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NOVEMBER 1937

ASTOUNDING STORIES



THE GOLDEN HORSESHOE *A Science-fiction Novel of Yellowstone* by Arthur J. Burks

in this issue: Nat Schachner, Warner Van Lorne, John W. Campbell, Jr., Eric Frank Russell, Dr. E. E. Smith

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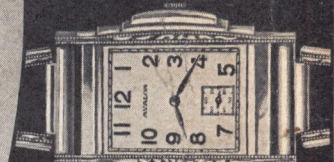
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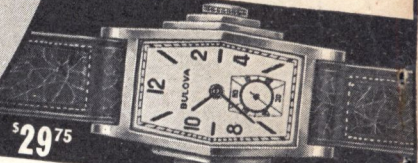
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ASTOUNDING STORIES

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November, 1937
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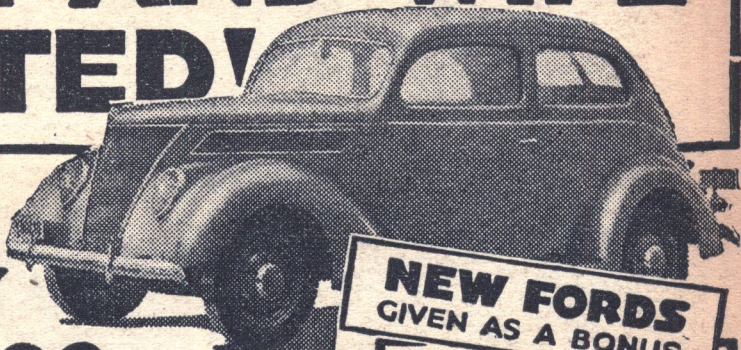
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Just as soon as I hear from you I will send you complete details—tell you all the inside workings of this nation-wide Coffee Agency Plan. I will explain just how to establish your customers; how to give them service and make good cash earnings. You can plan it so you give only 5 days a week to your business, collect your profits on Friday, and have all day Saturday and Sunday for vacation or rest. The plans I send you took years to perfect. You know they must be good because they have brought quick help to hundreds of other men and women, both married and single, who needed money.

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28x4.50-20	2.35	1.00	1.25	28x4 1/2	2.95	1.25	30x5	3.65	1.65
28x4.50-21	2.40	1.10	1.25	28x4 1/2	2.95	1.25	30x5 1/2	3.75	1.75
28x4.75-19	2.45	1.20	1.25	28x4 1/2	2.95	1.25	30x6	3.95	1.95
28x4.75-20	2.50	1.30	1.25	28x4 1/2	2.95	1.25	30x6 1/2	4.15	2.15
28x5.00-19	2.85	1.25	1.25	28x4 1/2	2.95	1.25	30x7	4.35	2.35
28x5.00-20	2.85	1.25	1.25	28x4 1/2	2.95	1.25	30x7 1/2	4.55	2.55
28x5.17	2.90	1.30	1.25	28x4 1/2	2.95	1.25	30x8	4.75	2.75
28x5.25-18	2.90	1.30	1.25	28x4 1/2	2.95	1.25	30x8 1/2	4.95	2.95
28x5.25-19	2.95	1.35	1.25	28x4 1/2	2.95	1.25	30x9	5.15	3.15
28x5.25-20	2.95	1.35	1.25	28x4 1/2	2.95	1.25	30x9 1/2	5.35	3.35
28x5.25-21	3.25	1.30	1.25	28x4 1/2	2.95	1.25	30x10	5.55	3.55
28x5.50-17	3.35	1.35	1.25	28x4 1/2	2.95	1.25	30x10 1/2	5.75	3.75
28x5.50-18	3.35	1.35	1.25	28x4 1/2	2.95	1.25	30x11	5.95	3.95
28x5.50-19	3.35	1.35	1.25	28x4 1/2	2.95	1.25	30x11 1/2	6.15	4.15
28x5.50-20	3.40	1.40	1.25	28x4 1/2	2.95	1.25	30x12	6.35	4.35
28x5.50-21	3.45	1.45	1.25	28x4 1/2	2.95	1.25	30x12 1/2	6.55	4.55
28x6.00-18	3.40	1.40	1.25	28x4 1/2	2.95	1.25	30x13	6.75	4.75
28x6.00-19	3.40	1.40	1.25	28x4 1/2	2.95	1.25	30x13 1/2	6.95	4.95
28x6.00-20	3.45	1.45	1.25	28x4 1/2	2.95	1.25	30x14	7.15	5.15
28x6.00-21	3.65	1.50	1.25	28x4 1/2	2.95	1.25	30x14 1/2	7.35	5.35
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34x9	14.95	4.95	34x9	14.95	4.95
34x10	16.95	5.25	34x10	16.95	5.25
34x11	18.95	5.55	34x11	18.95	5.55
34x12	20.95	5.85	34x12	20.95	5.85
34x13	22.95	6.15	34x13	22.95	6.15
34x14	24.95	6.45	34x14	24.95	6.45
34x15	26.95	6.75	34x15	26.95	6.75

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36x10	5.15	2.25	36x10	5.15	2.25
36x11	5.85	2.55	36x11	5.85	2.55
36x12	6.55	2.85	36x12	6.55	2.85
36x13	7.25	3.15	36x13	7.25	3.15
36x14	7.95	3.45	36x14	7.95	3.45
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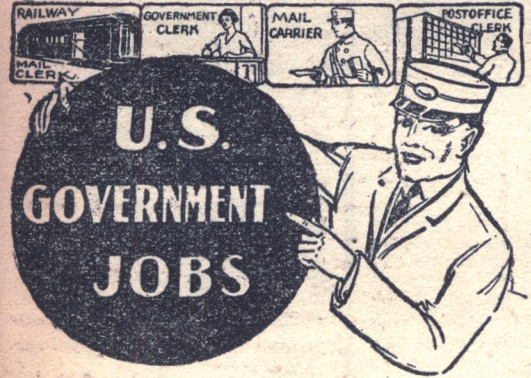
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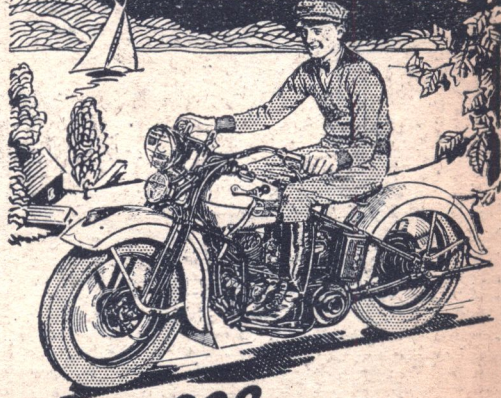
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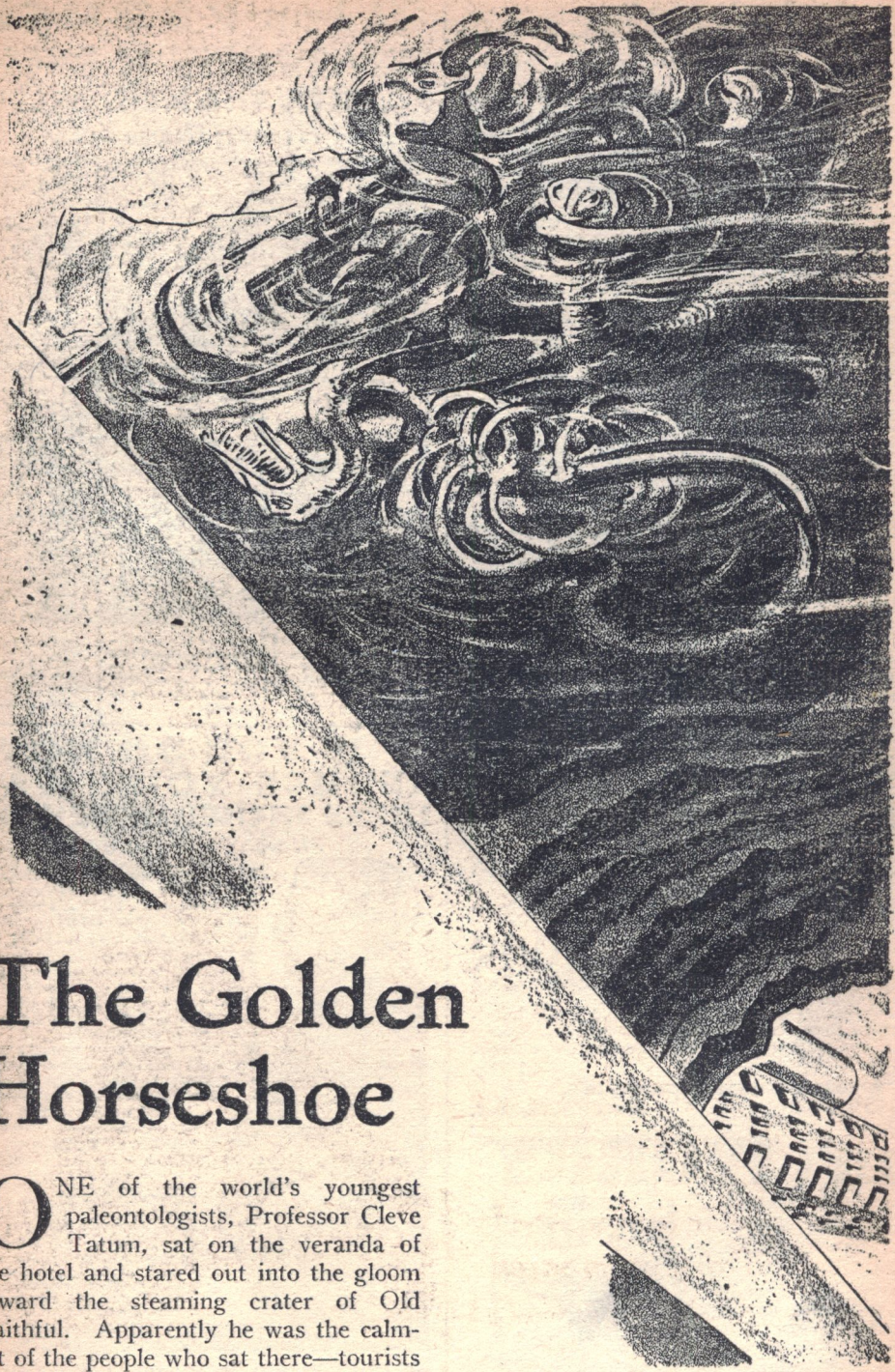
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The Golden Horseshoe

ONE of the world's youngest paleontologists, Professor Cleve Tatum, sat on the veranda of the hotel and stared out into the gloom toward the steaming crater of Old Faithful. Apparently he was the calmest of the people who sat there—tourists for the most part—awaiting the next eruption of the famous geyser.

Cleve Tatum was waiting for some-

He saw creatures—which could have swallowed present-day whales with ease—churn the sea into froth—



*A science story
of the phenomena
in Yellowstone National
Park*

by Arthur J. Burks

thing else; he didn't know exactly what. A clue perhaps; a clue to something that had been burning in his brain since he had visited Dr. Jasef Siegfriedt in Red Lodge, the night before. He'd gone there at Siegfriedt's request, because the old doctor believed him a friend who could be trusted. Siegfriedt's latest discovery—he had made many in the course of the last half dozen years, at which the world of science had come to sneer, but remained to applaud and heap honors upon the small town practitioner—was something, he wrote Tatum, that he feared to tell any one until he had Tatum's opinion.

Tatum was thinking of that now, living over again last night's conference with Siegfriedt in the latter's office.

"Look at this fossil, Tatum," Siegfriedt had said, trying with some difficulty to mask his excitement, "and tell me what it is."

Tatum had examined the figure in the rock—a huge figure which Siegfriedt had moved into his place with much effort, and for which he had reinforced the floor of his study—carefully before passing judgment. Then he stepped back, spoke with studied slowness. "I don't think I'm wrong, Doc, though I hesitate to say what I'm sure is true, especially in view of the other figure in the same piece of rock to which you did not refer at all—expecting me, of course, to note its presence."

"You mean, Tatum——"

"The *arthrodire*, of course! And laid down in the same rock formation as this manlike figure you especially called my attention to: this primate!"

"Then it is a primate?"

"Without the slightest doubt!"

Siegfriedt let out an explosive sigh of relief. He took off his steamed spectacles and polished them with hands that trembled. Yes, the hands of Siegfriedt, who performed miracles of surgery on smashed and broken miners

without a qualm, were shaking. And little wonder!

"It is even"—Siegfriedt hesitated, almost afraid to go on, then took the plunge—"a man?"

Tatum hesitated in his turn. His face was a little white. He examined the formation again before answering. "It's a man, Doc, as you very well know and were afraid to say. What sort of man, I don't know. His like has never been found in fossils hitherto. He's bigger than the Cro-Magnon or the Neanderthaler——"

Siegfriedt grabbed the shoulders of young Tatum, his fingers tightening until they bruised the paleontologist's flesh. "And you noted the formation in which my miners, over in the Bear-tooth, near Chrome Mountain, found him? You've seen the formation before, Cleve! Can we be wrong?"

"No, Doc, I gave you an estimate of that formation some months ago——"

"Which is why I asked you to come here and see me before I told the world of this new discovery. Tell me again, Tatum; how long ago was that formation laid down?"

"You know as well as I do. Allowing for natural human error, that formation was laid down sixty-three million years ago!"

SIEGFRIEDT sank back in his chair. He'd known, in his own mind, the truth of what Tatum had told him. But now that he had confirmation, from the best possible source, he was left weak and deflated.

"It means, then," he said finally, "that I can call in the newspapers, tell the world that man roamed this area—before the Pacific Ocean covered it! Before the Pacific Ocean flowed over it and then more millions of years later was forced back when Nature cast these Rocky Mountains up from her depths in the grand era of mountain building! This discovery will change the whole

theory of evolution, the whole story of mankind—for where this man was there must have been other men——”

“Just a moment, Doc, before you plan on giving out your story. Just whither does this formation bear from where you found this premountain-building man? I’m bewildered, stunned. I have to think.”

“What direction does the formation bear? Why, generally, toward Yellowstone Park. But what bearing——”

“I don’t know. But Yellowstone Park is supposed to be molten, far down, and if this fossil were, at some distant date, caught in a molten flow——”

“It won’t hold, Tatum. Lava would have destroyed all traces——”

“But wait. We’re both thinking of things man never thought of before. You’re thinking of a world different from any living man or any man of recorded history—including even history written in the rocks—has ever seen. You’re thinking of a world when continents did not even slightly resemble continents of to-day. The continents this man knew, for instance, might have included——”

“Mu? Atlantis?”

“Yes,” said Tatum, slowly nodding, “we *are* thinking along the same lines, aren’t we? For Mu and Atlantis both flashed through my mind just before you spoke. See where this thing might lead us? The world would call us crazy. Therefore, we have to find proof—something to back up our story of this man who roamed here sixty-odd millions of years ago—*maybe before the dinosaur laid the eggs you startled the world with a couple of years ago!* You see why I thought of Yellowstone? Its wonders are the closest to those which filled the world in the time of——”

“The *arthrodire!* The earliest sea creature of rock record with a *different* physical make-up, definitely connecting it with to-day’s low sea forms!”

“Right! You stay here, Doc. I’m

making a visit to Yellowstone, to find a clue to lead us further. I’ll come back if I fail, send for you if I find it, and we’ll dig into it together. Of course, full credit goes to you as the discoverer——”

“No! No! I needed your confirmation to prove——”

CLEVE TATUM had got that far in reliving his last night’s conference with Dr. Siegfriedt, when the words of his nearest neighbors broke in on him.

“Sometimes the interval between any two eruptions of Old Faithful is as much as seventy-five minutes, sometimes as little as forty-seven, with the average almost exactly on the hour! Strange, isn’t it, that it should vary so! The other geysers hereabouts, and those over in Norris Geyser Basin——”

“You know,” interrupted another man, whose face Tatum could not see clearly in the gloom, “queer fancies come to a chap in a place like this. Yellowstone Park, where the earth is still young! Where it hasn’t yet reached the Ice Age! Where everything is so close to things as they were in the days of the great reptiles! Take Old Faithful, for instance, with its strangely erratic periods of eruption. I get that feeling of vast, awesome machinery, miles below the surface, that isn’t running exactly right! You know, that has something wrong with its carburetors, a blown gasket, a cracked piston ring perhaps——”

It was just, of course, an imaginative man saying things inspired by the strange surroundings of Yellowstone, but something like a cold chill caressed the spine of Cleve Tatum as he listened. “Out of the mouths of babes and sucklings——” Out of the mouths of fools and tourists! Tatum’s brain went a little numb with the thought that was growing inside it. Maybe the talking fools, never suspecting that something cataclysmic was in their words, would

lead him further. Cleve Tatum believed in telepathy, in fact in *supertelepathy*, by which he explained the strange inspirations that come, sometimes, to men of genius, apparently from *outside*. If the talking fools were receiving sets—well, it certainly wasn't beyond the bounds of possibility—

At this point some one yelled: "There she goes!"

Old Faithful had been uttering her usual preparatory growls. Now, against the bright moon over Yellowstone, she suddenly hurled her white plumes of steam and boiling water into the sky to a height of well over a hundred feet. She looked like a mighty ghost coming out of a hole that led down to "caverns measureless to man." Cleve Tatum watched, spellbound, as had millions of people before him, until the fury of Old Faithful subsided—and the talk of his companions on the veranda sounded through again.

"Things like Old Faithful, who has been doing this for countless millions of years, far's we know, and will probably be doing it millions of years hence, make you realize the unimportance of time, the puniness of mankind. It's easy to believe what some idealists do, what some of our best minds profess to believe, and which seems reasonable—certainly in surroundings like this—when you take into consideration that everything known to science to-day, and everything science has yet to learn, has existed from remotest time; by which I mean, of course, the basic elements, electricity and, well, you know, everything like that. Of course, I don't believe that millions of years ago there were automobiles and electric lights—though why couldn't there have been a race of men, of which no trace remains to-day that we can find, who invented similar things? Eh, I ask you? Seems silly, sometimes, to insist that in a world a billion years old or a hundred times that—that sentient beings, not neces-

sarily men, only existed in the last few million of years. Maybe there have been vast cycles of time, of humanity, even——"

Tatum was listening with bated breath. The man who talked was obviously letting his imagination run wild, saying things he'd have pooh-poohed at any other time and place—especially if spoken by some one else—just to hear himself talk, to talk in tune with his surroundings.

In tune with his surroundings!

The speaker leaned toward his listener. "Why, do you know that there are vast areas of Yellowstone Park closed to everybody? Areas where there may be almost anything, for all the world knows? Areas which haven't even been explored? That are not definitely known to be either safe or unsafe for human beings——"

CLEVE TATUM, trying to keep the excitement out of his voice, leaned toward the speaker. "Might a stranger ask about where these areas lie? I've been listening with a great deal of interest to your fancies——"

"Fancies, sir? Fancies? And who is to say they are fancies? Can anybody dispute them, prove they're fancies? Why, sir——"

"Let's say I didn't use the word 'fancies.' Perhaps you'll forgive me and answer my question. I'd be deeply appreciative."

The man grunted. "Well," he said, "you know where the Morning Glory Pool is?"

"Yes, indeed. And an indescribably beautiful pool it is, with a purple crater twisting down——"

"That's it exactly, twisting down to what? Oh yes, well, you'll recall the geysers directly beyond the pool, almost in line from here, across the location of the Morning Glory Pool?"

"Yes."

"Well, there are geysers beyond

those. The people here don't encourage tourists to go much beyond sight of the main road, yet through the woods you can see the steam jets of other geysers. Beyond them are others, while beyond them— Look, mister, I don't like to get thinking about Yellowstone in detail. It frightens me, especially at night, to think of all the strange, awesome things that are going on under our feet. Glory be, what it would be like to be lost, afoot, on a dark night, somewhere in Yellowstone Park! I wouldn't even walk down the road after dark for all the gold in the world—all the gold in the world, I tell you!"

Tatum thanked the man, sat back, his heart hammering like a trip hammer. It was odd that the man should have mentioned "all the gold in the world," for last night Siegfriedt had said, talking of the Beartooth—and not, at the moment, about his "find"—that a literal "golden horseshoe," a colossal stratum of gold, started across the Beartooth from Red Lodge, went for hundreds of miles in a vast, rough semicircle—or horseshoe—and ended within a mile or so of Red Lodge.

Siegfriedt had said: "If that gold were ever mined, all at once, it would make gold cheaper than pebbles, cheaper even than sand on the beaches of the oceans—"

Tatum smiled as he recalled the statement. All the gold in the world, paradoxically, wouldn't be worth much. But he didn't explain that to the speaker. Instead, he rose, started down the steps.

"Where are you going?" asked some one on the veranda.

"Thought I'd have a look at those geysers beyond Morning Glory Pool by moonlight?"

