories will be another early future development, combining an extension of electronic-brain machines, with ideas of what we now know about automatic machine control. Even now, holes punched in a paper tape in Chicago can cause a column of type to be set, or guide a lathe in a distant part of the country. Future push-button factories will take leather into one end and send finished shoes out of the other. This is far from all the wonders possible.

Three-dimensional television, in color, will be here very soon, for television applied to industrial problems is already working wonders. Remote control and observation of certain operations on radioactive products are also being effected by television.

electricity

"Stomach Voltage Meter"

SOME day doctors will be able to tell whether a person's stomach is normal or not, simply by measuring the voltage it produces. A normal healthy stomach develops electrical impulses with a regular wave motion about one impulse every 20 seconds, and a potential of 12 to 15 thousandths of a volt. If the stomach is diseased, the electrical potential falls to 3 or 4 thousandths of a volt and appears in irregular waves. In one case, nausea was predicted by the sensitive electrical meter, known as an electrogastrograph. To make the tests, one electrode is placed in the stomach and a second electrode is attached to the arm of the patient. Tests were made on 150 patients at two hospitals in Montreal. The device was recently described by Dr. H. S. Morton and Dr. W. S. Martin of Montreal, before a convention of the National Gastroenterological Association in New York.—*The New York Times.*

Electric Welding of Glass

TWENTY-THOUSAND-VOLT electric currents now successfully weld glass parts. The current used varies from standard 60 cycle a.c. to ultra-high-frequency currents. Mass production of highly technical glass parts can now be accomplished by virtue of the rapid electric welding process, as according to M. R. Shaw, research engineer for the Corning Glass Co. Electric glass welding develops higher temperatures within glass bodies than flames do. Furthermore the high temperatures are attained in a shorter time and neither the main assembly of parts nor the glass surface is distorted by the method. Also, the degree of heat can be regulated accurately.—*Science Service.*

electronics

Automatic Air Map

AIRPLANE passengers will soon be able to observe the plane's position at any time by watching a dot on a wall chart. The device is an English invention and the equipment is now in development by a British radio company. A moving dot of light on a chart or map is controlled from an *automatic navigator* installed in the pilot's flight deck of the plane. The master control unit is an automatic form of the device which is now in use on ships at sea and which operates on radio signals from ground stations. The airplane apparatus correlates automatically the radio signals intercepted from the ground stations. The integrated direction angles of the various stations give the position of the plane at any instant.—*Science Service.*

Photoelectric "Reader"

A MACHINE that translates letters on a printed page into spoken letters or sound patterns, enabling a blind person to read by sound, has been patented by Dr. Vladimir K. Zworykin, RCA scientist, and Leslie E. Flory. A light source is used to scan each letter on a page. The light reflections, which are different for each letter, are impressed upon a photoelectric tube (or a photomultiplier), which translates them into voltage groups. The voltage surges activate recordings of the sounds of the respective letters. A blind person can thus *hear* a printed passage spelled out.—*Science Service.*

Portable TV Set

A ONE-TUBE, portable television receiver has at last made its appearance: 27 odd tubes in present-day TV sets were replaced by transistors. The only remaining tube is the cathode-ray picture tube. This remarkable TV set was demonstrated by the Radio Corporation of America at its Princeton research laboratories. The receiver used but one-tenth the power consumed by all-tube sets. A transistor-operated FM receiver was also shown, along with a portable radio broadcast receiver also fitted with transistors in place of the usual tubes. A few small batteries provide these transistor-equipped sets with power, the batteries lasting much longer in these sets, as the transistors use far less current than a number of tubes. Transistor-operated devices include a portable phonograph, an automobile radio receiver, an electrified ukulele, an electric eight-note toy piano, and a *wireless* roving microphone. The cables and booms used now in TV studios may be obviated soon by the use of the transistor-equipped roving mike. Transistors can be used to perform many of the tasks now done by tubes. They operate on potentials as low as 1 volt, requiring little current as rectifiers or amplifiers.—*New York Herald Tribune.*