"Why, you fool, after what I just said! Something horrible might happen to you, something—"

"I've always wanted something—well, not horrible, but, let us say, cataclysmic,

to happen to me. Maybe to-night's the night. Care to come along?"

But there was no answer from the veranda. Or if there were, Cleve Tatum didn't hear it. He was walking rapidly toward the Morning Glory Pool, and whatever might lie beyond—with the deep conviction in his soul that the talking fool on the veranda of the hotel had given him a clue to the solution of the nebulous something suggested last night in Siegfriedt's Red Lodge study, while the sightless eyes of a man sixty-three million years dead looked calmly down upon him.

II.

IT WAS not in Cleve Tatum to be afraid. He was too much the cool-headed scientist. But he could understand how average folk, abroad by accident or design at night in Yellowstone, could be frightened dreadfully. Yellowstone was the world when it was young—as science rebuilt it. Yellowstone was almost the proof that they were right.

No sooner had he left the hotel behind than he felt the strangeness—the youthfulness—of Yellowstone. Even the moon, riding high over Norris Geyser Basin, on the road to Mammoth Hot Springs, looked newly washed, smiling. Near at hand the thick trees were like other trees at night. But a little farther on they were black blobs of shadow—black piles of shadow out of which, here and there, yonder and almost everywhere, came puffs of white, as though invisible mortars were firing at the sky—invisible mortars that made little or no sound. They indicated the presence of geysers, great ones and small ones. The steam from them dropped down, after their leap aloft, and fled across the treetops like shrouds driven by breezes Cleve Tatum could not feel. It made him feel unreal himself, as though he were on another planet.

He came to a startled pause. He

saw himself lying flat on the ground, on his back. Then he laughed a bit shakily. It was his reflection in Morning Glory Pool. It gave him a slight touch of terror, at that, because the pool was surrounded only by eight-inch logs, lying end to end to form a rough circle about the crater that was brimful of scalding-hot, blue water. To stumble over the logs would have meant death—and a sinking into the funnellike crater he had studied during daylight.

Yes, even here, where people came, Yellowstone was dangerous. He wondered what tales, out of the past, this pool could tell if it could talk. Indian maidens, perhaps, had plunged into this pool to forget lost loves. All sorts of animals, naturally, had stepped into it in days when there had been no guards about it at all—though eight-inch logs, lying flat on the ground, could scarcely be called guards.

He circled the Morning Glory Pool, strode on toward the many geysers beyond. Now, in spite of what his feet told him—that he trod a regular, well-tested path—he walked with his eyes, most of the time, on the ground. Now and again he paused to look about him and listen to the majesty of the earth in travail.

And he couldn't get that "clue" out of his head—that "fancy" of the talker, about machinery hidden deep underground, ancient machinery, perhaps, which somehow caused these jets of steam all over Yellowstone; these jets of steam that were slightly irregular in their spoutings, as though the machinery were getting out of tune, or growing old and falling apart.

"Nonsense!" he told himself. "Machinery! Who, or what, operates it? And what's the sense of it?"

To follow that thought took him back to Siegfriedt's primate and that man's time in hitherto unrecorded history. All of Yellowstone Park had once been under what the world now knew as the

Pacific Ocean if Siegfriedt and paleontologists who agreed with him were right. That had been uncounted millions of years ago. Then the mountains had risen, and the ocean had been pushed back—Yellowstone Park and the Rockies had been born. That primate had walked this land *before* the Pacific covered it!

It made time seem small indeed, unimportant, but only because it covered a period too vast for man to grasp. It was difficult for man to grasp a time previous to his own first memories. He could no more think back beyond that than he could see what would come into the world after his death.

Tatum was feeling more and more the stranger on an alien, unnamed planet. This feeling grew on him the farther he pushed in among the geysers. He left the regular path—after how much time he did not even guess—and guided himself in what he thought a very simple manner, by traveling toward the next nearest geyser. One could see their jets on the darkest night, he was convinced of that. But now he was moving into unknown territory and—who knew?—there might be craters all around him which had been dead for ages—large, gaping craters, into which a man might plunge endlessly, twisting, falling, down and down. It made him gasp, just to think what it would be like—for example—if the Morning Glory suddenly went dry, and one fell into the abysmal crater of it.

So, he felt his way with his feet. He could travel faster than most men this way, because his feet were educated in such travel. For the paleontologist they had to be. Often the paleontologist's mind was so concerned with what he did that a misstep might mean death, and he might take it without ever realizing it. So one learned to think with one's feet as a separate act of thinking.

On and on he went. He noticed that each geyser had a different sound.

That one to his left stuttered, like an old man with his teeth missing. That one to the right screamed—a slobbering kind of scream—as though its lips were slashed and torn. One sounded like a peanut whistle. Another roared. Another whined. He kept thinking of them and their sounds—

BY THE TIME he had gone perhaps two miles into uncharted territory, it struck him with the force of a blow that all the geysers, heard together, formed a *system* of sounds. There was a pattern to them that perpetually repeated itself. Oddly, he thought, like cylinders on a many-cylindrical motor car, working in unison. Now and then there was a discordant note, as though a cylinder were missing!

"That talker has me going, no doubt about that!" thought Tatum. "And that thought of my own, about his talking 'in tune with his surroundings'! It's not especially silly, at that. Sensitive people, entering a room where others have suffered, feel the shadow, the *od*, of that suffering. Why, then, shouldn't they feel this, on a larger scale? Do I mean that this *land* is suffering?"

That made him think of the primate again and what, several times last night, he had thought was an expression of suffering on the fossil's face. "Nonsense!" he told himself again. "I'm letting fancy interfere with calm, scientific research!"

He began to realize that he was moving forward faster than was commensurate with safety, to realize that something was wrong. He tried for a little time to figure it out. He stopped, took off his hat, wiped the sweat off his brow. The geysers filled the night with clammy heat. Then, of course, down below—nobody knew how far down—there must be plenty of heat. He looked at his hat. With a low laugh, he threw it away. It didn't fit in. A simple

thing, but it helped. He was never to know exactly how.

His black hair now blew free in the breezes that kept the steam jets traveling through the trees. In a general way, he was traveling into the west. All he had to do to get out of here was travel east; return would be simple. But he gave little thought to that. There'd be food in the woods, of one kind or another. In case of need he could knock an antelope over with a rock. They were protected here, and almost tame. And there were other animals. And water—boiling water here, ice-cold water there, beside it. A land of impossibilities.

Everything was here. Mammoth Hot Springs, building its mines of travertine that would be hard enough to polish some million years hence. Firehole River, lined on one side with black basalt, proof of volcanic action which might have taken place before the ocean was pushed back. All the metals known to man were here somewhere: gold, silver, barium, chrome, coal—all the ages of metal.

Yellowstone Park was the gathering place of everything science had ever discovered and classified. Why, if it were not a place set aside for man's amusement, but were exploited—work, food, shelter and machinery for a race of people could be managed right here! *Had it done exactly that, sometime in the past?*

While his scientist's brain pondered these questions, his trained feet led him safely deeper and deeper into the unexplored area of Yellowstone Park. He didn't realize this until his feet betrayed him, almost led him into a broad, black pool that bubbled. He smelled the odor of tar. He shivered, knowing what would have happened to him, had he stepped into *that*.

He bent his steps to the left, walked for a hundred yards or so. A boiling stream of water, just too wide to jump

across—if one could have survived a jump through the steam—barred his way. He turned to the left again. This time he traveled perhaps an eighth of a mile before he was brought to a halt again. Another boiling stream came from the left, to empty into the one he had been following.

A little startled, he followed the second stream because he could do nothing else. A quarter of a mile, and a third stream poured into the second. He followed this to a series of geysers, set close together, that he recognized. He had passed this way. But how had he missed those bawling, boiling streams? How had he failed to hear them? The answer to that was simple. He had been thinking, and with the thinker who concentrated, all sound was shut out. He wouldn't have heard Old Faithful, had she erupted in his face.

He followed the row of geysers which were connected by bubbling, boiling streams—and was brought to pause by the tar pit!

"I can't get out," he said to himself, "but how did I get *in* here, without being parboiled or even getting my feet wet? I'm a prisoner, but how did I get that way?"

There had to be a way out, because he had found a way in. He'd find it by covering, carefully, the area he had just circumambulated.

He faced away from the tar pit, started across the rough rectangle formed by pit, geysers and streams. He crossed to the stream—the second stream—and started back.

FOR fully two hours he crossed and crisscrossed the circumscribed area, puzzled, furious with himself because his agile brain couldn't deliberately figure out a puzzle which had been no trouble to his feet on the way in. Then he stopped, stock-still.

Far below him, as though at the foot

of an incline he hadn't encountered before, was a rectangular shape that glowed, as though reflecting the light of the moon. He squinted, stared, turned his head away and looked up. The brightly washed moon seemed to be watching him. Yes, it was the reflection of the moon, all right; but on what?

Slowly he approached, while the glowing outline held its rectangular form. Under his feet the hard ground—most of his way had been over rough, jagged basalt that had almost cut the shoes from his feet—sloped swiftly away. When he had gone a few feet down the slope he gasped with amazement. The roughness under his feet had become smoothness! This incline had either been cut by the hand of man, or Yellowstone had a miracle not yet discovered.

Or maybe the whole world knew of this place, and only he had not been told. Maybe it was one of the famous wonders of Yellowstone. As he moved forward and downward more confidently, he was sure of it. That rectangular shape was apparently a high, massive door. Human hands must have put it there.

He stopped, gasped. His own shadow appeared on the door, grotesque, monstrous! No sooner had his shadow touched it than the door began slowly to open. That gave him a slight chill, but it wasn't the surprise of it so much as the sound the door made as it opened—seemingly with no hand to move it, no machinery to operate it. It was opening with strange unearthly screams of protest, as though its hinges were rusty from years, ages even, of disuse!

He could see plainly, because the incline had become a slope, from walls, floor and roof of which came a light that filled the slanting tunnel with a radiance brighter than midday in summer!

"Hurry!" said a voice, "so that the door may close and darken."

Automatically he obeyed, stepping

past the door. It creaked shut behind him with a grim note of finality.

"Do not be afraid," said the voice again. "You will return in safety."

Not until he had left the door well behind him did he realize that he hadn't, actually, *heard* the voice. Rather, in some inexplicable way, a message had struck his brain with such unmistakable meaning that he had *thought* he heard the voice.

"Anyway," he thought, "the message was in English. Whatever the stunt is, it can't be very disturbing—especially to me."

He was conscious of walking in something that eddied about his feet like—like—well, as though he were walking through pulverized leaves in a forest. He stopped, looked down. So far, he had made one mistake. He had been sure that the bright light, whose source he had not yet discovered, came from floor, ceiling and walls. Now he knew it did not come from the floor—because he stooped, lifted the stuff through which his feet had slid, and stared at it.

His eyes bulged. His heart, for a moment, almost stopped beating. The fine stuff in his hand was gold! No paleontologist worth his salt could mistake it! And Nature, he now knew, had never, unaided by other intelligence, dug this swiftly descending tunnel.

For a full minute he gave himself a careful examination to make sure that he was not mad. Then, shrugging, he accepted things as he found them—impossible as they seemed—and strode deeper into the bowels of Yellowstone to find the reason for them, forgetting his promise to send for Jasef Siegfriedt.

And so, at last—how long later he did not pretend to know—he came to another door, which opened as had the first, when his shadow touched it. He stepped through. As he did so, the tunnel along which he had come went dark with the darkness of a mile-deep mine, and the second door closed. When he

heard it fall snugly shut behind him, light again bathed him—light as brilliant as that which had died behind him.

He caught a glimpse of a vast cavern. Then he almost screamed—for the man who faced him—the man who stood against a broad wall of travertine that was simply one of the walls upholding the roof of the cavern—was Siegfriedt's primate.

Only, this one seemed alive. And this one spoke: "I am Tlalak. I bid you welcome. You have been a long time coming. Sit down on the bench to your right while I attempt to explain to you."

III.

CLEVE TATUM glanced to his right, where a bench of polished travertine was hewn out of the living rock, and sat down, rather limply. His mouth hung open as he stared at the man who called himself Tlalak—a man who stood all of seven feet in height, a man who could have broken Tatum in two with a twist of his hands.

"The mechanism which presents me to you began moving when the second door went shut. I am sorry that no mechanism is possible that will present you to me. I speak to you, as you must realize, from the grave." How old that grave is, you will, perhaps, know. I can never know, because it is not given to mankind to see so far into the future, or even to conceive of such a length of time. I can only estimate that it will be millions upon millions of seasons. I base this on history of other times, when the ocean had risen, covered the land, been driven back by the rising mountains, covered the land again—"

Tatum's brain whirled as he tried to conceive of what this man was putting into the simplest of words. Words! English words!

A smile, infinitely sad, crossed the swart face of the man called Tlalak. "I have no means of knowing what your

language will be. I can only hope that evolution will approximately repeat itself, and that man will again walk this section of the earth, as I am sure he walks the earth in areas beyond our reach. You probably think you can hear me—or such is my hope—speaking your own language. But surely, by this time, you realize that I do not speak at all! How could I reach your understanding with a language that had, by the time you come to Tardan, been dead for ages? No, my friend, gentleman or lady, I do not reach you through your ears. A sound strikes your ear, sends an impression to your brain, perhaps the name of an object. Your brain visualizes the object suggested by that word, that name, that you understand because it is the language you know. The word means something to you. But no word I speak could possibly mean anything, for I am the last of my race, and there is none to keep my language alive. It would be possible to preserve that language, so you could hear; but I cannot chance the possibility that no key could be found to it. So, I speak to you not by way of your ears, but directly to your brain!

"It is not simple. The mechanism which makes it possible is installed in the rock behind and above you, where your scientists—when you take the tale of your visit back to a world I will never see, nor can even visualize—may make such use of it as they will."

Cleve Tatum started to his feet. "My Lord!" he shouted. "You are explaining motion pictures of the distant future, when, no matter in what language they speak, they are understood by the audience in their own various tongues!"

Tlalak paid him not the slightest heed. Tatum's voice went rocketing through the mighty cavern, echoing and reëchoing. It came to Cleve Tatum then, a hint of the vastness yet to be explored, a consciousness of his own smallness in the great immensity. As though, at this

point, he expected his audience of one to be startled, even stunned Tlalak paused—and that sad smile was still on his face.

"My words," said Tlalak, "have been given to the mechanism. The mechanism receives, passes on—passes on the *meaning*. The mechanism is a delicate brain that transmits meaning to your brain—most of it in words you will understand. Perhaps there will be words you will not understand. They will doubtless be names of things, creatures, customs, perhaps, known to us, unknown to you. You will have to bridge the gaps as best you can. The pictures you will see, where I now stand, will aid you in bridging these gaps. Such is my hope. If I have erred, then the civilization of Tardan is lost beyond recall! A grave responsibility is mine. I would give all the wealth of Tardan if I could face you in the flesh, see you, greet you and speak to you in some common language. But even to express this wish is an idle waste of time."

CLEVE TATUM sat enthralled, watching the face of Tlalak. It did not seem possible that he was actually receiving a message from a time beyond the Ice Age, beyond the Rocky Mountains, beyond conception. He listened for the sound of the mechanism Tlalak had mentioned, and heard nothing. He could not forbear a smile, when he thought of the noise of present-day projection machines.

"We must be careful, very careful. I appeared to you when the second door closed. But when I have finished my introduction, you yourself must take the next step. Under the end of the bench on which you sit is a row of buttons. The button nearest me, when pressed full down, will show you segments of our earliest history. The next button will show you our communal life as it has been lived for a dozen generations. The next button will show



Yes, it was the reflection of the moon, all right—but on what?

you the animal life that has ceased to exist above us, because of the eating up of the land by the sea. Needless to say, you will actually hear the sounds of all that. The next will show you the encroaching sea, and the beasts that live in it, will show you the sea as it finally covers our Tardan with its crushing, catastrophic weight. The last button will show you our life in Tardan—underground city which we have, by the work of generations, prepared against the day when the waters cover us.

Select which of these you wish to see. At the end of each I will be back, prepared to lead you to the next stage on the journey into the heart of Tardan! In the event of failure of the mechanism, which is unlikely but possible, due to the vast lapse of time unused, walk to the door until your shadow appears upon it. It will open. Step back. When it closes, I will begin again, just as I began when you entered! Now, you have all the time you wish in which to choose where and when you will start!"

Tlalak stood for a moment, then vanished, to show Tatum only the smooth white wall of travertine—a wall perhaps forty feet wide, by twenty feet thick, and a hundred feet in height.

"Whew!" Tatum leaned back against the wall, wiped the perspiration from his brow. Then he sat up. He wasn't really hot, for the air in this place was delightfully cool, utterly pleasant. It was a welcome change from the muggy, sticky atmosphere of Yellowstone and her geysers.

Yellowstone! To-night it had seemed like another planet. Right now it seemed even more another planet. It seemed ages away in time, distance and perspective. And for a good reason. In this place it *was* ages away in time, distance and perspective, because the people who had created this Tardan mentioned by Tlalak—Tardan, of which this was only the entrance, where Tlalak stood to bid the visitor welcome—had

never seen Yellowstone or even conceived of such a place. Or *had* they?

Tatum pinched himself, grinned. "I'm not crazy," he said. "I'm not having a nightmare, and Tlalak meant exactly what he said. How will it affect my mind to go on? A cavern which has plainly been shut off from the world for æons, yet in which the air is sweet and cool! Air conditioning! Ridiculous—or would be if I hadn't already seen and listened to—or been telepathed by—Tlalak! Now, what do I wish to see first?"

HE FELT FOR, found a button, pressed it full down. It moved easily, smoothly.

Tlalak came back. There was happiness in the smile he bent on Tatum. It seemed almost impossible to realize that Tlalak wasn't really there—that, actually, he hadn't been there for millions of years.

"You are wise to press the last button. It proves your logical mind. I will show you Tardan and the mechanisms by which it survives below the sea. Then, when you are satisfied that you have been sufficiently prepared, I will take you into Tardan itself—a Tardan, alas, in which nothing sentient exists, where only the machines move smoothly on, self-existent and self-repairing. Pray Heaven that we have not been mistaken in them. If we have, Tardan will never be found, save in ruins incapable of restoration after millions of years under the sea. Their primary function is to keep back the waters of the sea! Their other functions, of course, are countless, but this is the first and most important, even now, when only I am left in Tardan. I must tell you that much you see, everything you see, will be terrifying, in spite of the fact that what you see are incredibly ancient shadows. By pressing the last button again, you need not see!"

Tatum hesitated, glanced a bit fear-

fully to his right, into the bright heart of the cavern—so empty, so filled with the echoes of his own breathing, like whispers out of the dim past. He pursed his lips with determination and did not press the button a second time.

Tlalak waited a moment, as though to give him time. Then he smiled, said: "Good! You have courage, too! Good-by for a little while!"

A vast concourse of people burst into view, amid a great roaring of sound. Tatum leaned forward to study them, marveling at the photography which brought out each individual in such a huge gathering. He was looking into a tremendous city—a city whose streets were hewn from the living rock, whose roof, hundreds of feet above, was the living rock of the earth's crust, and whose buildings, of many shapes, of many sizes, were all of the same height—for the simple reason that their bases were the floor, their roofs the common ceiling. The buildings themselves were columns which supported that awesome roof.

He tried at first to identify the sound—and it was almost as though he entered into the picture itself, became one with the people depicted there. He gazed fearfully aloft with them, at the domed ceiling whence the terrifying sound came—which now he was able to identify because, for a brief moment, the picture changed to show him the surface of the earth and the first rushing, supermountainous, tidal waves that had drowned that surface. He saw the waters swirl, become monstrous, Gargantuan maelstroms as they met in unbelievable, inconceivable tide rips—as they piled, tidal wave on tidal wave, up on the earth's surface. He heard the first protests of the vast roof of Tardan.

The picture flashed back to Tardan itself—back over the frightened, up-gazing people, blotted them out—showed him maze upon maze of what he knew instantly to be machinery, but such ma-

chinery as he had never, in his wildest flights of imagination, conceived. Forests of it, labyrinths of it, smoothly, efficiently working— Just where it was, in relation to the people, he could not tell. He would find out, he gathered, when finally, in the flesh, he went into the heart of long-dead Tardan.

He could wait for that. But the picture—which amazingly was able to show vast panoramas in the area that hitherto had been occupied by Tlalak—made plain the reason for the machines.

They were there, in readiness, to keep the waters of Mother Ocean from destroying the people of Tardan—to make sure that not even a hint of seepage came through that tremendous roof!

NOW the picture changed, to further clarify the meaning of those machines. A cross section was shown of the rock and soil that extended upward from the roof to what had been the surface of the earth, and now was the floor of the ocean—

Tatum grew dizzy for a moment, remembering something he had seen in a building near the hotel by Old Faithful—a cross section so nearly like this one that the memory startled him.

This cross section showed the waters of Mother Ocean seeping inexorably down, reaching for Tardan to drown it, obliterate it; that cross section, done by engineers who thought they knew all about Yellowstone's substrata, showed the causes, gaseous activity and general upward routes taken by Yellowstone's geysers—from inception to periodic eruptions! The parallel was startling, to say the least.

But now it became more startling still—for the cross section, on the travertine "screen," showed the power of the mechanisms, stopping the seepage of the water, hundreds of feet above the roof of Tardan—stopping it dead, at first—then slowly, surely, and with tremendous force, driving it back, up

to and through the floor of the ocean, back into the vastness of the water which had lowered it, like deathly tentacles, toward Tardan—forced it back with such power that the back-flung water shot into the ocean from below, there to spray out—whitely visible in the water, black with depth—to heights varying from a few to scores of feet! The result appeared to be *undersea geysers, erupting with tremendous force through the deep*—

Tatum was stunned by the thought this cross section led him to, until he remembered something else he had seen that day in Yellowstone—in fact in Yellowstone Lake—along the whole western side of which he had seen the steam jets of geysers, far out in the water. Where the water shelved off to great depths, of course, no steam was visible; but did that indicate that no geysers erupted from those depths?

“My Lord,” thought Tatum, “what has all this to do, if anything, with the geysers I saw to-day! What in Heaven’s name am I going to see down here, before I see those geysers again—and what will they mean to me when I go back?”

IV.

COULD the mechanisms of Tardan be the cause of the geysers? But how? It was absurd, of course. But was it? Suppose humanity was going to be buried by the sea. Would it sit supinely by and make no preparation to survive? Certainly not. And where would it go to escape? Well, Tardan had gone underground. Some day humanity would perhaps again go underground, or into the air. In any case, Cleve Tatum would have some sort of answer before he was finished with Tardan.

As he watched the story of Tardan and its people unfold, he thought of a belief of modern scientists—though who could possibly say who, or what, was “modern”? —that the sun was sure, one

day, to explode, perhaps at any minute, burning every living thing on the face of the earth. Given sufficient warning, where would humanity go to survive? Into the deep earth, if it could be made habitable and could, in some manner, be insulated against the heat. And, given time, science would find the answers, just as the scientists of Tardan appeared to have found the answers—to everything except how to survive whatever catastrophe had overtaken them. They’d kept back the sea—and the machinery with which they had done it still moved on through the ages, despite the millions of years that there had been no ocean above Tardan.

“And they built with amazing architectural surety,” thought Tatum, “for Tardan has plainly, and bodily, survived the era of mountain building that drove back the sea!”

Jumbled, chaotic thoughts! How many times had the earth been empty of all life save the very lowest known, the unicellular creatures, and from them, through the æons-long processes of evolution, became populated with creatures that were men, or approximated men?

Suppose the sun *did* burn all life upon earth, would earth again gradually cool, gradually become repopulated through the æons—even back, through millions of years, to man once more? It seemed reasonable. How many times had it happened in the past?

Cleve Tatum chuckled at these thoughts, because that seemed the sanest way to treat them. He was finding a new yardstick for them on the earth. Hereafter he would measure it by “periods of evolution following periods of cataclysmic destruction,” just as astronomers, stunned by the impossibility of measuring stellar distances in miles, measured them instead in light-years!

This led to one brain-numbing conclusion about what he was now seeing: by being tumbled backward millions of

years into the past, he was also being hurled millions of years into the future of his own civilization—for he was watching the yardstick of the past with the growing realization that it measured the future, too. All previous "evolutions" had been destroyed, or had in some way destroyed themselves when they reached the place in their development beyond which they could not go. Was Tatum's own "evolutionary period" to end in a like manner?

If this were likely, might he not find, in the history of Tardan, some means of averting that end?

This thought gave new interest to his investigation—which until now had seemed so utterly fantastic, but which all at once seemed right, reasonable, logical and to be expected. It even led him to wonder how many "cities" might be found, deep down in the earth, when man came again to bore into her, seeking wealth and knowledge.

AS HIS THOUGHTS ran on, his eyes followed the pictures that unrolled on the screen. Those machines—ponderous, huge, Gargantuan—were being gradually changed as the "film" unrolled. They became smaller and smaller. He knew instantly that he was watching, also, the evolution of machines. Watching how the brains of men were learning—or had learned—to do vaster things with smaller mechanical means, so that, at the end, instead of vast mechanisms that did comparatively little work for the power expended, there were tiny machines that did countless times the work the vast machines had done—and even these machines were a nuisance to the Tardanians. Finally, they were set at last into the walls of Tardan and sealed therein—out of sight. Sealed with them was the power to restore their own broken parts, to repair themselves, endlessly—leaving little for their human masters to do save accept the fruits of their labors.

And the labors of those machines were many. They prepared food from the sea, from the earth, from the very air—food infinitesimal in quantity, but perfect in value to the human machine. Those machines kept clean the streets and houses of Tardan and lighted the whole city. Those machines kept the air sweet and pure. Those machines transported people wherever they wished to go—though for some time Cleve Tatum could not see how this was done. It appeared that when a Tardanian wished to call on his neighbor, he could do so in pictures! Television—but a strange supertelevision, in which the figure on the "screen" simply stepped out, his or her everyday self, off said screen, and sat down with the person he wished to visit. But how? Disintegration at home; instant reintegration at the place visited?

Cleve Tatum could not find the answer to that, nor did he pause to try, for the history of Tardan was unreeling so fast that even when he paused for a split second to think, he might miss some vital portions of it. And the machines interested him beyond anything else—for even before the truth became apparent to him, it struck him that the masters of the machines—to which those masters had given superhuman intelligence, gradually—had finally become slaves of those machines. Certainly they had, figuratively—for they did nothing without using them. Tardan, when final catastrophe came, must have been the abode of the laziest, most useless people who ever lived anywhere!

"Just so will we become, if machines one day do all that science anticipates!" thought Cleve Tatum.

So, Tardan became empty of machines. None were visible anywhere—but only their activities—for all were hidden behind the travertine walls of the amazing city—

Here that reel came to an end—and Tlalak once more appeared, with that sad smile of his. "Those machines will

still be found behind the walls of Tardan, my friend of the distant future," he said. "They do everything the mind of man can conceive. They even *think* as he does. Their secrets are yours for the taking, but you are warned, of course, that those machines brought about the doom of Tardan's people—so be careful how you bring them forth and use them. We were infinitely foolish; it may be given you—and your scientists—to be infinitely wise! Look behind the walls *now*, if you feel that your race is ready. But if it is not ready, better for you and yours if Tardan were never to be opened at all!"

A chill caressed the spine of Cleve Tatum as Tlalak vanished. Tatum waited a bit to decide what he next wished to see, while his mind ticked off the wonders he had seen already, if Tlalak had not lied: supermotion pictures; air conditioning; perpetual motion; machines with intelligence; self-repairing machines; practically indestructible architecture—which had withstood the mightiest of all oceans and the greatest era of mountain building. Greatest era? Who could know? Might not the Rockies have been preceded by mountains a hundred times their height and bulk? His brain reeled with that thought, and he cast it aside as being, for the moment, frivolous.

HE let his breath out slowly, pressed another button—and his brain was filled with sounds hitherto not even imagined. This reel showed him, while Tlalak explained, off-screen, the monsters of the sea. He saw creatures—Tlalak's names for them meant nothing to him—which could have swallowed present-day whales with ease. Water serpents of unbelievable size and ferocity, which fought other monsters, churning the sea into froth over vast areas. And the sounds of those struggles were mighty beyond compare—as they must of necessity be, because Tatum had nothing with

which to compare them, not even in childhood nightmares. And when he saw how the sea was crowded with these creatures, he understood why Tardans were not seafaring folk! And he knew, too, whence, in racial memory, had come the monsters with which even wise men of Columbus' day had peopled the seas not then explored. He watched the evolution of those creatures, his brain numb with the might of it.

Then he saw the creatures of the land—before the sea covered Tardan. Cleve Tatum gasped and blushed with shame. For these creatures, though monsters, little resembled the "reconstructions" of them he and other scientists had made from their fossil remains. In only one way could they be indicated to present-day men—and that was as they were now being shown to Cleve Tatum himself. He could not even go back to the outside world and tell people, in words, or with comparisons that they would understand.

In general, however, their development followed the generally accepted theory of evolution. When he was sure of that much, he shut off the pictures of creatures and turned back to man and his development.

Here, too, evolution—as recognized by present-day scientists—was proved. For he watched man's "footprints on the sands of time," as Tlalak explained it. Hairy creatures, apelike, at first—He saw their single life, in the beginning the breaking away from others by the first manlike creature. Even then, he wondered again how many times this same thing had happened. There were gaps, of course, for Tlalak's scientists, too, had had to "reconstruct," and must have made approximately the same mistakes scientists of the present era were making and had made.

Then, the "modern" history of Tardan—and here the record had to be true,

for *this* was the actual, pictorial record—and Tatum had learned another thing in which Tardanians were uncounted ages in advance of his own “moderns.” For these very “films,” or whatever they were, analogous thereto, were showing him that record, after the passing of untold ages—while filmdom of today could not guarantee that any film yet made would last more than a few short years.

This film was a film of people. By dozens, scores, hundreds, those people came and faced Cleve Tatum. They spoke to him as Tlalak had spoken. He saw their faces, and that there was more than one race among them. There were men who looked like Tlalak, and women, too, who looked much like him. There were handsome men who—out of that film and dressed in modern garments—could have strolled unnoticed on the streets of New York or Hollywood. There were lovely women, as fair of skin as any Tatum had ever seen—women with lovely smiles—smiles that, so perfect was the pictorial art of Tardan, seemed for Cleve Tatum alone. There were times when he almost stepped forward, to take the hand of some lovely woman. He scarcely noticed the clothing of any of them—save that that of the women suited them.

There were children—and they gave him food for thought. He waited with hammering heart to see how far Tardanians had gone in the matter of eugenics. Without absorbing too much detail, it became evident to him that reproduction could, and did, take place without any conversation of the sexes—even from earliest times. Science, then, had taken one of the greatest reasons for discord out of the lives of the people of Tardan! It was significant that none of the records shown Cleve Tatum were of war or bloodshed. Perhaps there was, even, no love in Tardan. But that could not be—with those lovely women he saw—unless Tardan had dis-

covered something vastly more interesting to its people. But what could be more interesting?

Intellectual pursuits? Perhaps. Maybe even certainly, if one might put it like that—for the brains that had started the evolution of those machines and carried it forward to what seemed to Cleve Tatum to be perfection, had certainly been brains capable of labors only less mighty than those of the Creator Himself. Cleve Tatum thrilled to innumerable references to the Deity—as though, hearing such mention here, proved His existence, which it might well do.

He saw the evolution of a race, or combination of races. He saw the faces of many women he could have loved—might even then and there have loved, but for the fact that he kept reason securely in the saddle. What good, loving women dead these millions of years?

The story of Tardan's evolution from the sea to the land—the long growth on the land from unicellular creatures on up through the combinations known to all scientists, or at least *believed* to be known by them—to man, then as now, the apex. Man's development, growing intelligence, culture, literature—only Tardan's literature was pictorial instead of written, telepathic instead of oral—to the age of machines. The evolution, side by side, of man and his machines—the man growing less self-reliant as he depended more and more on his machines; his machines growing more and more nearly sentient beings, if not actually so—until man did not even wish to expend effort to operate his machines, but created mechanical men, robots, to perform his labors for him. And after the robots, machines which cared for themselves!

“At least we,” thought Tatum ruefully, “don't have to worry about machines running their own shows just yet! And still, with robot pilots, robots that can talk, walk, think—maybe we're closer

to what Tardan was at the end than it now appears. Invention accelerates, after a certain point, into a falling body, or speeds up as a number grows that is constantly doubled——”

THE EVOLUTION of Tardan had been all unreeled, but now it seemed there was more. The face of Tlalak had never been sadder. “I’ve shown you how Tardan became great, to the point where it could, apparently, become no greater. Now you will see how she fell, and how swiftly.”

A new picture, tacked onto the story of Tardan’s evolution, began to unreel darkly. It puzzled Cleve Tatum at first, because he could see no reason why it began just where it did.

The city of Tardan—her people—those people with smiles gone from their faces—haggard faces—— Cleve Tatum studied the city and the people, trying to find the answer to the terror that flowed out like an invisible tidal wave. And slowly he began to get the answer. Those people were rich beyond the dreams of avarice. They were so rich, even the poorest of them, that wealth meant nothing. Nothing any one wished was denied. He or she had only to press a button or *will* a machine to do it, and whatever he or she wished was there.

“Nothing to strive for! No reason for ambition!” Those words exploded in Tatum’s brain. He wasn’t sure whether they were his or Tlalak’s; but he was sure that they were the answer to Tardan’s beginning of catastrophe. Tardanians had nothing to live for; therefore, they sickened and died. There was no reason for them to bring into Tardan, with which they were deathly bored, children to be bored as they were. That must have been the answer. For in this reel he saw no children, though he searched for them all through Tardan.

The dead, he noticed, were burned. He could not be sure of the manner of burning. But he saw people die, saw them dead—and saw them disappear entirely through some action of certain of the machines. Absolute incineration, apparently. Score something else for Tardan!

Dying Tardan—Tardan almost dead—nobody left but Tlalak and some of his close friends, companions—whatever their relations were to one another.

Tlalak’s voice came out of the screen to Tatum. “We knew we were doomed. But we knew we had developed a worthwhile civilization, one that we ourselves did not deserve. Perhaps some race of the future might use it better. We knew we must preserve it. So, the members of Tardan’s council decided that the councilmen would not be incinerated as other dead Tardanians—but turned into stone! We searched our most ancient archives for secrets of corporeal transmutation, which hadn’t been used in Tardan for generations. We found them. Thereafter, as one of us died, he was transmuted, cast into the sea. It was our hope that some of us would be preserved, whole, go into the silt, become part of the rock—and be found in that rock, as you, my friend, must have found one of us—even myself perhaps, since I have arranged that a machine transmute my body when I die—and come seeking the story of your find. For only thus can you have found Tardan. When I die, I leave this much of my will to rule over the machines—that no man, save one who has found a Tardanian, and touched him, and understood his meaning, however nebulously, shall cast his shadow on the first door to the city. Any other who approaches, the machines will deter or destroy!”

What in Heaven’s name was Tlalak so calmly telling Cleve Tatum? That he, Tatum, had reached Tardan’s outer gates by *direct command across the ages?* Tatum’s mind reeled with the

thought that such a thing could be possible. Was it? Wasn't it? It was! For what man could imagine, man could, eventually, *do!*

Tatum, then, was here because the man who now addressed him by telepathy had given his command to the city of machines he had left behind him. That the command had been executed, was even now being executed, was proved by one simple fact: Cleve Tatum was there in Tardan, ready now to obey the rest of that command, however much it might be.

Tlalak spoke again. "Now, my friend, you are ready, if your courage still holds, to go on into the heart of Tardan—city of the dead, where only machines rule—where even the little mechanical men must long since have destroyed themselves!"

Little mechanical men? Yes, tiny robots. In the pictorial he had seen many of them, without understanding their nature or even guessing at it. But now it came to him what they were, or had been.

Those little yellow robots, that for a brief period of time had operated the machines, had been fashioned of gold! It was strange how everything, at one stage or the other, came back to gold—which, of course, had been one of the symbols of wealth in Tardan, until it had become so plentiful it had been used in the making of the little mechanical men.

As Cleve Tatum rose to continue on into Tardan, all of the vast panorama of life he had just witnessed of the ages, of worlds made and torn down was suddenly dominated, in his mind, by the golden robots.

Something of them, beyond a doubt, must survive in the city. It was as though his fantastic walk, down the incline, inside the first door, through infinitesimal "leaves" of gold, was a promise that fabulous things yet un-

dreamed of would be found ahead, and far below—even, perhaps, the fabled wealth at the rainbow's end.

V.

CLEVE TATUM ROSE, passed around the pillar of travertine upon whose face he had "seen" and "heard" Tlalak, and moved down into Tardan. As he went he tried to marshal his thoughts, to set them in order from the very beginning, bring them down to date, with explanations to himself that would seem reasonable.

His coming here hadn't been chance, then, but design. In only one way had it been done. Dr. Siegfriedt's miners had found the fossil of the Tardanian—Tlalak himself, or one of his companions—and that, of course, had to be put down to chance. Perhaps even the fact that Siegfriedt had sent for Cleve Tatum had been chance.

But from the moment Tatum had examined the fossil, nothing that followed had been chance, but design—a design whose pattern had been planned millions of years ago. Why, seeing the fossil, had Tatum gone straight to Yellowstone? If the hint given him by the ghostly Tlalak were true, he had gone there on something that might be termed a scientific hunch, in the hope of finding, in an area of chaotic formations approximating that in which the fossil of the Tardanian had been laid down, something more to explain that fossil.

Had he been sent? But of course he hadn't been sent to Yellowstone, for the Tardanians had never heard or conceived of Yellowstone. Yellowstone had merely been on the road to Tardan. From the moment he had left the office of Siegfriedt he had been obeying the will of that fossil, and hurrying as straightly as possible to Tardan itself!

The thought was staggering, until he began to reason on the basis of what he had so far accepted of Tardan's story,

as told by Tlalak. *There* was the answer. The fossil hadn't become a fossil by accident, but had been "transmuted," from human flesh to rock shaped like human flesh—a kind of embalming.

Even as Cleve Tatum felt sure of this, he wondered why his own so-called "ancients," the Egyptians, had not thought of this manner of embalming. Embalming was an expression of man's egotism, a symbol of his desire for immortality. Yet the Egyptians did it with drugs, herbs, and with materials whose secrets had been lost for thousands of years. Those Egyptians, along with other oldsters, had doubtless sought for the secret of transmuting base metals into gold. Why had not the corollary—that now appeared so simple—occurred to them? Why hadn't they transmuted human flesh into imperishable stone, preserving the bodily form as long as the rock itself lasted?

For that matter, why hadn't the Tardanians continued the practice? He could think of but one answer to that: disappearance of the desire for bodily continuance, a dying of egotism. It fitted in, too, with a Tardan who had died of his own vanished will to live. Only Tlalak and his companions had revived the old "embalming," because through it they wished to make contact with the dim and incredibly distant future.

Somewhere in that fossil at Siegfried's would be found a bit of mechanism—in the area where the human brain had been perhaps—which had issued a command to the brain of Cleve Tatum, sending him to Tardan.

The command had been imperfect, causing Cleve Tatum to stumble around, seeking for a clue. Either that or else his brain had not been up to receiving the full command. Or more likely still, whoever had cast forth that fossil could not possibly have known where, in relation to Tardan, it would eventually be found. The era of mountain building

had intervened between the casting forth and the discovery. There was one other possibility: that the fossil had been injured; that the mechanism had not been entirely able to constantly repair itself, and the command had not been complete.

Tatum felt strangely like bowing down to the awesome intelligence of the brilliant ones of long-dead Tardan. The greatest scientists of to-day were pygmies compared to Tlalak and his brethren. But, by mastering, as best he could, the secrets of Tardan, and giving them to his confreres—or better still, bringing those confreres here to Tardan to solve the riddles—he would place the brightest of those scientists on a par with scientific Tardan.

Would it be anticlimactic to enter Tardan, after having already seen it in pictures? Tlalak *wanted* him to go into deserted, empty Tardan—to see for himself what it might mean to his, Tatum's, civilization if he gave the civilization Tardan's secrets before it was ready. He was to look upon Tardan empty of a living soul, to enter it solemnly, alone, as a devotee should enter a cathedral to pray for guidance, and to meditate.

CLEVE TATUM traveled a broad highway which might have accommodated and doubtless had, the feet of multitudes—multitudes who hadn't walked here since the mountains had pushed back the sea.

There was light everywhere through the cavern that was a gateway to Tardan. Indirect lighting? He puzzled over that light for a time. No such primitive things as incandescents or globes of any kind—simply a glow of light everywhere about him, which had been turned on when that second massive door had closed behind him.

Now he came to the first buildings. They were, as he had known ahead of time, the columns which supported the roof of Tardan. Inside the columns

were rooms. Doors led into the columns, and Cleve was tempted to enter the very first one, to see what manner of people had occupied it, what kind of business had been conducted in it.

But he did not, after some thought. The building might well have been a tomb. He stood and looked at it, and silence beyond expression settled about him. The first building in the dead city! Through those doors had walked generations of happy, laughing people. Out of those openings, which were windows, smiling faces had looked—out of windows that never needed to be closed, because no storms ever came down into Tardan—bright eyes had watched people passing to and fro in the streets.