geology

Time Measure, Thermoluminescence

GEOLOGISTS have long sought a method for determining the geologic age of rocks. A useful method was recently described by Dr. Edward J. Zeller, of the University of Wisconsin, before a meeting of the Geological Society of America. Limestone, when heated to 400° C in a darkroom, gives off light (thermoluminescence), which varies in direct proportion to the geologic age of the limestone specimen. In order to check the accuracy of the results, the age of the limestone samples is previously compared with fossil samples. This new thermoluminescence method can aid in determining the age of limestone and other rocks, such as dolomite, quartz, fluorite, and the feldspars, which are highly thermoluminescent. It is also easier to perform and more accurate than the previously devised lead-uranium technique.—*Chemistry.*

medicine

Blood-Pumping Machine

SURGEONS have long known how to repair defective heart valves, but could not bypass the blood while the surgery was performed. A new blood-pumping machine now enables surgeons to divert the blood which is headed for the left side of the heart from the lung. The blood is squeezed back into the arteries.

In a specific operation on a 41-year-old man the left side of the heart became relatively empty; a little blood remained, sufficient to nourish the heart muscle. Under these conditions it was possible for the surgeon to correct a defective valve in the heart, without the chance of a dangerous hemorrhage. Complete substitution of blood pumping (ordinarily done by the left ventricle) was maintained for 50 minutes. This operation is believed to be the first of its kind where the patient survived, and where a mechanical heart was successfully used to fulfill the function of maintaining the body's blood supply while surgeons opened the heart for operation.—*The Journal of the American Medical Association.*

Heart-Beat Restoration

WHEN the heart stops beating, as in heart disease, shock, or drowning, an electric shock may start it beating again. The *New England Journal of Medicine* described the necessary apparatus ("Thyratron stimulator") and its application to the patient. Hypodermic needles are inserted into each side of the chest; the needles are then connected to the stimulator. The electrical impulses from the machine pass from the negative electrode (needle) through the heart to the positive electrode on the opposite side of the chest. The electrical impulses, which can be adjusted to occur at any rate from 25 to 90 a minute, stimulate the heart's ventricular muscles and restore the beating. In some cases considerable time elapses before the heart beats naturally—one patient required five days of continual treatment with the stimulator before the heart resumed its natural pumping action. The new method of electrically shocking the heart into action was developed by Dr. Paul M. Zoll, associate in medicine at the Harvard Medical School and chief of the Cardiac Clinic of the Beth Israel Hospital, Boston. If the heart-beat stops for a long time, the patient dies; the heart pulsation or pumping of blood must be restored within several minutes, or irreparable damage may occur.—*New York Herald Tribune.*

psychology

Feelings of Tension

DR. ROBERT VOAS, University of California psychologist, is trying to ascertain what causes that "all-tied-up" feeling when one frowns, grits the teeth, clenches the fists, and feels tense all over. The research is being concentrated on how tension is reflected in electrical activity in seven important muscles—the brow muscle, the masseter (a jaw muscle), the back-of-the-neck muscle, and the fore-arm and leg muscles. Delicate instruments measure the electrical activity of the muscles, while the subjects are presented various problems, such as mental arithmetic. This reaction was reflected in the activity of the two fore-arm muscles. While performing mental arithmetic, stress-frustration situations were induced by continuous loud

noises. Some activity in all the muscles resulted especially in the face muscles, and to a lesser degree in the leg muscles. The brow muscle was most consistently under tension, and it was the last one to become inactive when the subject was told to relax and try to sleep. —*Science Service.*

physics

A Pen Weather Forecaster

WITH the aid of a radioactive pen point on a slender shaft mounted atop the G-E research laboratory, scientists are gauging the electrical activity generated by changes in the weather. The pen registers even so slight an effect as a change in wind direction. Even variations in intensity of light reflected from clouds are sometimes detected. Electric currents collecting on the radioactive pen from the high potential developed between the earth and the atmosphere are registered by an extremely sensitive photoelectric recorder. The outbreaks of showers are registered (with clear skies overhead) within a radius of 450 miles. The recorder heralds the approach of thunderstorms at a considerable distance. The cost of the apparatus is far below that of an equivalent radar system capable of indicating changes in atmospheric disturbances at a distance.