Tatum stood at the beginning of one of those streets—if it might be called that—and looked down what seemed to be an endless, glowing corridor, leading farther and farther into Tardan. Not a living thing save himself moved on it, anywhere. A little fearfully, he walked on to the first intersection. There he looked right and left along another endless, glowing corridor. For a moment he stood, musing, trying to picture this place alive with Tardanians. It was not difficult, for he had seen this very corner in the pictures—what else could you call them?—Tlalak had shown him. He remembered faces that had passed exactly here, remembered tall men, lovely women, passing to and fro, talking, laughing—because they had absolutely nothing else to do!

He had, he remembered, seen a man fall dead at this very corner—and vanish instantly from sight—incinerated by the machines in the walls.

He started, looked about him. The machines! Where were they? Carefully searching, he noted that not all of the massive columns had been the abodes of people. Some of them were solid. Now that he looked more closely, he noticed that at least one in ten of the columns was solid. Those columns,

without a doubt, were the abodes of the machines. There must be thousands of them, all through Tardan. From where he stood he could see dozens of the solid columns. He strode calmly to the first one, intending to make a thorough examination of it.

It was solid travertine, no doubt about that. Putting his face close to it, he began to look over the surface, all around the column, from floor level to as far as he could see by standing on tip-toe. There must be openings, apertures through which the machines ruled Tardan. But he could find nothing.

"Damn it!" he said aloud, while startled echoes of his words went rolling away in all directions. "Why didn't Tlalak say something about this, give me more of a clue? I wish the fellow were here, to tell you. If I could have brought him along——"

Instantly, against the wall he now touched, a picture took form. Terrified, he jumped and, jumping back, gained perspective whereby he could see Tlalak.

"AGAIN," said Tlalak, "you justify yourself. The machines obey your will, and I appear here to explain to you what you are sure to wish to know. The mechanisms developed by Tardanians are incased in these solid columns, including this one against which I appear to you. Note that at their tops, which connect with the roof, and their bases, which connect with the floor, the columns contact the earth above and below—all the earth above, to the floor of the sea, and all the earth below. From these two sources the mechanisms set into the columns, procure whatever they need that the earth contains. If it is a piece of metal, needed by them for self-repair, impulses—which carry with them exact measurements and exact weights of broken parts, together with specific gravity of such pieces, thus automatically establishing their metallic identity—are transmitted either up or

down, depending on whether the desired materials are between Tardan and the surface, or below Tardan. The exact metal is taken from the earth, is molded as it is conducted to its proper location and fitted into place.

"If a man or woman dies within the sphere of influence of this particular column—either on the street or in one of the buildings—the fact of death itself, flashed to the machines, not by the mentality of the dead or dying, but by the sudden cessation of that mentality, causes the instant incineration of that dead body. The machines, of course, usually have warning, as death is ordinarily preceded by illness, and are prepared to take care of the body. But even in cases of instant death, with no warning at all, the machines act—or did act when there were living people in Tardan. The impulse caused by the cessation of a single intelligence reacts on the proper mechanism—and the body burns instantly, leaving no trace, and with no danger to any one near the dead!

"Near the top of this column—and all other columns—is the machinery which keeps back the sea by impounding gases in the earth above, increasing their propulsive force countless times, then discharging them into the strata above. As a result, the downseeping moisture is hurled back up through the earth, into the sea——"

"Into the sea," repeated Cleve Tatum softly. "And now that the sea isn't even a memory above, those machines work on—forming gases which force back the natural seepage through the earth, as surface and subterranean waters seek their natural level. The result is geysers, boiling pools, hotly bubbling streams—all the watery phenomena of Yellowstone. And the very heat as the waters come forth are proof of the propulsive forces of these machines!"

And wise men, on the surface above, spoke knowingly of cooling lava far

down under Yellowstone—lava in which gases formed slowly, *periodically*, finally expelling the water through fissures in the substrata with terrific explosions of force! That was *their* explanation of the geysers and the hot springs!

"Even so, they are partly right," thought Tatum. "They are right about everything except the lava. Maybe they're smarter than they seem from Tardan, at that—for how could they possibly conceive of Tardan? And yet, that fool on the veranda of the hotel made a wild, fantastic guess that wasn't a guess at all, though he didn't know it. Or *did* he know it, subconsciously? Was he feeling, in his brain, some of the command that Siegfriedt's fossil gave me? Did the fossil—or the mechanism which dominated him—despairing of making me understand where to find the gate to Tardan, cause that talker to have a brain storm that gave me the clue I couldn't get for myself?"

TLALAK had paused, as though to give Tatum time to assimilate what he had already told him. Now he went on: "In this column is a complete arrangement of mechanisms. Every other solid column houses a complete array of mechanisms, also. Those mechanisms were evolved for the purpose of taking care of every conceivable need within the area of Tardan served by a given column. That area could be isolated from every other part of Tardan—yet go on with its life without change, complete in itself—for each column is the center, the heart, the nerve headquarters, of a little Tardan, a city within a city. It is independent of all other headquarters, self-fulfilling, self-contained and, of course, self-repairing—since its contact with the earth, above and below, is the same as that of all other columns——"

"This isolation of little cities was considered necessary because there was always the possibility of individual breakdown elsewhere in Tardan. Some one

column might break or crack under the power of some unforeseen force—the shifting of a subterranean fault far below it, for instance—and if all mechanisms in Tardan were mutually dependent, Tardan would instantly lose all the value of her machinery.” Tlalak vanished again.

Tatum decided on a bold experiment. “I want a drink of cold water!” he said, looking at the column as though to defy it to perform *this* miracle. No sooner had he spoken than he realized that his thirst was a tremendous thing. How would his wish be granted, if at all? Would a genie come with water in a golden pail? Would a fountain appear in the street of Tardan? Would a bubbling spring appear before his eyes?

To his vast disappointment nothing whatever happened. Nothing? He felt strange, a bit stunned—for he no longer wished a drink of water! His body felt that glow of satisfaction which comes to the thirsty man when he has just drunk to repletion. No water had entered his mouth. There had been no physical contact of any sort whatever—yet Cleve Tatum’s thirst had been slaked!

“Were Tardanians, toward the last, so lazy they didn’t even want to open their mouths, drink and swallow?” he thought. “The answer seems to be approximately in the affirmative. But how did I get that drink of water? Or maybe I’m just imagining it. Let’s try something else. I am hungry. I wish food!”

No food appeared. Nothing, apparently, happened. But Cleve Tatum was no longer hungry! Not only did he not feel hungry, but he had the slightly uncomfortable feeling of a man who has eaten a bit more than he should!

Yet he hadn’t eaten at all. Whence, then, had the food come, and how had it been administered? The secret of it, he knew, was in the column, amid the silent, ghostly, superhumanly powerful mechanisms which must pack and jam it.

“I vision whole tiers and piles of ma-

chinery inside that column,” thought Tatum. “Yet it may all be done by a mechanism no bigger than my hand or a pea—or even something I’d have to use a microscope to see. I’m afraid to know for a certainty.”

TLALAK had said nothing about how Tardanians were fed, how they slaked their thirst. There was a reason for that, of course. It hadn’t occurred to Tlalak—when he had prepared his records for the coming of that wished-for human, millions of years in the future—that the manner of Tardan’s eating and drinking would be anything but commonplace. Tlalak had taken it for granted that his visitor would know!

“Artificial feeding was known to medicine—but how far would one have to look into the future to visualize feeding that was *invisible*, needing only the will of the individual to bring it about? It was fantastic in the world above, even to hint of such a thing. Here it had been commonplace! It was enough to make the keenest brain reel. Had the “water” he had “drunk,” the “food” he had “eaten,” entered his body with the air he breathed—so tiny that it traveled on, in, or through that air he sucked constantly into his lungs? Had he, in effect, been *bombarded* with some invisible *essence* of water, some infinitesimal “meal” of food?

He couldn’t even guess how it had been done, but he understood exactly why such a manner of eating and drinking had been worked out. Tardan had disposed of the vulgarity of filling the human face and stomach where others could watch. Humanity wove rules and regulations, etiquette, about the necessary habit of eating—but never, to Cleve Tatum, had even the prissiest rules of etiquette camouflaged the fact that drinking and eating were the most uncouth activities of humankind. Public tables, filled with men, women and children, opening their gaping mouths to show

dirty teeth, stuffing those mouths with food, chewing it lustily, swallowing it — Oh, necessity, of course. But eating should be done privately.

So Tatum had always felt, believed. He hated public restaurants, and when he had to visit them, the countless chewing mouths about him filled him with disgust, no matter how good the table manners were—and he knew that his own eating, chewing, must look as bad to all those others, if they thought about it, as the sensitive ones must. Tatum liked to eat alone.

Far back in man's history, man had procreated as simply, freely, openly, as did all other animals, then and to-day. Mankind had evolved, however, until love had become a beautiful thing, about which singers fashioned songs, geniuses wrote books and poets sighed at the moon. Mankind had gradually overcome most of his uncouthness, most of his natural crudities—save the horrible one of eating unashamedly in front of his fellows!

"How was my thirst satisfied?" demanded Cleve Tatum, hoping for some answer that would help. "How was I fed?"

Could Tlalak possibly explain? Give him an answer? An answer came, all right, but certainly not as he expected. For suddenly it seemed to him that he had taken another drink of water, eaten another meal! He could not mistake the feeling. There could be no conscious humor in those machines, nor was the result especially funny. A wave of sickness swept over Tatum almost as soon as he realized he had drunk and eaten again. His sickness was exactly what a man might expect who, on a wager, drank more water than he should, and ate one hearty meal on top of another.

"I am ill," he said, putting his hands to his agonized midriff. "If my pain could be eased, I'd never ask silly questions again!"

Instantly his pain was gone! The sensation of having drunk too much and eaten too much was gone. In his mouth was a slight foreign taste. He tested that taste with tongue and lips—as a man might test the taste of an intravenous injection. He could not classify it, but it had done the work, beyond question. How? Therapeutic rays of some sort? Medicine administered instantly, as the food and drink had been?

In only one way would he ever find out—if his mind were keen enough to solve the enigmas of the machines when—and if—they were deliberately uncovered by the upper world of science.

Tatum walked on, marveling at the immaculately clean streets of Tardan—streets that held no débris whatsoever, except bits of gold in almost every conceivable form. In some corners, where buildings abutted, he found little golden dolls, lifted them, shook them. Sounds came through, and he knew that these were the golden robots that had operated the machines of long ago—before they had been developed to the point of self-operation in perpetuity—and which, when no longer used, might have been playthings of Tardan's children. Gold was everywhere—long thin leaves of it; thin pieces of it bearing peculiar, incomprehensible marks, which probably indicated that it had been used as a medium of exchange. But what had the Tardanians needed to buy? Nothing they wished for was denied them.

But stay, humanity must always have had something to barter: land, buildings. Maybe there had been gambling. Whatever the gold coins had been used for, this much became certain before Cleve Tatum had penetrated a mile farther into Tardan: Tardan had possessed so much gold it might have plated its streets with it, and when that was worn away by the feet of Tardanians, replated it again, and yet again—always with gold—

THE TRUTH burst on Tatum like a bombshell. He shouted aloud: "Tardan drew gold from the very golden horseshoe Dr. Siegfriedt told me about—for Tardan must either lie in the middle of it, or countless offshoots of it must have been encountered when Tardan was being built! Tardanians experimented with it because of its extreme pliability!" And wealth, with consequent idleness, had destroyed Tardan!

The gold he saw everywhere now began to fill him with terror. Its glow seemed one of mighty malevolence. He had the urge to flee from it, anywhere as long as it was away. Yet as long as he remained in Tardan, he could not escape it. Indestructible in itself, it had vanquished Tardan's people—and now sprawled through all of Tardan's streets, as though to emphasize its power. It was as soft as a woman's hand to the touch, almost—but nothing could destroy it.

He walked until he was tired. Then he sat on a bench, pressed buttons, listened to Tlalak and witnessed other pictures of Tardan and her people. By so doing he could almost people these empty, whispering streets again.

"If you had a cure for tiredness," he said, yawning as he listened to Tardan, "it would be a boom to civilization. People would go on indefinitely. That's an idea! I'm tired; rest me!"

He was not surprised at all to discover that he was no longer tired, that he could, if he wished, run at top speed through the rest of Tardan. He had been invisibly "bombarded" with something that had banished fatigue.

When, after many hours, he was able to estimate that Tardan spread under almost all of Yellowstone, he felt it was time to go back, confer with Siegfriedt and decide what was to be done about it.

He turned, looked about him. He hadn't the slightest idea what direction to take in the maze of streets—through

the packed forests of columns! He was lost in a labyrinth it might take him all his life to escape.

He began running.

VI.

HE STOPPED short; running would avail him nothing. He could run until he dropped, and it would do no good. He must not go into a panic.

Tardan, shaped much like Yellowstone, curved back on itself like the bend of a horseshoe—

"My Lord!" he thought. "A horseshoe! When people drive through Yellowstone, they 'make the circle,' which means that Yellowstone itself lies almost in the shape of a horseshoe. Tardan is shaped the same way, because but for Tardan there would be no Yellowstone—certainly not as we know it now. But when Tardan was built, there was no Yellowstone, so why was that shape taken by the builders of Tardan?"

Again Cleve harked back to Siegfriedt's talk of a vast "golden horseshoe," dropped upon a segment of the Rockies—a horseshoe so seeded with gold that, if mined, it would make gold valueless.

Tardan's shape was not accidental. Tardanians, before building their city, had known of the golden horseshoe, and had built their city in its shape—nestling roughly inside it, as though the gold might have helped to guard them. Had he guessed wide of the mark when he thought of gold as their god? Had they not literally taken the wealth of the horseshoe with them—like misers? The shape of the mountains had been different, then, of course. They hadn't been high. But the gold must certainly have been there, and they must have known about it. They'd taken what they wished of it—

And in Tardan they had continued, through their machines, to take of the riches of the golden horseshoe. But

they had taken too much—and Tardan had died, leaving only its indestructible shell.

Tatum *must* get back. There was so much he must discuss with Siegfriedt. But how to get back? He remembered the supertelevision he had studied under the tutorship of Tlalak, and for the first time he entered one of the houses of Tardan—seeking just one thing; a machine that televised. That such a machine should remain intact, through the æons, did not seem possible. For what earthly reason need they have been self-repairing? Nevertheless, he entered a house to investigate. It was as light in the house as outside. A bare first floor, rock-floored, and rock-walled, of course. There were stone stairs leading up to a second story. That surprised him. He couldn't imagine Tardanians climbing steps.

He put his foot on the first step. Instantly, the steps began to move upward! Not surprised at anything, he chuckled. He hadn't been mistaken about Tardanians—they hadn't walked up steps! Cleve rode up on a silent escalator!

ON THE SECOND FLOOR, he looked swiftly around. He wondered, as he had wondered all along, why there were no decorations anywhere, no rugs, carpets—nothing that would seem to have been necessary to make a house habitable—just bare rock walls. There were no beds, even. Had Tardan banished sleep as well as fatigue and sickness? Or did people sleep where they stood?

There were many questions still to be answered. Corps of investigators must make notes of their investigations—and those notes would certainly fill countless volumes. Tatum, at the moment, was concerned with just one thing: getting out of Tardan.

He was hunting for a television machine. He saw nothing. It, like all machinery in Tardan, was hidden in the

walls—maybe not even in the houses that used it. But there was a bench, with buttons, and he sat down—facing the wall where *something* must appear—pressed the first button.

On the bare space flashed a segment of Tardan—and Cleve Tatum knew that he was looking into the room which had been of vital interest to the last occupant of this bench! Had he, or she, gone visiting—or brought some one to visit him or her? There was no way of knowing—nor did he recognize the section. "I don't know just how to wish for it," he said softly, "but I wish to return to the bench inside the second door."

There was a swift blur—as Tatum pressed the second button—and on the bare space on the wall was the bench he desired! So plainly was it visible, it looked as though he could go to it and sit down. Was that how it was done? Would he understand the "visiting" customs of Tardan if he did that?

Cleve Tatum rose from the house bench, walked to the televised bench and turned to sit down on it. He felt a little silly; he fully expected to bump his posterior against the smooth stone wall of the house he had entered.

Instead, he sat on the bench he had first occupied—stared at that first column he had seen. No mistaking it, for to his left was that second door!

"Good Heaven," thought Tatum, "it's like going through a door in 'Frisco and finding oneself in a room in New York City!"

He hadn't learned a thing, experienced a sensation of any sort—save of surprise at finding himself on that bench—during the instantaneous translation. But he wished to make one more test, be sure this was the right place. He walked to that door until his shadow was on it. It began to open. He stepped back until his shadow left the door. It clicked audibly shut.

He turned around, and there was

Tlalak—Tlalak speaking: "I am Tlalak. I bid you welcome. You have been a long time coming. Sit down on the bench to your right while I attempt to explain our civilization to you, happy at long last that it has not been lost to the world——"

"Sorry, old-timer," said Tatum softly, "but there is a possibility that it *has* been lost—for the mere thought of bringing it in contact with mine fills me with terror of the possible consequences."

Tatum moved until his shadow was on the door again. It opened. Cleve waved his hand at the ancient shadow, passed through the door—wondering as he did so, if, when the door closed, Tlalak would begin again his introduction—if now it would go on to the end of time. He would only know when, and if, he returned to Tardan.

He moved quickly up the ramp toward the first door. It opened as he approached, again with a protesting of what sounded like hinges needing oil.

He passed through. The door swung shut behind him. In the slanting incline he looked back at the door. There was no reflection on it now—for the simple reason that silently, surely, behind him, the outer ramp was filling up, covering the door!

It was filling with rock that welded instantly with the other about it. He

stopped. The filling of the cut stopped. He turned, moved on a few paces. The filling continued—in utter silence.

"The entrance," Tatum decided, "had been closed for millions of years by lava—until I came. Then, by some mechanical means—which started working when I blundered into a certain area here—the stuff that filled the entrance was disintegrated, or turned into smoke or gas, and the way was open for me. Now that same stuff, somehow held under control above the entrance, is being allowed to reform in the pit. In effect, I walked through solid rock to that first door. The rock was there, but rendered as unresisting as air, and as invisible. Some terrific impulse caused it by explainable means. Electricity? Some sort of rays from the door? Will I be able to get back if I want to?"

He turned deliberately, started back for the door—and he hadn't taken one step, before the door was visible, the ramp was visible——

"Yes, I can get back, no doubt about that," he decided. This time he walked clear out of the ramp before turning. Then, when he looked, there was nothing to be seen—save the wilderness which was this unexplored portion of Yellowstone.

HE STARTED eastward, forgetting the boiling streams. He came to the

SENSATION!

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PROBAK JUNIOR

first one. It was a dry water course. The need for it had passed! With it, and the others, Tardan had captured Cleve Tatum. Now it was giving him up again—to return or not, as he chose.

It was still night, which surprised Cleve Tatum—until he stepped, after many hours, onto the steps of the hotel by Old Faithful, just as the famous geyser erupted. He stood on the steps for a moment, looking at the majestic sight. "If I tried to tell what really caused you, old-timer," he apostrophized the geyser, "the world would put me in a madhouse."

A cry of dismay came from the veranda. Cleve Tatum recognized the voice of the man who had warned him against going into Yellowstone at night. "Where in the world," the fellow cried, "have you been since night before last? Searching parties have been combing all Yellowstone for you. The newspapers have reported your disappearance. A friend of yours from Red Lodge, a Dr. Siegfriedt, is here—blaming himself because you were lost——"

Tatum waited to hear no more. "Where's Siegfriedt?" he asked.

"In the hotel. He's an old man, and the officials wouldn't let him kill himself by climbing all over Yellowstone——"

Cleve went directly to Siegfriedt's room. The doctor looked up, said nothing—was neither startled nor surprised. He simply waited, with a still look in his eyes.

"Where's the truck, Doc?" said Tatum.

"How did you know——"

"I knew you'd bring your primate, Doc. It was written in the cards. Now, we're going to do something, you and I. We're going to destroy him, piece by piece, so that nobody else, ever, will find him again. Come along."

"But why—why——"

On the way to the truck, Cleve told him, omitting nothing. "You see, Doc," he finished, "I've made up my mind. I

won't take the responsibility. If we uncover Tardan, we give the world to machines—and *certainly* we'll make gold the cheapest commodity on the face of the earth. I won't risk it. We're striving for the perfection Tardan-had. They died off when they got it, because there wasn't anything else to do. It is the striving, Doc, that makes life worth living. Maybe I'm wrong, but I'm going to make certain—as far as it's within my power to do it—that humanity, in my time, continues to live by the sweat of its brow. It's the only way to happiness——"

"Well," said Siegfriedt, "maybe you're right. I'm an old man. I've worked hard for everything I ever got. But I was just thinking, waiting for word of you, that I'd like to live every day of it over again. I wouldn't change a tarnation thing!"

"Good. Get a sledge hammer. We'll get to work on the fossil."

THEY DROVE the truck toward Norris Geyser Basin, then off the road, driving with care. They made sure no cars were coming, so no one would interrupt them to ask questions. Then Siegfriedt uncovered the fossil in the back of the truck. Cleve Tatum stared at the thing for a long time. Tlalak? Probably not. Just the same, he felt a queer kinship with the stone image.

Cleve Tatum struck the fossil in the face with the sledge hammer. A crashing echo thundered out into the night. He struck again, and again, growing a bit terrified that he might not be able to break the thing at all. Then, it cracked, fell apart. "A flashlight, Doc," he said, tensely. Siegfriedt produced it. Both men looked into what had been the skull of the Tardanian. Nestling in its center was a metal pellet that Nature could never have molded by chance. It was oval, of some metal Cleve Tatum had never seen, nor Siegfriedt—about an inch and a half long,

by half inch an inch through its thickest part.

"What is that?" asked Siegfriedt. "Did you expect to find it there?"

"I have a general idea what it is. I expected to find something like it here. It is a—a—call it a telepathic ovoid for want of a better name. It ordered me into the Yellowstone. It made you follow me in. It is imperishable—and self-repairing as long as the fossil is in contact with the earth!"

"I don't get it——"

"It's a broadcasting station attuned to the human brain, Doc, and to the machines in Tardan. The men who perfected it knew how to work it. They were the original broadcasters. If we knew how to use this thing, Doc, we could rule anybody we cared to. Pretty

dangerous, don't you think? I do, and I'm going to destroy it——"

"But how, if it is self-repairing——"

It can't move of its own accord. Let it send whatever messages it likes from where I'm going to drop it."

"Where's that?"

"Into the crater of Old Faithful. Let's slide this Tardanian into the first hot springs we find, and then go back and dispose of this infernal, everlasting telepath where nobody in our time will ever be influenced by it."

"O. K., Cleve, but what a story—and this primate of mine sixty-three million years old!"

"Sorry, Doc, but—Heaven forbid—maybe some of these days your mine in the Beartooth Mountains will find another one!"



*He—alone—knew the story of life
from the beginning—*

MARINORRO

I AM sorry for what has happened in the planet earth. I, Marinorro, love it as a mother loves her child, yet did not understand the reason for human inhabitants until a short time ago.

As man counts time it may have been a thousand years, yet it is only a moment in my life. I can not figure it as time, but simply the period in which life can develop in the lower stages. As man views the development of germ life in a few short hours, so I view the expired time since my great discovery.

For ages beyond thought I have ruled the planet. I have seen man develop from an order of being which fought to exist, to where he lives in comfort even greater than I.

To him belongs the continents, but to me the seas. The great oceans, which roll and toss endlessly, are my playground. The sea is my music and my home.

Many times have I taken men to my home, to learn why they exist. But they were failures. They could only live under normal conditions and did not survive for a sufficient period for study.

For ages my form has been too big to travel over the hard surface above water, so I brought men beneath. Now I regret it. I could see in their eyes that they loathed me, while I treated them kindly. I understand their feelings, but they could not comprehend mine.

I first felt life in the dim past, when the earth was new. I was the feeling within the great mass of water. With the feeling life instilled within me I began to advance. I absorbed food to

develop my form and care for my brain. All other creatures were without knowledge of existence, created for my use and pleasure.

Following the absorption of food I experimented with other forms of life. Many times I crossed the same germ life, until I could follow certain trends in their development.

From my work sprang every creature of the deep for many ages. Then they went forward themselves. They crossed and recrossed, while I watched the results.

Many forms they acquired, all unknowing. At times they reverted, and slipped back many stages, only to rebuild again. As the waters cooled, life advanced faster. Advanced stages began to seek other life without help or guidance.

The first thought had been born in me, and as time passed my brain increased until I understood the movement for every creature. I could guide them, and help them in their search for companionship. I brought mates together who could not know there were others of their kind.

I was respected and feared by all living creatures. Some fled to far parts of the earth to escape, but all the seas belonged to me, so I brought them back to punish them for their actions. But they did not understand this punishment and I stopped, to let them seek life in their own way.

Soon they lost their fear, and came to me for help. When they were sick they sought me. At times I restored health; at others I eliminated life to avoid the spread of disease.

by
Warner
Van
Lorne

*To them my breath was
death— I exhaled a gas
foreign to their nature—*



To man I would be a strange creature. My form changes to adapt itself to my desires. I have legs that I once used for travel on land, but the effort became so great I discarded their use and will forever remain below the surface.

The stories of great sea monsters, that

mariners took home from their travels, referred to me. I used to appear above the surface to watch them at work, although never more than once in the lifetime of a man. No one ever saw me twice. But my observations were poor, and I could not decide why they wanted to cross from shore to shore.

I still cannot understand many things which men do, but I believe they have reason for each of their actions. When I first discovered that man inhabited land, I was surprised. I had not known that life could exist out of water.

They were savage and would run at me in great numbers, to die as they came. To them my breath was death. I exhaled a gas foreign to their nature. Slowly they learned to understand fear, and tried to avoid me. Man was becoming a thinking being.

MY INTEREST increased. For the first time there was another creature who could reason. Previously I had been the only thinking being on the planet.

I fed my brain constantly. It took centuries for me to develop a single brain cell, while man developed with each generation. I *had* to develop my thoughts to conquer man.

At times I destroyed his civilization. One continent I sank forever beneath the sea. Now I regret it. I destroyed man when he could not yet protect himself. There was no fight; I simply conquered or destroyed, because I feared competitive thought.

After sinking the great continent, and sending man back hundreds of generations, I turned to sea life again. While I had watched man so closely my old pastime had outgrown me. Life had gone on developing beneath the waters, without guidance. It took a long time to learn of my own creatures, and I let man work out his destiny alone.

Great fish had developed in my seas. Some tried to destroy me instead of doing my bidding, but I stopped that. I had more respect for man—he could think. But my own creatures, without thought, had no right to question my control.

It took time to make them understand that I ruled, and must not be bothered with their search for food. I

lost three legs in a battle with one giant fish, but I have many more. The fish that bothered me the most, by his development, was the whale. He had grown to resemble me in some ways and considered himself better than other creatures.

When I found that he could live out of water as well as in it I became jealous. So I left him all the equipment for air existence, without means of using it on shore. I destroyed his legs in three generations, and gave him more of the fish shape. That punishment he deserved, for adopting my form.

For many generations he was sad, but did not understand the reason. He could not think, but simply knew his actions were restricted. Slowly, he became accustomed to the new form, and seems contented now.

One thing about man I disliked for a long time: he catches my creatures to use for food. They have no feeling of what takes place, but it annoys me to have them hauled out of water on the end of a piece of string. I have slowly become used to it and do not mind. I eat them, and they live upon each other; but having outsiders use them somehow seemed vastly different.

My greatest admiration for man has come from the equipment used on his ships. I have gathered decorations from many of the more beautiful and used them near my habitation. The pictures of sea creatures are most interesting, and some of them well done.

Much of their equipment is beyond my understanding. They carry big tanks of water, while their ships are surrounded with water at all times and they could dip up what they need on board. I even found fish in a globe in one ship. But I suppose that sea creatures amuse them as men would amuse me, if I could keep them alive.

I start dreaming as I think back over the ages and realize that I alone know the story of life from the beginning. I

think now of the time when I first knew life, when the oceans steamed and I could not hold solid form, but had to be content with a semisolid existence.

What I am no one knows, not even I. I have no counterpart or companion, and must live alone—unless? But I'm dreaming again. Sometimes I think of creating a mate for myself, by dividing my brain and forming two new bodies to carry me. This would create companionship, but would set me back nearer the lower creatures and well below man in mental ability.

MAN does many things I do not understand, but if I spent the effort I could understand each of his actions. If I could find out what man is composed of it would be simple to know his every movement.

Man could not understand my actions any better, but would stumble along trying to fathom the actions of a sea creature. I do not pretend even to myself that he would understand. To him I would remain an ugly creature. He would treat me as he does whales and other creatures of the deep. I would be something to be caught and used for any purpose he chose.

My present shape would be obnoxious to a human being, yet it is more practical than theirs. I can do many things that they cannot. I can climb or swim faster than any creature in the sea, and one day's travel will carry me across the largest ocean.

I have compressed my form until it is terrifically heavy, and will remain at the bottom in the deepest water. The shell around my body is harder than any metal man uses. It would be amusing to see him try to penetrate it with one of his bullets. It could not even dent the outside surface, and would not bother me at all.

To man I would appear more like an enormous, hard-shelled worm than any creature he knows. My armor overlaps

and gives as I move in the water. Twisting back and forth gives me high speed with little effort. This form I adopted after centuries of experimenting with every possible shape.

Beneath me are over a thousand small legs, supporting my three-hundred-foot length. They enable me to cling to the smallest cracks, and travel in any place. I first grew them for travel on land, and have kept them because they were useful. I can gather food with little effort, as my main diet is vegetable.

My home is a series of caves that were once part of the continent I sank. For centuries I traveled over this vast land, to see man's workings. These were less advanced than his present construction, but to me they were great marvels.

It has been disappointing to see them crumble in ruin and slowly disappear. To-day there is little to remind me of the splendor that once existed. The buildings are gone, and all machinery with them. At one time they stood majestically for miles and I spent days at a time admiring them.

In the cities there were buildings of several stories, but in the country they were all of one story. Three of the settlements covered a lot of ground, and housed thousands of people.

Streets were paved with rock to make them smooth, for boxes on wheels drawn by animals. Some of these boxes were quite attractive and must have been comfortable to ride in. Many had covers over the top to keep the sun from shining in.

All buildings that were not of stone were destroyed when the land sank beneath the sea. Even the strongest were finally toppled by the great currents, and to-day lie as heaps of stone, where the small fishes live.

One of the great buildings I could pass through with my whole body, by being careful not to rub against the walls. The doorways at both ends were large enough when I removed the wood frames.

IT TOOK DAYS to examine all the objects within. The upper floors I could not pass through, so I removed the stone work carefully and examined the contents of each story before I reached the one below.

The main points of history about the human race were told by the objects. Man had saved relics from his earliest time, even stone implements.

On the floor above the bottom were figures of people. Some stood in groups, while others were single pieces of stone or wax. Many of these I have saved among those that were cut from stone.

One stone woman is still very beautiful. I have kept her far from the wash of water, covered except when I wanted to see her. She has made me realize how beautiful the human race is. If I could exist in such a form I would be satisfied, but that is denied me.

The human form would be useless beneath water, and I could not exist indefinitely on land. I was formed in and of water and my existence is bound up with it too strongly to change now. If I had known in the early time how much more attractive life on land could be, I would have chosen that.

Only beneath the sea is my power great. I can control water, but land is difficult to mold in any form. I only control the action of a continent by the use of water. If I sink one it is due to the action of water. I can create currents that will do the work.

Aside from the stone woman I saved little from the work of man. There were many beautiful objects, but none that could stand through the ages without deteriorating. Perhaps men of the present age would have liked to keep the objects that were destroyed, but they could not be preserved beneath the sea.

As the ages wore away the buildings, and the civilization of the sunken continent slowly disappeared, it seemed as if my heart would break. I had enjoyed the diversion for a long time, and learned

much about man. I had learned to take a personal interest in what he had done, although I had destroyed his work.

The work that stood as a monument on this continent brought my first feeling of pity for man. I could not destroy such a creature without giving him a chance to retaliate. Slowly I realized what the trouble was. *I was jealous!*

Man had so much that was denied me: companionship, community interest, and a home that was not barren. My own life appeared dreary and lacked all of the feeling that man knew. I stood alone in the universe.

I had only one thing that man lacked: a knowledge of each and every form of material, as well as how life was formed. Man was the only exception to my monopoly of understanding.

It was simple for me to destroy the human race. I saw the land form into a solid piece on which man survived. I knew the weak spots and where I could do the most damage.

There is no continent on earth that I could not destroy in a few centuries. I can undermine the strongest sections and break the weaker. My mind is capable of creating or destroying.

Man dreams about the passage of time, but he can not really *understand* it. I have *seen* it pass. With the passage of time I have acquired knowledge that man can never have. I have seen him try, and fail, to do things which were very simple to me.

He experiments with the action of living cells, yet I know every one of them. Man is made up of cells which I know, but they are now in a different form than any I have seen develop. Perhaps I could create a creature like him in time, but it would require many ages.

I would still have no way to develop brain cells to equal his. My creation would remain dumb. I have not sufficient cells to spare, or I might use some from my own brain and let them expand with his form.

I am *very* jealous of man. I look at him as a lower order of intelligence, but would gladly exchange. I would be willing to die if I could live one life as a normal human being.

UNTIL I studied man so carefully I didn't know what a tender sentiment could mean. He taught me. I had little feeling for any creature, simply a cold delight in the results I could obtain by using their ability to reproduce.

Yes, I crossed forms many times that should not have been together, and created many poor creatures. I created

life that did not know enough to seek food, but had to be fed and taken care of. These I let die, and have not tried them again. Others which showed abnormal intelligence, I destroyed.

I have enjoyed reproducing animals in the sea that resembled animals on land. The flesh of land animals is delicious, and I try to obtain as many as possible without too great effort. Recently I have felt tired, and do not like to travel far from my habitation.

It worries me slightly. Perhaps my life is coming to an end, the same as

*Once inside the globe alive, it
would be easy to carry them
to the dome—but—*



every other creature in the sea. I cannot understand it, unless my body is tiring to my brain. My thought *should* go on through the ages unhampered. It should never tire.

I can find no weak spot in my present body; it seems as healthy as the day it was completed, but I may have to build a new one before my energy runs too low. It requires centuries to make it what I want.

I can date the feeling of restlessness, as well as my lack of ambition, to the time I succeeded in keeping man alive in my own world. I learned to understand him better and admire him for his great courage and sympathy.

Three centuries ago I prepared a place where I could keep man alive and study his actions. It took much effort and time to accomplish, but was worth the trouble.

For this purpose I built a dome of clear material. I developed a small creature which did the work and had only one aim instilled in its brain: to build solidly and thicken the wall as long as I desired.

I watched as the huge dome took form and rose higher each day. My creatures seemed tireless and kept constantly at it. They even seemed happy at their work, as if they understood that they were chosen for an important part.

The foundation was several hundred feet across, and the walls rose from the edge at a gentle curve, to meet two hundred feet above. The interior was less than one hundred feet across, in order to obtain the maximum of strength.

Inside I stored a great deal of food, removed from ships only recently sunk. Some of this food was in containers and seemed in perfect condition. But I stored a great quantity of fish (that I preserved in my own way) so that man would have ample food for a long period.

WHILE the dome was being constructed, I developed creatures to do the

other important work. The interior had to be drained of water, and the air kept in perfect condition.

It was simpler to develop creatures that could suck the water out, than the ones which must create oxygen. The giant valves worked properly, and withdrew the water, even under high pressure.

I grew cells that absorbed the salt in sea water and left it fresh for drinking. I had seen that man preferred it that way, although I do not know why.

When I had cells that could create oxygen in sufficient quantity to sustain life, the great experiment was ready.

I removed some of the creatures from the dome and set them at another task. They built a globe for transporting human beings from the surface. This small sphere also had to have cells for creating oxygen.

This task proved almost too much. It was hard to build a small globe that could withstand high pressure and not be too heavy to transport.

It had to be constructed so the opening could be sealed in a short time. Human beings could not stand pressure to resist water, but must be protected from it.

All work at the surface must be done by myself. None of my creatures could stand the light water pressure. Sealing the dome after placing the human beings in it I must do alone. This required a carefully fitted section, water tight, that pressure would seal in place.

I was taking every precaution to see the safe delivery of my prizes. There must be no slip. Several times I had failed to keep them alive, but had never taken as much pains to protect them from the effects of the sea. It had taken several experiments to find they were sensitive to salt water and could not stand submersion.

At last the day came for my adventure. I was as excited as a small fish with a big one chasing it. The com-

pletion of my equipment had required centuries, while the experiment would last only a few years.

At the depth I stayed there was little effect from sunlight, and I closed several layers of skin over my eyes before venturing near the surface. It was the first time in years that my legs had been used for transportation above water. Although they were strong, my body was as heavy as the heaviest metal and as hard to carry.

I rose slowly toward the surface with the small globe. My body was like a huge metal girder wrapped around a glass bowl.

It was night when I reached the surface. The light was easier to stand than I had expected, although the glow from the stars hurt slightly. It was hard to breathe. The water was so light I had to exert my strength constantly to keep from sinking, and couldn't absorb oxygen at the rate I was accustomed to.

When I visited the surface before I experienced the same difficulty, but had grown used to it. This time it was like my first visit. I was tired before I reached land, where I could rest.

With my form half out of water I lay dozing for several hours before I had sufficient energy to go on. The sun came up, and I suffered from the heat. The rays seemed to burn into my eyes and I had to turn back to sea. A short way from the shore I settled to the bottom and spent the day resting in the water. It was only deep enough to cover me, but I was worried about my lack of strength.

Several times I nearly lost my small globe, and jerked awake to save it from smashing on the rock. It was more fragile than I had expected. When it was made under heavy water pressure it was strong, but without pressure it was much weaker. The material had expanded. I was thankful the opening hadn't warped.

As night came again I returned to shore, prepared to travel until I found human beings to take back. I wanted people who resembled the stone woman I had saved so long. I knew there must be some, although I had never seen any as pretty. Most men had heavy growths of hair on their faces, and their features were not as well made.

As I dragged my form slowly out of the water I began to be afraid. I no longer had strength to travel on land! I was condemned to the sea for the rest of my existence, unless I grew new legs. My legs had lost their powerful muscles.

FOR A MOMENT I hated the human race, which could move around so easily on land. They had everything that I lacked. Then my thoughts cleared. I compared their existence with mine. I had knowledge they could never have, and could grow new legs in a short period of my existence.

They were tied to their bodies and would end with their physical selves. I would go on through the ages. I could change my form to suit changing conditions, and live when there was no nourishment for other life.

This thought brought slight satisfaction, but jealousy for man remained. As I drew myself back beneath the water I looked longingly at the green trees and grass a short distance away. It was beyond reach until I developed a new body. At that moment I again considered forming a body similar to man's.

For several days I roamed through the sea before I saw any human beings. Then I saw a settlement on the edge of the water. I had approached a continent.

It was dark when I drew near shore. I could see plainer than during the day. The water close to the land was not deep enough to travel through and I had to remain several hundred feet away.

During the time I traveled around,

the globe became a real burden. I would be glad to head back toward the dome at the bottom of the sea. It would feel good to sink into the depths again.

For two days no opportunity came to obtain my specimens. Boats came into the town and went away again, but none seemed to have any one on board who resembled the stone woman.

As I watched this night, three small boats came farther from shore than usual. The sea was smooth and they were not afraid. I knew there was a big storm coming, following the calm, but they did not seem afraid. Slowly, they drew apart and drifted of their own accord.

The one which drifted farthest from shore drew my attention. The girl looked a lot like my stone woman, and I watched for a long time. They were too much interested in each other to know I was within a few hundred feet, although a lot of my body was above water.

They were blowing farther from shore all the time, and small whitecaps appeared in several places. The other two boats went back and still this one drifted. All that disturbed the silence of night was the tinkle of a laugh. I knew it was the woman; I had heard the man's voice earlier.

Suddenly, the wind became stronger. The boat began to rock. The waves tossed it back and forth like a small fish at the surface. I could see the man look frantically around the sea. Even then he did not notice me, but turned his attention to getting back to shore.

He worked desperately at the oars, while the woman huddled in the back seat. There was no laughter now, and I felt sorry for them. The storm was coming up too fast to row into it, and instead of gaining they were being washed out to sea. If I hadn't been there, their lives would have ended. I was not snatching people out of a happy life, but simply using two people who

would have perished. There was no chance that they might have reached home alive.

Twice the man stopped rowing and tried to comfort the woman. Both knew they had reached the end. Then the man started rowing desperately again, as if to beat the storm by his strength.

I emptied the water from the globe as I approached. This was the most difficult part. Once inside the globe alive, it would be easy to carry them to the dome.

I could not reach over the boat with my legs, to pick them up, so I tipped it over. They sank for a moment, then the man appeared, supporting the woman.

For the first time they saw me! The girl screamed, and went limp, but the man acted differently. He kicked and yelled, as if to scare me away.

I curved around in the water until I could reach them with my back legs. The man tried to swim away with the girl and I had to take hold of them. I was afraid I would break them before they slid through the opening in the globe, but I didn't. A little water washed in, but there was still ample air to breathe.

The man went limp as he was pushed inside, but I did not believe they were injured. They were simply terrified at the sight of me.

A MOMENT LATER I had the trap closed and the globe below the surface, to hold it in place. My heart was light. I was heading for home with perfect success.

I could see them through the clear surface, and was proud of the two people I had obtained. They were both fine specimens, almost as perfect as my stone woman.