spatialogy

Gravity-Free State

HUMAN pilots placed in a rocket can survive a gravity-free state out in space. Recent experiments with monkeys and mice sent up in a rocket to altitudes of 80 miles, seem to show that for brief periods at least, such gravity-free conditions can be tolerated. Pictures were taken automatically of the animals while the rockets were in flight, which revealed the struggles of two white mice at a height of 38 miles above the earth. One mouse floated helplessly in a smooth-sided plastic drum and could not obtain a foothold. The other mouse in an adjoining section of the drum was able to take a firm hold because this section had a *shelf*. There were no effects on monkeys and mice, during the two-minute period of *zero gravity*. The report of the experiment made at the Holloman Air Force Base, Alamogordo, New Mexico (plus a number of human experiments in jet fighters) states that if a man is properly secured in an aircraft, he can function normally during brief periods of zero gravity and can perform any operations necessary in piloting an aircraft. However, owing to the difference between mice and men, the results of the research on the rocket-borne monkeys and mice has to be applied to humans with caution.—*Science News Letter.*

Deep-Sea Bacteria

SCIENTISTS have found bacteria at a depth of 34,000 feet below sea level. The latest deep-sea explorations were carried out under the direction of Dr. Anton Bruun, of Copenhagen University. Dr. Bruun's team of explorers discovered bacteria in mud obtained by sampling the sea-bed at a depth of 34,000 feet. Two years ago, Dr. Claude E. Zobell, of the Scripps Institution of Oceanography in California, had discovered deep-sea bacteria from depths up to 15,000 feet. The bacteria were full of life in the laboratory, and they multiplied rapidly. The living organisms survived after having been subjected to temperatures near the freezing point and pressures reaching 7,500 pounds per square inch (for 15,000 feet below sea level). The deep-sea bacteria differ in structure and shape from ordinary bacteria. Their food is still a mystery. Further research may answer this question in time. It was another striking example of the tenacity of bacteriological life.—*Discovery.*

book reviews

I Thought He Said a Billion!

THE NEXT MILLION YEARS, by Charles Galton Darwin. Rupert Hart-Davis, London, England, 1952. 210 pages. 15s.

THIS volume, written by the son of the great Charles Darwin, (whose contributions to science need not be enumerated), has been the subject of tremendous discussion in England, and will probably evoke even greater interest in the U. S. when the American edition appears (before this review.)

Charles Galton Darwin delineates a bleak picture of life on this planet, one million years hence, when most natural resources have been depleted and overpopulation has become disastrous. The work is not fiction, but a scientific discourse encompassing philosophical and psychological as well as physical factors. He holds little hope for the improvement of the human being whom he maintains is but a wild animal.

While this book is a fountain of plot ideas for the science fiction writer, its conclusions, which do not encompass the possibilities of space flight as a solution to the problems posed, or the tremendous potentiality of future invention, will strike science fiction readers as being unduly pessimistic.

The Unfinished Classic

THE TITAN, by P. Schuyler Miller. Fantasy Press, Reading, Pa., 1952. 252 pages. $3.00.

FIFTEEN years ago, the author of this collection of short stories was an outstanding name in the field of science-fiction. His stories found a ready market in the science-fiction magazines with the outstanding exception of the title story, *The Titan*. When William Crawford began a semi-professional science-fiction magazine in 1934, entitled *Marvel Tales* (which never boasted a paid circulation of over 200), he began to serialize *The Titan* in his magazine. Although it was far ahead of its time, and had a limited readership, the story was a great success. The magazine collapsed, however, before the story could be completed. Subsequently the remaining manuscript was lost. Finally after a gap of many years, the author has completed and had published for the first time, the entire legendary story. *The Titan* was worth waiting for, since it has zest, color, drama, human interest and a sense of wonder seldom seen in science-fiction stories.