I had traveled a long way before either one opened their eyes; then the woman sat up. For a moment she stared blankly, then caught sight of my

body through the side. She buried her face in her hands before looking a second time.

When she realized the man was with her, she picked up his head and stroked his hair back. It was interesting to watch. Each seemed more interested in the other than in himself. This feeling was different than any my creatures displayed. A moment later the man sat up, and joined the woman watching me.

As we sank deeper, I was glad the opening in the globe was sealed tight. I could not travel fast, as the globe was buoyant. It kept trying to rise to the surface and required weight to hold it before we reached the dome.

As soon as I pushed the globe through the opening in the dome, I put the cover in place. Then my cells went to work to seal it permanently.

When this was done the huge valves began to suck, and the water level slowly dropped. There was not enough oxygen in the interior to support the human beings, but mixed with the air in the globe I hoped it would last until the cells could supply more. It would take days for the water to be withdrawn, and a great deal of oxygen could be manufactured in that time.

As the water sank lower in the dome, the globe slowly turned. I could not see the human beings through the double wall, and had to wait for the water to be drained out before knowing whether they survived.

I watched constantly as the water was withdrawn, and examined the surface of the dome many times to make sure there was no leak. It had never been tried under the terrific pressure that was applied now, and it worried me slightly. I had allowed for the necessary strength, but still there was a chance of trouble.

As the water sank, the small globe rested on the foundation and began to rise above the surface. There was no way to release the human beings from the sphere, and if it did not rest on the

side the trap would remain in place.

I wished I had built a dome which could house my own body as well, but that was beyond changing. My plans must go ahead as I had figured for three centuries. Even after the water was gone I had no way of knowing they were alive.

For two days I watched every minute, but there was no sign of life. Twice I thought I saw the globe sway slightly, but could not be sure.

My body was tired after the long vigil, and I turned away to rest with a bitter feeling. With all the preparation, I had failed. But I fell asleep from exhaustion, and slept for many hours.

The cave in which I slept was only a short distance from the dome. A disturbance caught my attention that drove sleep from my mind. As I drew myself from the cave I could see thousands of sea people gathered outside the dome.

They did not even guess at the origin of the human beings, but movement inside had drawn their attention. The main thought in their lives was for food. Life and movement represented something edible. Curiosity held them after they gave up hope of reaching the man and woman.

When I approached they scattered in every direction.

I COULD SEE the man and woman, and spread myself over the top of the dome to watch.

At first sight they were wandering about, arm in arm, examining articles prepared for them. They looked the food over carefully, and finally sampled some of the things in containers. They recognized it and made a meal from it.

When they discovered my form spread over the top of the dome they turned away in disgust, but a moment later looked again. They could hardly believe their eyes, but I knew they credited me with the transfer from their world to this, so far beneath the sea.

Suddenly the woman burst into tears. The man held her against him for comfort. It was a marvel to see them. They showed an understanding of each other.

The man cared for the woman carefully. He fed her the tastiest bits of food, while he ate other things; although she insisted that he join her in some of the preserved goods.

I had put many furnishings from a ship inside the dome and they used them constantly. Some of the things I did not know the use of, but they used them. They constantly bent in the middle and rested that way on the small soft things. That action I still cannot understand. If human beings are tired I can't understand why they don't lie down instead of simply bending and resting half upright.

A feeling that they had more in common than I had dreamed came to me. They were together all the time and seemed to enjoy everything better that way than alone.

I had not put anything in the dome to shed light, and they were not able to see much. Everywhere they went, they groped, although I could see perfectly. However, enough light penetrated even at that depth of water. They soon became accustomed to it and could find their way about without difficulty.

I wondered why they were able to see my form at all outside the thick wall; then I remembered that my body shone slightly in the dark. I realized that without my form shedding the slight glow they might not have been able to see at all, but would have had to live by their sense of touch.

They were far from happy. I saw the woman cry many times. The man seemed to hate me more and shook his fist at me. I believe he would have attacked me if there had not been so much wall between us.

This surprised me. I had not believed that he would know I was to blame.

A feeling of pity for these helpless beings crept over me. I had made pets of them for my amusement. It was much worse than for them to keep my fish in bowls. Human beings suffer more. My creatures were almost without feeling, while man had more feeling than I. I had to admit they were almost on a level with myself in development.

I pictured myself held a prisoner by them, watched every minute of the day. I was ashamed, and would have returned them to their former home if it had been possible.

I left them alone for a long time, and kept close to my caves. I felt that I should not watch.

If they had known enough to reënter the globe and seal themselves within, I could have returned them to the surface. But it was impossible to make them understand.

WHEN I returned to the dome again they didn't appear very healthy. They moved slowly from one spot to another, the man helping the woman. Her eyes were red from constant crying, and the sight of her bothered me. When the man saw that I had returned he almost went out of his head and shook both hands at me furiously.

As weak as the woman was she tried to calm him. I was watching my stone woman, in real life. I could see that neither human being would survive long under the conditions I had created.

I felt terribly tired when the full significance struck me. I knew that the human beings would have done much better with me, if the positions had been reversed. I remembered many things that I had overlooked in the preparations. They needed green food and I hadn't prepared any for their use. This alone would kill them.

The water which was manufactured in a small hollow bowl for their use might not be exactly what they needed.

All my cells could do was remove the salt and leave the water clear. It could not be freshened, as it was in the atmosphere.

From shaking his fist at me impatiently, the man turned to begging me on his knees for some action. At first I couldn't understand what he wanted; but slowly the realization that he requested death became a certainty.

I could hardly believe it. It was unreasonable for any creature to *seek* death. I knew I could not seek it, no matter what happened to me. Certainly their feelings were a detriment, as well as an advantage in life.

Soon the woman joined the man, and both of them got on their knees to gaze up at me. Then the man motioned as if to break the walls of their dome. Every little while the same thing was repeated, until I could hardly stand it. They sought relief from the life I had given them. They considered existence in a cage worse than death.

The life seemed to have gone out of me. I found I hardly had strength enough to move around. It was an effort to twist myself through the water to my cave.

For a long time I didn't approach them, but stayed where I couldn't see the suffering. They could suffer so much more than I that I could not understand it. Alas, they must be able to enjoy life that much more.

When I returned to watch again, the woman was not walking around. She lay in one spot. I thought she was dead until the man took water to her.

This time my mind was made up. They shouldn't suffer any longer. When the man got down on his knees to me again I knew the time had come. Then the woman raised her hands weakly toward me to ask for relief.

Slowly, I slid my form to one of the valves and moved it away from the small opening. The water shot across the dome in a stream that would have killed the people if they were hit.

When I glanced again, and saw the water slowly rising around their forms, I felt sick. A moment later they were both smiling at me happily. *They were happier at death than in life!*

For the first time I realized how little I amounted to in a great world. I was *nothing*; no longer needed. *There were greater beings than I!*

Mankind, you owe a great deal to the two people I took home with me. They are greater than any of you who live. Never again will I disturb man. He can go his own way.

Perhaps I shall never reach the surface again. My body is very tired. I think I shall rest—and perhaps when another age has come I also will know the calm and serenity of death.

I do not know—but the human race has made me hope for it.



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LOST in the

Which explains why Roger Bacon's ideas were so in advance of his time—

by NAT SCHACHNER

THE unnamed box canyon was ideal for the purpose of Childs Peartree's frightening experiment. It buried itself into the remote reaches of the Peacock Range at the western tip of Arizona. On three sides it was inclosed by cliff walls that rose sheerly to heights of over a thousand feet. On the fourth side a corps of native workmen, under the direction of Fred Walcott, his young, hard-bitten assistant, had erected a stone barrier that blocked off effectually all possible curiosity seekers, if any there might be who would be tempted to traverse the fifty miles of intervening desert.

For almost a month the perspiring laborers had transported by pack-mule trains from the nearest railhead tons of strange equipment, queer machines at the sight of which they devoutly crossed themselves and mumbled hasty prayers. The canyon at best had an unsavory reputation among the superstitious Mexicans.

But the prospect of high wages and the heartening presence of an obviously competent and muscular young man like Fred Walcott held them to their tasks. They prepared the central platform, the bases for the dynamos, the small but superpowerful electrostatic machines; they helped set up the long blue vacuum tubes, the spectral wave troughs, the giant hyperbolic deflectors, the magnetic gravity-compensating coils, the vibration dampeners, and other novel instruments evolved by Peartree for the

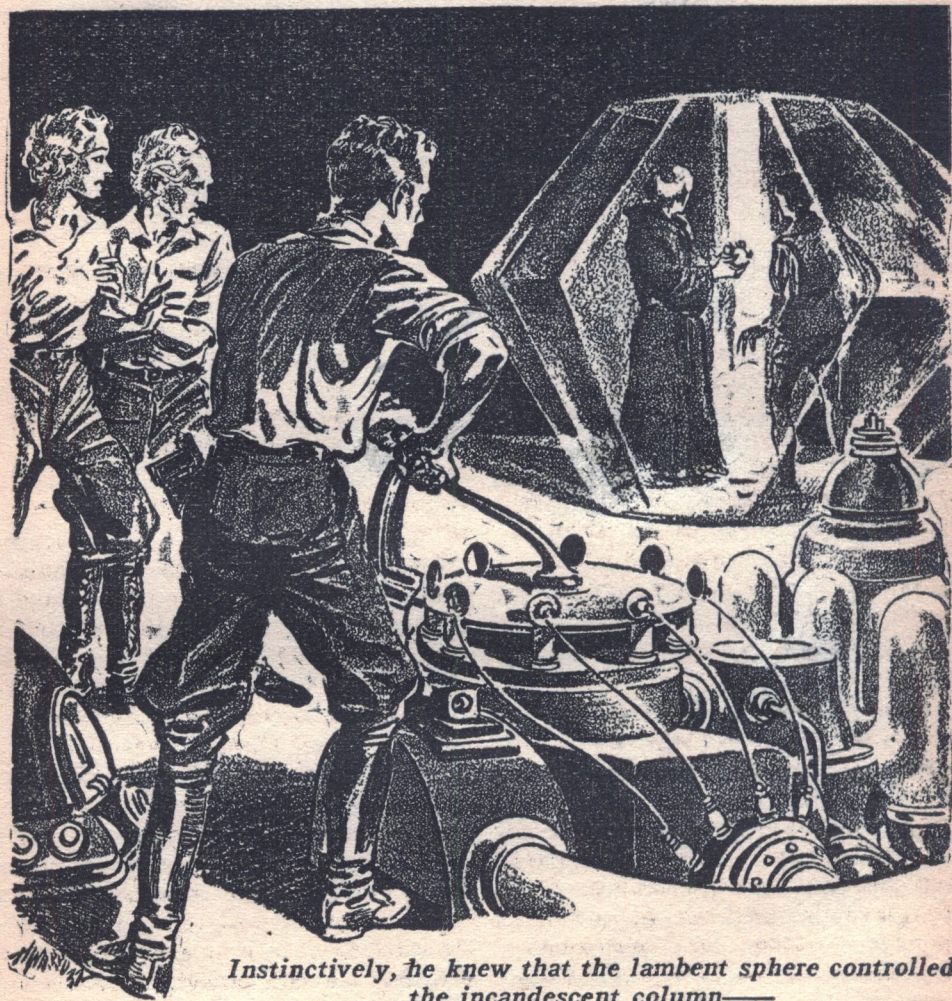
sole purposes of this culminating experiment.

They also helped string wires over the face of the precipitous cliffs, bringing surges of power from the canyon floor to the myriad reflectors that rimmed the high edges and made an inclosed cup of the canyon itself—a cup that would soon fill to the brim with Peartree's experiment.

Finally all preparations were complete. The workmen were paid off and left most willingly. Fred Walcott they could understand—he might have been a young mining engineer, accustomed to the outdoors, bronzed with much sun. The girl, Anne Howard, was also explicable in a fashion. Perhaps she was the old man's daughter; she obviously was in love with the younger man and he with her. She was beautiful, they agreed gravely among themselves, with her bright-blue eyes, her hair that shamed the sun with its glow, her firm, oval chin and slim, straight body which the whipcord breeches and white shirt flaring at the neck set off with gracious regard. Of which at least half was true. She was beautiful, and the sparks needed but the proper channeling to leap in open flame between the young man and the young woman.

But she was not old Peartree's daughter. She was his secretary, his buffer against the world, his assistant in the minor details of the laboratory, and very competent in all her protean capacities. It was only at her own vehement in-

DIMENSIONS



Instinctively, he knew that the lambent sphere controlled the incandescent column—

sistence that the two men had reluctantly permitted her to come along. The experiment they were contriving was most dangerous.

It was Childs Peartree himself, however, who excited the fearful regard of the Mexicans, and was the motivating reason for their haste in clattering away immediately on receiving their pay. To their superstitious eyes he was the high priest of all these strange goings-on, the only begetter of this fantastic machinery.

He was old and dried, like a leaf in the fall. His hands trembled with impatient eagerness; his hair was white and unkempt; his eyes pierced them with unendurable luster.

How were they to know that the name of Childs Peartree had been a power in the world up to three years before, when he had voluntarily retired from university honors to devote himself with a unified fanaticism to this last and greatest research of his life?

WHEN the hoofs of the departing mules faded into the silences of the surrounding mountains, Fred Walcott straightened from the final unnecessary tightening of a bolt, swept a last swift glance around the tiny canyon with its towering walls and rimming reflectors, said somberly, "I still think, Peartree, this is no place for Anne. If the experiment should succeed, the consequences may be incalculable. Even if it doesn't, you're setting loose some mighty dangerous forces."

The girl faced him furiously. "We've been through that before," she said. "I'm staying."

Old Peartree shrugged thin shoulders. "You see, Fred, I can't do a thing with her. And"—he smiled one of his rare smiles—"I don't think you can, either. Anne has a will of her own. Besides, there's nothing to worry about. This central platform on which we stand will protect us from harm. It is shielded. I have labored the mathematical equations and the areas involved to the last millimeter."

Fred shook his head stubbornly. "It's still a desperate gamble. Look what you're trying to do. You're attempting to clear a definite segment of space from all matter, all energy of whatever origin. Such a condition exists nowhere in all the universe. Even in the remotest sections of intergalactic space there exists an infinite interplay of light waves, electromagnetic surges, atoms and molecules of matter, free electrons, cosmic rays. According to the latest refinements on Einstein's original theory, space time itself is but a function of matter and its concomitant, energy. Remove the latter, and space time has no meaning. Perhaps it even disappears altogether."

The old scientist's eyes glowed. "Exactly," he agreed eagerly. "My own formulæ point to the same conclusion. That is why I devoted the remaining years of my life to this crucial experi-

ment, invented the machines that would divorce space of all its attributes, even the integral one of gravitation. It may be we shall pierce the ultimate secrets of the constitution of the universe."

"More likely," Fred avowed gloomily, "we'll blast ourselves out of existence in the attempt."

Anne said, with a certain amount of repressed pain, "If you are afraid, Fred, your horse is tethered outside the canyon."

He looked at her a moment, his eyes dark with anger, his lips tight and hard. Then, without a word, he stepped upon the shielding platform beside them, pushed down with bitter strength upon the master lever.

The girl started toward him, remorseful. "Fred," she gasped, "I didn't mean that——"

But it was too late. The die had been cast, the deed done. The experiment, for good or ill, was on its way!

Anne swung around with a startled cry. Fred's eyes widened in spite of himself. Peartree leaned forward, shaking as with ague.

AT THE down swing of the lever, the conglomerate of machines had flared into mighty being. The canyon buzzed with a million bees. The dynamos whirred and spun; the tall vacuum tubes flamed with multicolored lightnings; the electrostatic balls crackled and sparkled; the down-tilted reflectors on the cliff walls blazed with unendurable stabs of light.

A huge rainbow appeared suddenly, spanned the arc of the box canyon. The spectral colors surged and eddied, flashed with giant streamers to a dazzling brilliance.

Then everything faded, slowly but surely. Gravity flattened out its warping contours; all matter died within the prescribed area; the air went out with a soft *whoosh*; parts of the abutting cliffs, unwarily inside the zone, vanished into nothingness. Sound and heat went with

them, electric impulses later, and, last of all, reluctantly, light. The rainbow gasped out its paling luster; the mountains disappeared from view—then, with a final rush, the world seemed to come to an end.

Nothing existed any more, neither time nor space nor light nor motion—only a tiny platform with its still buzzing machines, its three paralyzed occupants, its puny shield of force that guarded it from the enveloping blankness. It was a precarious island in the illimitable inane, a spot of light and life and energy in a frozen nothingness.

The experiment had been a success! Anne clung suddenly to the tall, lean young man at her side. All her valor was gone. This was more terrible than anything she had imagined. "Fred," she whispered, "I'm—afraid."

He might have retorted on certain biting phrases she had used, but he was beyond irony. He held a sickish feeling within him. Suppose what Peartree had done was beyond redemption. Suppose the process were irreversible, in spite of his confident assurances to the contrary. Suppose they were marooned forever on their island platform, doomed to await a slow and horrible death. The air that beat within the inclosing shield of force could last at the uttermost for a few hours.

Beyond that rim he could see nothing. It was black with a blackness beyond all human conceiving. No tiniest ray of light could penetrate that profound void, no faintest wave of energy stirred in those moveless depths. They were cut off from the rest of the world, from the universe of familiar things, more effectually than if they had been suddenly transported to the remotest galaxy. The thought stopped his heart, thickened his blood. He knew that a hundred yards to either side Earth still existed—matter, sunshine, heat, energy. But no life, no matter, no wave motion, could traverse that paltry distance. It

was the perfect vacuum, the utter non-being that no human mind had heretofore conceived.

Childs Peartree's voice rose startlingly in the stillness. It was curiously bitter with disappointment. "Damn!" he said. "It's only a vacuum. I have emptied space, but the fundamental stuff of space time still exists." He sighed wearily. "All my theories were wrong. My life work has collapsed."

Fred stared around that inclosing wall of blankness. "How do you know space time exists out there?"

"Because," the old scientist retorted with asperity, "my equations call for no such thing as this featureless void. They demand, in fact, the appearance of a new space time. On the removal of our familiar four-dimensional continuum we should have been transported into a different series. I had hoped that we might even find a new universe, a new life, in that ultra-dimensional continuum beyond our own."

"Good Lord!" Fred cried. "You never told us; I never dreamed—"

Peartree averted his gaze. "You might have backed out if I had," he mumbled. "And I needed your help, and the help of Anne."

Fred was appalled. He had known that Peartree was ruthlessly fanatic in the name of science, but not to this extent. In the furtherance of his experiments he had been willing to sacrifice not only his own life, but the lives of others. Transportation to another dimensional space indeed! A trip from which there would have been no returning. Not, he told himself carefully, that he would have held back if the truth had been divulged to him; but to bring Anne along!

Peartree saw the gathering thundercloud, spoke hastily. "It does not matter now. I have failed. You may as well reverse the lever, stop the machines. I can study this silly phenomenon I have accomplished," he continued with quiet

bitterness, "in the private recesses of my laboratory. I did not need all this space."

Unaccountably, Anne Howard was at his side. Her slender arm patted his drooping shoulder. "Please don't despair," she begged. "Perhaps you didn't evacuate space completely. There may be a tiny flaw in your calculations that can be rectified. And next time"—she threw a defiant glance at the young man—"you can count on me to go along with you—even into that ultra-dimensional universe."

FRED caught hold of the lever savagely. Just like a woman, he raged. She chose deliberately to misunderstand his motives, the reason for his obvious anger. Very well, then. His grip tightened; he started to swing upward. Almost he hoped, and cursed himself for a fool in so hoping, that there could be no return.

Halfway toward the locking notch, however, his fingers froze.

Out of the impenetrable black that surrounded them, hurtling into the field of warm illumination, materializing on the farther bare-swept end of the platform with not the tiniest thud, was a hive-shaped structure of gleaming crystal.

Two men stood within its shining depths, two men of strange demeanor and stranger costumes. The older one's brown, skinny hand clutched with desperate grip at a tiny sphere that writhed like a snake over a central column of incandescence. He was old and worn, with gray locks and peppered beard. His face was lean and hawklike, his nose long and narrow, his lips bitter-bitten. Lines of harsh experience etched his forehead and hollowed his cheeks. A gray single garment enveloped his spare body, held around the middle by a woven cord. Dusty sandals shod his bare feet.

His companion was much younger, a mere lad, in fact. Light-brown ringlets

framed his rounded, smooth-skinned face. A leather, tight-fitting jerkin, long, brown stockings up to leather breeches, and pointed shoes completed his attire.

They had not seen the platform upon which they had dropped out of the void; they had not noted the startled occupants thereon. Their heads were twisted backward over their shoulders, toward the featureless space from which they had emerged; and old eyes and young alike held a desperate, haunted terror. The lean fingers crawled over the sphere, started to twist.