Venus Is Not a Dust Bowl

THE UNIVERSE WE LIVE IN, by John Robinson. Thomas Y. Crowell Co., New York, 1952. 252 pages. $4.50.

POPULAR books on astronomy and related subjects are not new, nor are well written and entertaining astronomy volumes rare. Astronomers seem to have imagination and a gift for expression. However, *The Universe We Live In* has special distinction because the author is not afraid to come to grips with the most modern theories and searchingly analyze them. For example, he strikes a body blow to the theory that the planet Venus may be a dust-bowl instead of a cloud-enshrouded planet. The Dust Bowl theory is based on the spectroscopic examination of the upper atmosphere of Venus which reveals no water-vapor and quantities of carbon-monoxide at that level. The author points out that at 70 miles above the surface of the earth the atmosphere contains *no oxygen or water vapor at all*, and that the atmosphere is almost 100% hydrogen, an entirely unbreathable and highly inflammable gas. The earth nevertheless teems with life despite the fact that there is no oxygen and water vapor in the outer 400 miles of its atmosphere. All oxygen, water vapor, and hence life exist only within a few miles of the surface.

The many science-fiction authors who have unthinkingly accepted the dust-bowl hypothesis as gospel, will find that they are on shaky scientific ground.

Woman Science-Fiction Writer

JUDGEMENT NIGHT, by C. L. Moore. Gnome Press, New York, 1952. 344 pages. $3.50.

IN RECENT years, science-fiction, because of the improvement in its literary and narrative tone has become increasingly interesting to women. Yet, even from its earliest days when there was a strong emphasis on science, science-fiction had not only women adherents but women writers as well.

This is the first collection of stories by C. L. Moore, and it leads off with her short novel, *Judgement Night*. An impressive bit of interplanetary writing, but often too verbose and self-conscious in style. A fault of many of the other stories of the collection is their comparative recentness. It is also an obvious reflection on the knowledge of most science-fiction anthologists that C. L. Moore's very outstanding story, *Greater Than Gods*, has yet to appear.

Science Questions and Answers

(1) Space Suits

Editor,

We read a lot of conflicting scientific gibberish about space suits. What can you tell us about them?

Arthur Haywood
Pasadena, Calif.

Answer:

Space suits *in some form* are an absolute necessity in open space, where there is no atmosphere. On Earth, the atmosphere presses on every part of your body at the rate of 14.7 pounds per square inch. Take this weight or pressure away and immediately the human body starts to blow up like a balloon. Blood will issue from under the fingernails, from the nose, and other bodily orifices because the pressure of the blood—which is considerable in the human body—will, without air atmospheric pressure drive the blood through these orifices. Worse yet, the blood will start boiling. This happens when men ascend into the stratosphere where the atmospheric pressure is only a few pounds. For this and other reasons it is essential that the human must be protected in some way. He must, in other words, replace the atmospheric pressure by something else. This can be accomplished in a number of ways.

One would be to fit the body with tight elastic clothing to bring back the 14.7-pound pressure. Even a ten-pound pressure in this way might be sufficient. But, unfortunately, this would not work out because the human would soon smother. Furthermore, as Professor Donald H. Menzel of Harvard Observatory has pointed out in a recent letter to the editor, the human body is a pretty good heat machine. *It radiates heat at the rate of about 100 Watts constantly.* Dr. Menzel also pointed out that a human being in a space suit on the Moon will not be bothered so much by the cold *as by the heat.*

The important thing is to make the suit as *brilliantly white as possible* to reflect the external radiation of the Sun. The lunar fierce heat during the daytime is about 200° F. Add to this the human heat generation of 100 Watts, and immediately you have two problems—not only the high solar heat, but also the 100-Watt radiation of the human body. Hence, a *tight-fitting* suit would raise instant havoc.

Also the fabric or material must have many special characteristics. First the space suit must be tough enough to withstand the onslaught of small meteoric dust particles and grains. If larger particles pierce the suit there will be a blow-out, spelling almost instant death to the wearer. Hence the suit must be very tough and in addition it should be self-healing to prevent blow-outs. Despite its elasticity, the suit must be capable of holding the high internal pressure, against the outer vacuum of space.

The suit must be radiation-proof, and must not become brittle in a temperature of −250° F cold. Gloves of a similar fabric will allow man to use his fingers with fair dexterity on the Moon.

To be sure, man must use a helmet completely enclosing his head, but this and an oxygen tank can be made of a very light-weight metal or plastic.

—Editor.

In this department we will print every month letters from readers, particularly those letters that have to do with the science content of the stories published in this magazine. For the present, it will not be possible to answer questions by mail.

(2) Lunar Atmosphere

Editor,

We are a group of students and recently we have had a lot of discussion on the pros and cons of a lunar atmosphere. What is the latest information on this subject?

Homer Wadsworth
Springfield, Ill.

Answer:

There is still a great deal of controversy on a lunar atmosphere. One reason for this is the breadth of the term "atmosphere." To be sure, scientists are all agreed unanimously that the Moon cannot support an extensive atmosphere similar to that on Earth. The Moon's low gravitational pull cannot hold back the atoms as readily as on Earth. Any vestigial atmosphere the Moon may possess must be of extremely low density.

Although some changes have been occasionally reported in some of the Moon's craters none has been verified. A few observers have thought that they saw mists of various densities in some of the lunar craters. Other astronomers have noted greenish-tinted spots in some of the craters, which they suggested might be some type of vegetation, such as lichens. No one, however, can be certain about this.

It is not impossible for certain low types of vegetation to grow in a near-vacuum. The famed Swedish scientist, Svante Arrhenius, as far back as the turn of the century, maintained that life-bearing spores could be propagated through free space by the pressure of sunlight. Such spores might come from the Earth or from other planets, and even from distant star systems. The spores might travel millions of years before they would fall on a body where conditions were right for germination and growing. Science long demonstrated that the cold of interplanetary space in no wise kills the germination power of such spores. Yet consider that the surface temperature of the Moon in the daytime can exceed that of boiling water (at sea level on Earth). It thus becomes doubtful, that seeds, spores, or life of any sort could exist under the alternate extremes of 200° F heat and −200° F cold on the Moon's surface.

All of this is pure scientific speculation, and we will not know anything certain about the subject until man actually visits the Moon. It would seem plausible, however, that in the deep crevices and caves of the Moon, peculiar forms of life could exist. But most scientists now agree that the Moon is completely lifeless.

—Editor.

(3) Sounds on Airless Body

Editor,

One of the things that keeps puzzling me is what happens to sound on an airless body, such as an asteroid or the Moon? What happens if a cannon is fired? Another question is how is radio propagated on a small planetary body, such as Ceres or the Moon?

Donald H. Farmer
Cleveland Heights, Ohio

Answer:

Where there is no atmosphere, there cannot be sound. If you fire a gun and you are a distance away from the weapon and you wear a space helmet, no sound of any kind will be heard. You will see the flash and the usual smoke will issue from the cannon, unless special smokeless powder is used. This smoke will soon dissipate into space, depending on how large a planetary body you are standing on. If the ground is solid, such as granite, and you were to put your space helmet against the granite, you would then actually hear the sound of the gun quite a distance away. The sound is conducted through the granite, but it would not be as loud as the sound of a cannon on Earth in the open air. If you were not too far away from the cannon, you would, however, feel the explosion *through your feet* or by resting your hands on the ground. If conditions were right, you would feel the vibrations of the explosion.

A simple way for two people to communicate on an airless body or in space is to put the heads together so that the two space helmets *actually touch.* You then have a solid conducting "bridge" and you can converse in this manner.

As to propagation of radio waves, if very short waves are used principally, these will follow straight lines only. There is no ionosphere (so far as we know) to reflect sky waves as on earth. On the Moon, due to the near horizon, a six-foot man will be able to communicate about two or three miles, depending upon where he walks. This is for a more or less level ground condition. If one man stands at the bottom of a crater and the other man is, say 14,000 feet up on a Moon-peak, there would be no difficulty in short wave communication. Far below the horizon, these waves cannot be used for communication.