Fred jerked out of his reverie, lunged forward with a shout. Instinctively, he knew that the lambent sphere controlled the incandescent column, that a further twist would send the strange mechanism catapulting from their world into the night of other space from which it had come. Peartree's experiment had been only too successful.

The youngster whirled on his pointed toes at the shout. There was a dreadful fear in his eyes. Then they widened in mutual amazement. He cried out sharply to the older man.

The gray-garmented one's hand trembled irresolutely, fell away from the orb control. He swung and stared.

Peartree said very rapidly to himself, "Oh, my Lord!"

Anne cried out, "Fred, come back! They may mean harm!"

BUT Fred Walcott feared no man or beast, though they had come like plumbets from another world. He sprang close to the hive-shaped crystal. It was of a material he had never seen; it was not of earth. He cupped his hands, shouted, "Do not be afraid. We are friends!" Then, suddenly, he felt sheepish. What would these strange visitants know of English?

Wonder filled the old man's face to the brim. The dread vanished from his eyes. "A miracle! A miracle, O John, son of Dominick!" he said hoarsely.

"These are men like ourselves; they speak our own patois of England."

The lad crossed himself devoutly. "Yet they are fantastically dressed," he objected. "It is incredible, master, that we could have returned. It is but another enchantment of the arch enchanter, Mardu—the foul fiends seize and rend him limb from limb."

"John, son of Dominick," the old man returned severely, "how often have I told you that Mardu is no enchanter, that he is the fiend himself, come from a hell beyond the seven crystalline spheres; that Heaven itself knows naught of him."

Childs Peartree merely gaped. He was beyond words.

Anne firmed her slender shoulders, pushed herself by a feat of will to Fred's side. "Are you sure we are not dreaming?" she whispered in scared accents.

The young man clenched sweaty palms. "That," he said harshly, "is the speech and dress of medieval England." He stared at the older man, at his gray garment, and the sweat broke out on his forehead also. "Anne!" He gripped her arm. "There was only one man in all that time who could have —" He broke off, raised his voice. "Who are you?" he shouted. "What are your names and where do you come from?"

The old man said quietly: "If ye be in truth what ye seem, then are we rescued from Mardu and a doom more dreadful than any mortal could have encompassed. My name is only too familiar, stranger. I am Roger Bacon, Friar of the Franciscan Order, and this is my trusty lad and assistant, John, son of Dominick. But tell me, who are you, and what means this queer platform and its curious apparatus that partakes of the alchemical?"

Fred groaned. "I was afraid of this, Peartree. You succeeded beyond your dreams. You broke down the wall of space time that surrounded us, and

somehow switched Roger Bacon from thirteenth-century England into our day and age."

The scientist was a taut, quivering bow. "Roger Bacon!" he repeated huskily. "The greatest of the medieval scientists! The man who prophesied the airplane, the automobile, the telescope. By Heaven, there is more to this than a mere transposition, Fred! No wonder he knew so much. He had discovered the secret of time travel." He gesticulated frantically. "Bacon, come out! We have heard of you, but not as you think. Your name appears in history as the first modern."

The Friar's eyes were puzzled. "In history?" He pondered the phrase. "In truth have we been so long gone that we are deemed dead?"

"A mere matter of over six hundred years," Peartree assured him. "This is 1937 *Anno Domini*, and this land is America, wholly unknown in your own time."

John, the son of Dominick, fell on his knees and prayed fervently. "This," he cried despairingly, "is the foul Mardu's revenge. I shall never see my own peaceful village again, with the fat kine wandering by the stream, nor the yellow locks and impish smile of Catherine that is like to tear my heart straight from the body."

"Hush your idle prating," Roger Bacon said severely. "This is matter we must understand." He twisted the squirming ball slightly. The central column flared to purple hue. The wall of the crystal inclosure seemed to vanish. He gathered his long gray robe of the Franciscans about him, padded out on sandaled feet. The lad followed more reluctantly.

"Now explain," he demanded with a philosophic calm.

THEY DID, Childs Peartree and Fred and Anne, with quick, staccato phrases and hurried words. Much of it

was obviously beyond the comprehension of the medieval man—space time, divorcement from matter and energy, warps, Einsteinian universe, modern geography and civilization.

But Friar Bacon seized on ultra-dimensional theory, nodded his head. "Of that," he declared with somber emphasis, while young John shivered, "I know much. We have been through many dimensions, beyond the crystalline spheres themselves, seeking escape from Mardu, seeking always a return to my own prison cell."

Then *he* explained.

"My story," he avowed, "is a strange one, even as this marvelous tale of yours. Because of my ponderings on alchemy, because of searchings into the things of nature, and not of Aristotle, Bonaventura, General of the Franciscans, placed me under surveillance in the Chapter of Paris. But in my cell, through the aid of this lad, John, son of Dominick, and the secret benevolence of one or two of the good Friars, I continued my experiments."

He stared at the banked instruments on the platform in frank puzzlement. "I know not how it happened. But something I did, or some combination of things, brought a void about myself and John even as this. We trembled. We trembled even more when this curious contrivance"—he indicated the hive-shaped traveler—"broke suddenly through the veil, precipitated itself at our feet. It held a demon within, black and hideous beyond conception."

"Satan himself," John muttered and crossed himself in fear.

"Perhaps," the Friar agreed. "We never were able to discover the truth. He spoke to us only in signs. Nevertheless, it seemed he had come from a distant place, beyond the heavens themselves, and there were more of his kind in that far-off land."

"A dweller in an ultra-dimension,"

Peartree breathed with repressed excitement.

"I have seen many such"—Bacon nodded—"but not such as he. But to continue. He treated us with manifest contempt, as if we were worms too poor for his feet to crush. He quit his shining conveyance, prowled around my cell, fingered my retorts and crucibles as though they were mere childish playthings."

"And all the while," the boy interjected, "I groveled in an agony of dread for my immortal soul."

Roger Bacon smiled. "I feared not for that," he said. "But there was an arrogant cruelty about the demon that minded me we would not escape alive from his clutches. I was not prepared to die. Furthermore, I always was of a mechanical, foolishly daring bent. I had noted what the black creature had done with the little gleaming sphere when he slowed down and thrust open the wall. I was sorely tempted.

"Even as he turned, having sated his curiosity on the poor contents of my cell, I thrust John, son of Dominick, headlong into the cage, sprang after. There was a huge cry—a scream not of this Earth—filled with a fury and venom that are indescribable. Flame shot forward toward me. I verily believe had it touched my body I would have crisped to a tiny cinder. But already my hand was on the hovering sphere. I twisted it desperately. Even as the flame darted out, the crystal wall misted over; the cell and its howling occupant disappeared, and we were enfolded in unutterable darkness."

HIS HAND shook as it wiped his forehead. His head turned uneasily toward the surrounding void. "What happened after is a hideous nightmare. I mastered somewhat the control of the gleaming ball. At times we found ourselves unawares on worlds beyond our



Then—like an evanescent note in a beam of sunshine—they vanished into the illimitable inane.

knowledge. One was red in color, parched and drear. Great canals tapped the water through the deserts. But the inhabitants drove us off with hurtling lightning bolts."

Fred breathed hard. "Mars!" he whispered.

"Then night inclosed us again. When it cleared, our conveyance tossed as

though it were a feather in a seething cauldron of flame and fury. Another instant and we had been molten specks. But luckily, in the last gasp, I turned the ball."

Peartree shook violently. "Good Lord! They must have broken through space into the Sun!"

Roger Bacon said gravely: "I know,

not where it was, unless it were in hell itself. But then, as the black mist lightened again, we were in a world of metal. There was neither up nor down, nor side to side. Everything revolved and writhed and contorted in ever-changing shapes. Monstrous things hemmed us in, all of metal angles, and they shifted and retracted shapes and size even as we watched aghast. They were not human, yet they seemed endowed with life, Heaven forgive me for the sacrilege."

"It was there that Mardu caught up with us," said John.

"But how could he?" Anne protested. "You were in a different dimension; you had left him stranded back in thirteenth-century France."

"He had built himself another conveyance," the Friar explained. "Perhaps there were materials in my laboratory he could use. Yet it was our salvation that the crude materials of our world are not like the subtle elements he employed in this first incandescent column. What he made up in skill, he lost in the greater efficacy of the ship we stole. Nevertheless, he almost got us. We hurled ourselves into the void between the dimensions just in time. 'Mardu!' he shouted after us in an ecstasy of rage. Whether that be a tremendous curse, we know not. We have called him ever since by that word."

"But if you lost him," Anne protested, "why were you so dreadfully afraid when you broke through to us?"

Friar Bacon smiled sadly. "We did not lose him. Always has he been on our trail. In universe on universe he follows us, like a hunting dog nosing a hare, like a falcon winging a drumming partridge. And always we escape by the merest hairbreadth, because our shining ball turns faster, our central shaft of flame is more subtle in its workings."

"He will catch us yet, master," the boy said with conviction.

The Friar's eyes darkened. "Never!"

he affirmed with sudden energy. "Know ye, sirs and lady," he addressed the three, "this chase has been the greatest since Michael and his angels pursued the devilish hordes through tumbling chaos to hell. We have seen worlds and sights beyond the power of mortal tongue, we have been in places that Heaven itself knows nothing of; yet always we try to return to our own cozy time and the pleasant Earth with which we are familiar." His face saddened. "For the moment I thought that we had succeeded."

"Stay with us," Fred advised. "This is the nearest approach you may ever get. And once I reverse this lever and dissipate the ultra-void with which we have surrounded ourselves, you will be safe from Mardu, your pursuer. There will be no break in our space time for him to span."

"And I," Childs Peartree spoke up suddenly, "will utilize that strange machine of yours for purposes of my own."

"What purposes?" Fred demanded sharply.

The scientist's eyes were burning torches. "Why, to visit these vast other dimensions of which they speak, to survey all universes entire, to seek the secret of creation at its very source. What nobler, greater task has ever awaited mortal man?"

"But you will never return," cried Anne.

"Bah! I do not wish to. Earth is but a small, dusty ball after all."

"You forget," said Fred quietly, "Mardu!"

"I'll chance him," Peartree retorted, and started for the conveyance of shimmering crystal with its shining inner column of flame.

Fred jumped after him with a curse. He'd save the old fanatic from the consequence of his reckless enthusiasm by forcible means if necessary.

But it was John's terrible cry that

stopped them both dead in their tracks.

Fred whirled. His hand streaked to his belt, where a .38 Colt fitted snug in a holster. It was too late!

OUT of the Stygian nothingness that surrounded their platform like a shoreless sea, another hive-shaped vehicle had materialized—a twin to the one in which Friar Bacon and the lad John had come. But it was cruder in material and workmanship. Even in that split second Fred noted that clumsy glass, cleverly welded into a single sheet, was its covering. The column by which it maneuvered through the dimensions seemed of fused Earthern crucibles, inclosed in a vacuum sheath of glass. Its glow was duller, more subdued.

The vessel had floated to rest on the farther end of the platform. Its exterior shimmered wide, and a black figure glided forth—a being shaped like a man, though taller, dark as the void from which he had sprung. His face was pointed and elongated like one of Modigliani's painted creatures. His feet were clubbed and toeless. His eyes were slanting slits, and they flamed with furious fires.

"*Mardu!*" he screeched in a thin, eerie voice.

John, the son of Dominick, had fallen to his knees. "*Domine, salve!*" he shrieked. Roger Bacon pulled his cloak about his head, bent to the expected blast of extinction. Anne, close to the lever, seemed turned to stone.

Mardu, denizen of a strange dimension, saw Fred's swift motion. He saw the jerked-out muzzle of the gun. There was cold cruelty in his face, but there was also intelligence. He had never seen a gun before; his own weapon was a blast of energy built up out of space potential. Yet he knew that this inferior creature of a lesser world held a certain power of destruction. It might leap the intervening space before he

could raise his hand. He took no chances.

With another screech he leaped. His long, boneless arms wrapped suddenly about the motionless girl. She screamed, struggled. But he was too powerful. Even as Fred leveled his gun despairingly, crashed forward to the rescue, Mardu had darted back into his vehicle, using Anne as a shield. From behind her squirming form his black, unjointed hand curled around the little ball.

Fred shot, directly for the glowing column.

The roar of the gun echoed deafeningly around the limited closure; smoke spumed from the muzzle. But the pointed dimension traveler was gone, catapulted into the circumambient void. And Anne and her captor, Mardu, had vanished with it.

Old Peartree stirred weakly. "He has taken Anne," he mumbled in a daze.

But Fred wasted no time. Grimlipped, jaw tight with corded muscles, he whirled to the astounded Friar. "Quick!" he rasped. "Into the other machine! We're going after him."

Roger Bacon lowered his muffling robe. He made a gesture of utter futility. "But how can we?" he asked. "Already he is lost among the countless worlds."

"There must be a way," Fred said. "He managed to follow you, didn't he?"

John, son of Dominick, staggered to his feet. He shook with fear. "He will kill you," he cried. "He is Satan himself. His arm flashes lightnings."

Fred patted his holster grimly. "I, too, can flash lightnings on occasion. But this is no time to argue. We've got to make haste."

The thought of Anne, with her slim, pliant body, her bright, blue eyes, carried off by an alien creature into the unimaginable intervals of space time, was a searing torture to him. He knew now

that he loved her—now that he had lost her forever.

"But——" started John.

"I'm not asking you to come along," Fred snapped. "Stay here with Peartree. You'll be safe with him."

The boy straightened. His eyes hardened with sudden maturity. "And lose all chance of ever seeing my Catherine again?" he said steadily. "Rather I'll take my risk with Mardu himself. I am coming."

"Good lad!" Fred approved. "Get in."

"Here!" the old scientist demanded in alarm. "How about me?"

"You've got to stay behind," Fred told him swiftly. "You won't be much help in a fight. And you'll have to keep this channel of communication open for us. Or else," he added with emphasis, "even if we do find Anne, we, too, will be wanderers through all eternity."

Then he swung inside, before Peartree could protest. "Let's start," he said.

Friar Roger Bacon took a deep breath. A prayer worked silently over his lips. Then he twisted the ball.

THE incandescent column leaped into flaming life. A supernal glow blasted its depths. The crystal hive hazed, turned opalescent, then slowly cleared. The platform was gone; so was Childs Peartree and the apparatus he had evolved. Outside was nothingness—black as the pit, featureless, without form or substance. They seemed suspended in a shoreless void, where time and space and man himself had no meaning, no purpose.

"How can we ever find them in this?" John asked in despair.

But Fred Walcott was not listening. All his trained and critical intelligence was focused on the terrific problem before him. Quickly he learned whatever Friar Bacon could teach him of the mechanism of the interdimensional

traveler. It was not much. The thirteenth-century man, philosopher, scholastic, groping scientist though he was, was not mentally equipped to grapple with the superscience of Mardu and his creation.

By trial and error he had discovered the method by which the slithering crystal ball controlled the column of heatless flame. That was all.

But Fred experimented, racing against a time that did not exist, feverishly bending every faculty to the task. While he blundered, Anne might already be lost forever in some unimaginable dimension.

He gave up at once the task of determining the nature of the energy column, of the materials of which the machine was composed. They were not of Earth, without doubt not of the universe in which Earth existed. Dimly, he sensed that here was an energy breakdown of the fundamental structure of subspace itself, the primitive continuum which underlay the space-time formulæ of the several universes. But how it worked, how it shifted the hive-shaped structure from one dimension to another, through what patterned warp it operated, were beyond even his faculties. Nor was he interested just now. All his being concentrated on the single task of tracking Mardu and the girl through the bewildering infinities in which they were enmeshed.

"There must be a way to trace his course," he said with quiet desperation. "Mardu knows it; he chased you from thirteenth-century France to beyond the universe and back again."

"I do not know the method," Bacon declared with philosophic fatalism.

Fred flung himself intensely into the task. He turned and twisted the writhing ball; he searched every nook and cranny of the circumscribed inclosure—without success. He must have changed their hurtling flight a hundred times.

Once they flashed into a supernal blue in which worlds of fantastic geometric angles and curves spun and gyrated—and flashed out again. But no sign of Mardu, no sign of the method by which pursuit was possible.

As to a magnet, Fred returned time and again to the column of sourceless energy. Its smooth, shining surface raced with heatless flame. Fred considered it with furrowed brows. Somehow, within that lambent round—

WITH A CRY, he leaned forward. The tiny sphere control hung quivering on the convexity. A thin hairline bisected it into hemispheres—so thin, so faint, he had not noted it before. With tentative finger nail, Fred tapped along the edge, seeking the inner mechanism. Even as he edged around, there was a tiny whir. The crystal ball swung open on a hemispherical axis. Its polished planes were opaque, and even as they stared, the surfaces clouded, cleared into miniature but mechanically perfect pictures.

Pictures of far-off universes, of vast nebula spiraling along the immensities, of triple and quadruple suns in intricate orbits, of huge life forms floating in the void, whose brooding intelligences caused the central column to flicker and fade with the impact of their mighty thoughts.

"I've got it," Fred shouted joyfully. "This is a subspace scanner, which picks up the energy flows of electron wave trains, and retranslates them into visual light." With taut fingers he swung the angle of the sphere.

The scene shifted to new quarters. A comet gleamed with pale, wild light, vanished. A city sprang into view, a jumble of strange towers and leaping fires. Creatures beyond human comprehension peopled its heights, swarmed out like bees in flight. Fred spun the angle.

Worlds tumbled on worlds; dimensions leaped into view and gave way

in turn; space glittered like a whirling kaleidoscope, creation came and so did moveless death. But always Fred twisted the angles, seeking but one thing and one thing alone—the sight of a hive-shaped mechanism and of a black, ultra-dimensional creature and a slim, struggling girl within.

Then he saw them! In the remotest corner of the upper hemisphere, so infinitely remote that they were but microscopic pin points on a mosaic of endless universes. Yet even as he cried out fiercely, it seemed Mardu stared directly up at him with cruel mockery, and twisted the sphere. Like an evanescent mote in a beam of sunshine, they vanished into the illimitable inane.

With grim intensity, Fred spun the scanning hemispheres through all the angles, caught them again. But even as he set the total sphere upon the course, Mardu had dodged into nothingness again.

It became a game of hide and seek, a cosmic chase such as all the space times had never witnessed since the first creation—a deadly game in which Anne Howard was the pawn, and a thousand, thousand dimensions the field. They flashed through space of many colors; they startled strange civilizations with the apparition of their flight; they materialized within the depths of strange suns and stranger entities. And always Mardu, with his cruel grin, twisted and ducked, vanishing seconds or minutes or æons—they had no means of judging time—before the space-crashing pursuit of his own machine.

John, son of Dominick, gaped like a fish at the dizziness of that terrific chase; even Friar Roger Bacon lost his philosophic calm and hunched over with blazing eyes. But Fred followed every vanishment, every sudden lurch into new spaces and new times, with remorseless rigor. He had the better machine, but Mardu was more skilled in operation. A sickening sensation overcame him.

He would never be able to catch up with the slippery prey. And sooner or later, in some unimaginable dimension, Mardu would achieve his native universe, would obtain the succor of his own kind, and blast Fred and his companions into dissipating nothingness.

ALL THIS WHILE, a tiny, moveless doll, Anne Howard had crouched in the farthest round of Mardu's machine, just as she had been flung in the first onslaught. Fred groaned his despair, thrust out his arm in a mute gesture of appeal to the pictured representation of the girl he loved. Her eyes lifted. They seemed to cling to his.

Slowly, Anne raised herself. Her slender body tightened like a drawn bow. She leaped with unleashed motion upon the huge black back of her captor. John, son of Dominick, cried out in unwitting, unheard encouragement, "A brave girl!"

Her impact staggered Mardu. His black paw wrenched at the sphere; he flung around to meet the attack. Then scene and all vanished, to give way to the featureless inane of some universe where space and time had not yet been created.

"She'll be killed," John gasped.

The old Friar groaned.

The sweat burst out in huge globules on Fred's forehead. Frantically, he turned the sphere, spun it round and round, trying to pick up the lost trail, to gain once more the sight of the struggling pair.

"There they are," the lad screamed. Fred stopped just in time. In his agony he had almost overleaped.

The girl was beating with vain, small fists upon the great bulk of her adversary. His mocking grin had given way to a soundless snarl of rage. He lifted his paw, clubbed her down with brutal blows. She sank quivering to the floor of the pictured cage. Fred,

helpless, unimaginably remote, cursed frantically. But it was Roger Bacon who kept his wits about him. The gray-robed Franciscan Friar leaped to the control sphere, held it steady toward the far-distant scene.

Mardu straightened up from the motionless girl, grinning. Then his cruel eyes lighted with alarm. He sprang to his own sphere. It was too late. Directly alongside, spanning the intermediate dimensions, crashing into that alien space and time, materialized the pursuing trio.