With long radio waves we are not certain what the results will be on a body like the Moon. We know that on Earth some of the long waves travel along, or over the surface. The long waves are also reflected from the Earth's ionosphere. The Moon, as far as is known, has no such gaseous layer. Hence, the only transmission of the longer waves could be along the surface or *through* the Moon.

—Editor.

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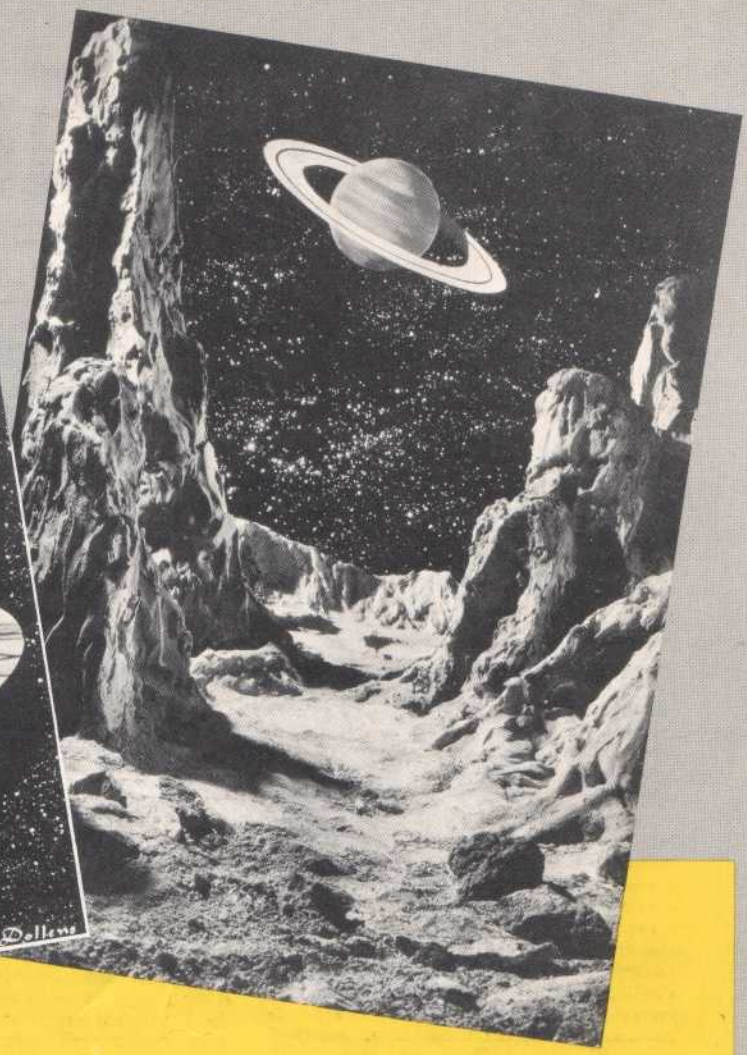


ONCE AROUND THE SOLAR SYSTEM

NOW in production in Hollywood—the first reel completed—is this remarkable scientifilm, DREAM OF THE STARS, from which four advance stills are shown on this page. The astronomical feature is the dream of Morris Scott Dollens.

An artificial satellite, Space Station No. 1, is seen constructed for the preliminary lunar flight, before man branches out to the neighboring worlds.

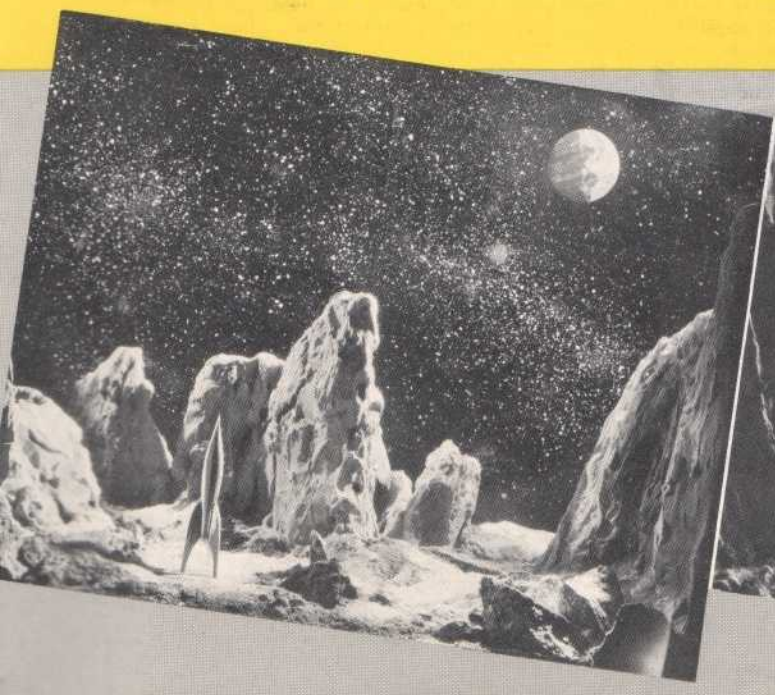
Early experimental footage on the scientifilm was first previewed to attendees in London of the First International Science Fiction Convention, 1951; while further footage was enthusiastically received at a special showing at the *Los Angeles Science Fantasy Society* during one of its late 1952 meetings.

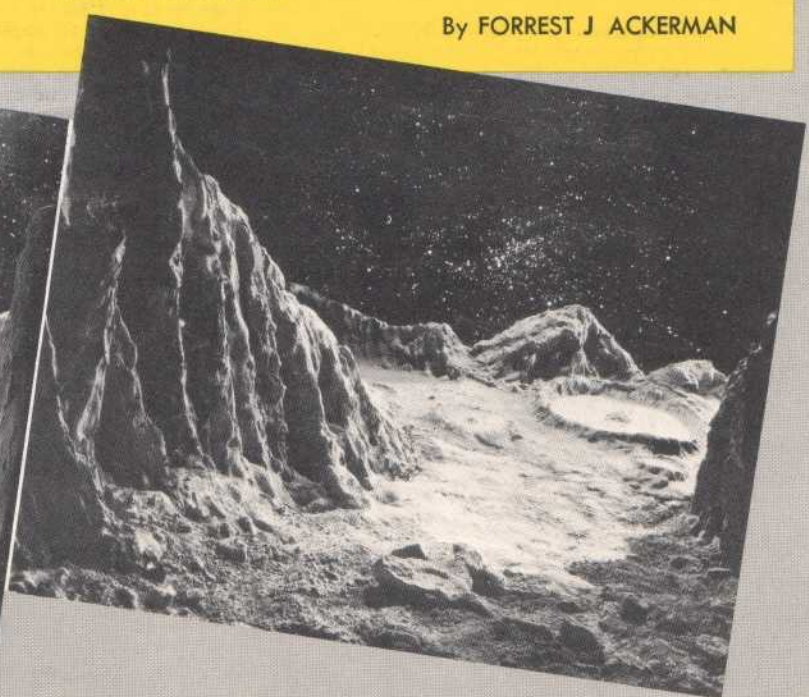
The work seen here is table top process, built and photographed by Mr. Dollens. A self-instructed expert in the fields of photography, art, electronics, sound recording and mechanics, Mr. Dollens is now devoting his talent to making his mark in the professional world via DREAM OF THE STARS,* the Dollens & Laredo Production which may beat Geo. Pal's CONQUEST OF SPACE, based on the Ley & Bonestell book, to the silver screen.

A treat well worth waiting for!

*The picture will, on a "Clarke's Tour", as it were, of the Solar System, project its spellbound audiences millions of miles into space, with stops on the Moon, Mars and the other planets.

By FORREST J ACKERMAN





SCIENCE-FICTION VIEWS THE COSMOS