His arm arced upward with the speed of light. But fast as he was, Fred Walcott was faster. The heavy Colt leaped from its holster, trigger pressed even as it leaped. The heavy bullet roared from the muzzle, slammed through the other-universe crystal, whizzed through a green-tinged space, splintered the farther glass of fused retorts, and caught Mardu, arm swinging upward, full in the forehead.

He fell backward, crashing into the ball control, hurtling into the column of incandescent glow. Flame sheeted outward; the vehicle expanded, burst into a thousand splintering shards.

"Protect us, Heavenly Father!" moaned John through whitened lips.

Fred jerked the ball madly. The side of their own conveyance misted, vanished.

Roger Bacon started forward with a cry of alarm. "Don't, my son! It is death what you intend."

But Fred had already catapulted out into the alien space. Through the flame and shifting smoke he saw the motionless form of Anne, floating in green-tinged nothingness as on a tideless sea.

His lungs filled to bursting. He gasped in the airless void. His hurtling body sped toward the limp girl; his hands groped out to catch her in fierce embrace. He seemed on fire with strange pricklings, with collapsing

pressures. Perhaps this space was radioactive. There seemed no gravity. Far off, a rose-tinted world moved in the placid depths.

His brain was on fire, his lungs a gasping bellows. Anne was moveless in his arms—dead, perhaps. And he, too, was as good as dead. He thrashed arms and legs in frantic motion. He made no progress, could not. The pressures increased. He burned with torturing fires.

THEN something caught him, pulled. Air sighed past him with a thin *whoosh*; crystal materialized suddenly in front of him.

"Praise to the saints, my master lost not his head," John, son of Dominick, gasped heavily as he released his grip on the suffocated young man and the girl to whom he still clung with a fierce, unbreakable grip. "He manipulated the control so that we came alongside, and I was enabled to drag you both within."

The aged Friar shook his head sadly. "Aye, but we have lost much of precious air. It will be but a matter of little time before what is left will foul beyond endurance."

Anne moaned a little, opened her eyes. "Where am I?" she murmured. Then she saw Fred bending with agonized look, felt his strong arms tightening. She smiled faintly, happily, relapsed into unconsciousness.

Outside, in the strange green space, the exploded vessel drifted in a thousand scattered pieces. Amid the *débris* drifted, as well, Mardu, a round hole tunneled into his Stygian forehead.

Friar Bacon said with quiet resignation. "He is dead—devil or demon or whatever he was. No longer need we fear his eternal pursuit. You, Fred Walcott, man of my own Earth of a future time, have slain him for us. But to what profit? Even now the little remaining air grows stale, unbreathable. In but a

few bare minutes we, too, shall be dead."

The young man deposited the girl gently on the floor. His mind raced. They must not die—not now! "How," he demanded tensely, "did you happen to crash through to our platform on Earth?"

The old man thought heavily. It was hard to think. There was a roaring in his brain from the lack of air. "I know not," he said with painful intake. "I know but that we two had despaired of all return, that I had held the crystal globe motionless in my hand while I had pondered what to do."

In one swift stride Fred was at the control, had gripped the shifting ball, held it taut. As he did so, the column waned and dulled to a mere thin phosphorescence. "That must be it," he gasped, fighting for breath. "You shut off the power unwittingly, and the break in space time that Peartree had engineered had drawn you through. If only——"

Light beat about them, brilliant, dazzling after the solid black to which they had become accustomed. Some one was shouting, incredulously, joyfully.

Fred blinked, grinned slowly. With utter recklessness he took a deep breath of the failing air.

Outside was the familiar platform, with Childs Peartree, his white hair tousled, wrestling frantically at the master lever. They had come home, home to Earth and the Peacock Mountains of Arizona, and the twentieth century!

THEY TRIED to persuade Friar Roger Bacon and young John, son of Dominick, to remain. The old Franciscan shook his head quietly. "This is not my time or age," he said. "I would be but a groping neophyte amid your marvels; I would never feel at home. Besides"—and his eyes glowed with a proud light—"I must tell my country-

men, the scholars I know, of what I have seen. Perhaps thus I may be able to remold my times nearer to truth and the future."

"And I"—the lad held himself very straight—"do wish to return to my pleasant village, and the comely arms of my dearest Catherine."

"You will lose yourself once more in infinity," Fred declared. "Stay!"

"Nay!" answered the Friar confidently. "We shall return. I know more of the manipulation than I did before."

Gravely, they shook hands; steadfastly, the pair stepped back into Mardu's machine. A final wave of farewell, a twist of the ball, and they had vanished into the black surrounding non-space.

Fred held Anne tight to him, staring into the void with heartbreaking eyes. "They will never make it," he whispered huskily.

"But they did," answered Peartree. "Remember the *Opus Major*, the *Opus Minor*. In those ancient volumes are prophecies of our day, of the things which we explained to him."

Fred shook his head. "There is no mention of Mardu and the dimensional

traveler. How do you account for that?"

"Easily! These volumes were written for the pope at his request. Nothing more was heard of them for many years. Very likely there was another manuscript, of such startling import that the pope ordered it hastily destroyed as stemming from the devil himself. Remember that Roger Bacon was soon thereafter imprisoned and held in close confinement, until, as a very old man, his mind tottering, he was released to die." Peartree's face clouded. "That," he said as if to himself, "is the common fate of pioneers."

He reached for the master lever. Slowly, it came up in reverse. The conglomerate of apparatus whined and hummed and buzzed. The circumscribing blackness gave way to gray. There was a roar of intruding elements, of air and matter and energy and gravity. The platform rocked in the turmoil.

Then, as they clung close together in the whirling madness, sunshine blazed suddenly into the box canyon, and the mountains stared down upon them with eternal calm.

The experiment of Childs Peartree was over!

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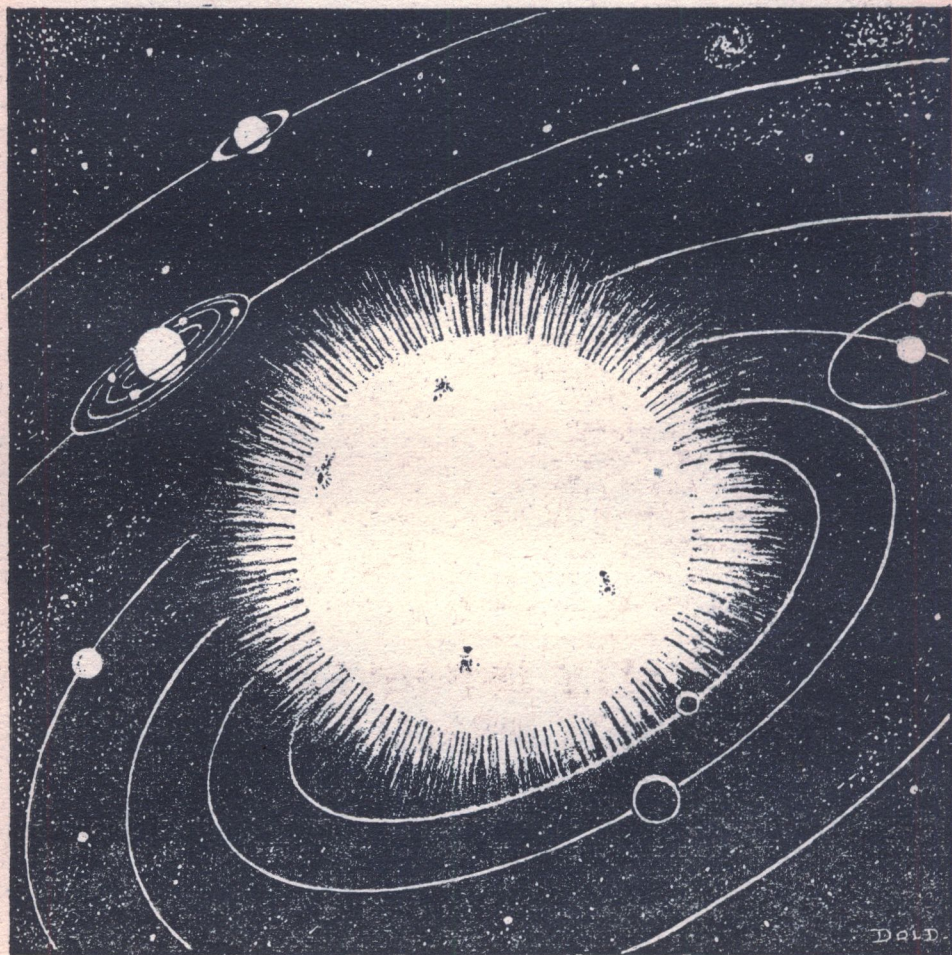
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Atomic Generator

by John W. Campbell, Jr.

Article No. 18 in a study of the Solar System



THE SUN is 866,000 miles in diameter, and its mass is 332,000 times as great as Earth. But it is not to be regarded as a mass of inert matter; it is a functioning, delicately adjusted atomic generator, a machine of infinite complexity, titanic size, yet con-

trolling and regulating the vast efflux of energy it pours out with a delicacy and precision utterly astounding in any machine.

To call the Sun a machine is not metaphor, or allegory; it is a machine in the truest sense. A machine might be

defined as a mechanism which integrates a series of natural laws into a sequence of reactions that produces a certain end. The atomic generator which supplies Earth with light and heat, by using a series of very involved physical laws, succeeds first in transmuting matter mass to pure energy, then processing the crude energy released through a long series of reactions to a usable type of radiation; light.

To a certain extent, we know sufficient to draw up specifications on that atomic generator. Its rough dimensions have been given, mass and outside diameter. Its average density is about 1.41 times that of water. Incidental to the vast bulk of that generator is that mass; something of its specifications as a power plant can be given, too.

As a power plant, it is a completely self-contained unit, sealed in with sufficient fuel to last the life of the unit. The mechanism is completely self-maintaining, operating without care, repair or regulation for not less than 30,000,000,000 years. The fuel is automatically fed, and will not require renewing; so carefully and perfectly designed are the multitude of controls placed upon it that despite the fact that fuel is more stupendously explosive than anything known to man, no accident need be feared. Hundreds of thousands of millions of these units in varying sizes and types are in operation, and there is some doubt that any explosions have been observed.

This unit transmutes the mass of matter directly to energy mass. The Einstein formula $E=Mc^2$ gives the figures on that conversion. One gram of matter mass may be transmuted to one gram of energy mass; this latter being equivalent to 9×10^{20} ergs. In more comprehensible terms; a first-rate trans-pacific liner contains about 1400 tons of steel. One gram of energy would be sufficient to reduce that metal to

incandescent, gently bubbling liquid. The atomic-generator unit under discussion converts matter to energy at the rate of 4,000,000,000,000 grams of matter per second, each gram of which is quite capable of the above destruction.

Each second, 4,000,000,000,000 grams of matter are destroyed and radiate away as radiant energy. But the unit is packed with sufficient fuel to last out its life. At that enormous rate of radiation, 4,000,000,000 tons a second, 240,000,000 a minute, at the end of 150,000,000,000 radiation will have carried away all but about 99 per cent of the Sun. Precise instruments could, perhaps, tell the difference.

GASOLINE is not explosive; it won't react unless oxygen is present. Therefore, there is no danger in a full tank of gasoline. But substances such as nitroglycerin are explosive. Nitroglycerin contains, in itself, all the oxygen and other elements needed for a violent and instantaneous reaction. But it would take just about that 14,000 tons of nitroglycerin to equal in explosive potentialities one gram of atomic fuel. And the Sun is stored with sufficient atomic fuel to last a minimum of 30,000,000,000 years at 4,000,000,000,000 grams a second.

This is in connection with novas. A nova is not a true explosion of a star; it merely represents a slight blow-off, the safety valve pops for a moment, a mere instant of stellar time. The design of that atomic-generator unit of ours is far too perfect to allow an explosion; there is a second line of defenses that keeps it under control. If the safety valve does release for a moment, the powerful controlling forces promptly bring the atomic release back under its sway.

For truly, a nova is an overrated thing. Typically, an ordinary nova flares up swiftly and enormously for not

more than a few weeks, then promptly the controls reassert themselves, and the exnova returns to its original delicately balanced rate of generation.

But even that safety-valve blow-off isn't so terrifically violent; it can't be called a genuine explosion, not when the utterly indescribable potentialities for explosion present are taken into consideration. If a star really exploded, released all the stored energy designed to last its Gargantuan furnaces for meaninglessly great periods of time, in a single, brief flare, it would be a shock of energy so vast as to wipe out whole sections of a galaxy. The ordinary nova, at its maximum, releases energy no more swiftly than do certain of the greater stars at their perfectly normal output. Rigel, for instance, is one of the brighter stars of the galaxy, and in normal output exceeds many nova, and about equals the average.

No, an ordinary nova cannot be called a true explosion.* The control of that atomic generator is too sound. The exact mechanism of that control? We do not know, nor do we know even approximately the mechanism of the generation (if we did, it might well be that there would be certain lesser generators here on Earth). Certain rough outlines of it we can understand, the method of ignition perhaps, and a possible answer to the control question.

Apparently no body more than about 30,000 times as massive as the Earth can exist without becoming self-luminous. The immense pressures exerted on the atoms at its core by the thousands of miles of overlying material stress atoms beyond their ability to resist through structural, static strength;

* "Ordinary" with intent aforethought. There are also certain objects called "supernova" with sound reason, but they are a subject to themselves, and a very limited subject. So rare are they that none has yet been observed in our galaxy of thousands of millions of stars. However, they might conceivably represent that complete loss of control, which an ordinary nova, definitely, does not.

only by adding to this static strength the kinetic resistance of immensely high temperatures can the pressures be supported.

THOSE TEMPERATURES in the Sun at its core run to immense intensity. Whatever the figure may be, all authorities agree on one thing: it is measured in millions of degrees. Eddington proposes a temperature of about 10,000,000° C., while Milne believes it to be many times higher. (Jeans suggests 32,000,000° as a working basis; other astrophysicists vary their estimates from Eddington's conservative figure up to 500,000,000° C.) At such temperatures bodies do not radiate heat; they give off X rays and they give them off with an intensity and fervor that is quite incomprehensible to ordinary life. Even at 1,000,000° the radiation would be X-ray energy, albeit somewhat soft rays, but the intensity is—beyond conception.

The Sun is, really, too immense to be pictured as a whole. However, the distance from even Earth to Moon is an interplanetary distance, too great for humans to negotiate to-day. The distance from Earth to Venus is a vaster gulf of interplanetary space. Yet Earth, as the Sun's center, would find the Moon in its orbit still *200,000 miles beneath the Sun's surface*. The distance from Earth to Venus is only a bit more than twoscore times the Sun's diameter. The Sun, in other words, is practically of interplanetary size itself; beings theoretically imagined as capable of living on it would find themselves faced with interplanetary distances of millions of miles in visiting "neighboring" cities. And that interplanetary-sized surface is about twice as hot as a tungsten lamp filament, even at its cold outer surface.

This to illustrate the meaning of a million degrees centigrade. For a body 28 miles in diameter, equal to one of the lesser asteroids, astronomically micro-

scopic, would outshine the Sun, give off more energy than all that colossal thing, if its surface temperature were only 1,000,000 degrees. At 10,000,000 equal to the most conservative estimates of the Sun's interior temperature, a body with a diameter of 2000 feet would radiate as much energy as all the vast 866,000-mile Sun. The radiation jetting out from such a surface would be more solid than any material we know. An imaginary (and physically impossible) opaque surface exposed to the full brunt of that solid radiation would be subjected to a radiation pressure of 140,000 tons per square inch. (Steel of the best kind resists almost 250 tons per square inch).

Stated in terms of the Sun's interior, the terrific pressures there are borne by ions (atoms stripped of their electrons), by the electrons from those atom cores, and by driving, mad quanta of radiation seeking escape into space. This radiation alone would sustain an immense pressure, and any increase in the temperature there would increase its driving force.

Have you seen a Kipp gas generator? Essentially it consists of 2 flasks: a lower one filled with, say, marble chips that will release carbon dioxide on contact with acid; and an upper flask filled with dilute acid. A rubber tube connected with the lower flask leads the gas away. The 2 flasks fit hermetically; the only escape for the gas is through the tube, or by forcing the liquid back up the tube into the upper flask. If gas is drawn off through the tube, the pressure in the lower flask falls; acid runs down from above, releases gas, and the gas so generated creates pressure to force the acid back up. Fresh acid can enter at only such a rate as to balance the withdrawal.

AS THE SUN throws out energy, it tends to cool, but cooling would mean

less radiation pressure, less heat movement of ions and electrons to hold up those outer, pressing layers. They squeeze inward, perhaps feeding fresh fuel to that atomic reaction—and a new violence forces them outward again. Long since, a balance has been reached, a steady state where fuel leaks inward slowly to that internal destruction, its entry neatly and exactly balancing the outpouring radiation.

What that fuel is, we do not know. There is a present, widely considered theory that it may be hydrogen atoms, the energy release resulting from the "packing" of hydrogen atoms to make more and more complex atoms, first 4 hydrogens being forced together to make 1 helium, then more and more atoms packing in to produce heavy atoms such as iron. That could account for it, but present knowledge is far too limited to say that it *does*. It may be such a process as that, or it may be that total annihilation of atoms takes place, utterly destroying all trace of the atom involved to leave only pure radiant energy. This theory has met difficulties in the last few years. Originally, it seemed that the combination of a positive proton and a negative electron might lead to such a destruction and release of radiant energy. Now, we know it does not; it leads to the production of a neutron instead.

The difference is, however, fundamental and important in cosmology. If atoms are annihilated, then, presumably, a large portion of the Sun's mass might ultimately be consumed in that reaction. If instead, the hydrogen reaction is the power source, then only the small proportion of the mass represented by the so-called "packing fraction" of hydrogen is available, a quantity probably of the order of one one-hundredth of the energy available on the other scheme. That difference means an immense fore-shortening of the Sun's total life.

In one respect the 2 energy releases are identical: they would release energy in the Sun's heart as a crude, savage type of radiant energy of unbearable concentration. Such energy released to space would destroy any exposed living matter instantly; life on Earth would be starkly impossible.

But our atomic generator ages and refines that crude energy into a more usable form.

The exact type of energy released at the Sun's heart depends on the type of annihilation taking place; but whatever it may be, it represents quanta of immensely penetrant and energetic type, more deadly than X rays certainly. This radiation, released 430,000 miles beneath the Sun's surface, savagely seeks a way of escape. Driving outward at 186,000 miles a second, it is nevertheless stopped almost instantly by absorption in one of the savagely battered atomic nuclei packed to enormous density there at the Sun's heart. For a moment of time—perhaps a hundred-millionth of a second—it is held trapped, before the nucleus discharges it again. But probably its release (which may be in any direction) is not in the original outward direction; it may be forced to retrace its course. In any case, it is reabsorbed, reradiated, time after time, each absorption and release occupying that brief fragment of a second.

What infinities of absorption and radiation it undergoes in its near half-million-mile journey to the far surface, no one can guess. But each absorption takes its minute fraction of a second, and in the countless repetitions of that process, ages pass countless centuries, myriad of milleniums. Probably that aging and refining process that each quantum of energy must undergo takes in all millions and tens of million of years, all that vast aging being made up in units of hundred-millionths of a second.

THE OUTPUT terminal of that atomic generator has an area of something like 3,000,000,000,000 square miles, the Sun's surface. It's "potential" is its temperature; about 6000° C. It is impossible to give an accurate temperature, such as 6115° C., because there is nothing that can be pointed out and labeled: "This is the radiating surface of the Sun." The "surface" is a radiating layer, the *photosphere*, probably thousands of miles in depth. The temperature of this layer varies widely with depth, so that 6000° represents the effective temperature of the effective surface.

That temperature is high enough to volatilize all known substances; it is higher than any chemical reaction can produce (most reactions known on Earth run the other way there: water yields hydrogen plus oxygen). Obviously then, this output terminal represents a higher concentration of energy than we can produce on Earth to-day.

Even on Earth, where the energy concentration has been diluted by nearly 100,000,000 miles of distance, the density is still nearly 650,000 horse power per square mile. Probably the greatest concentration of man-made power plants is centered about Manhattan Island; one plant alone generates 1,000,000 electrical horse power. Yet in all the clustered plants in that concentratedly developed little district, the most highly developed area on Earth perhaps, the electrical and steam-power plants could not equal the Sun's concentration of energy. And the Sun is working on the hard end of the inverse square law, to the tune of 100,000,000 miles.

At the Sun's surface, the power concentration is 70,000 horse power per square yard (enough to run an ocean liner). 3,970,600 square yards make one square mile. And about 3,000,000,000,000 square miles makes one Sun surface. The Sun, in other words,

radiates about 450 million million million horse power. One two-billionth of that is sufficient to warm all Earth, for of all that vast flood Earth intercepts only that microscopic fraction.

But to astronomy, the Sun has yet other meanings. First, it is the lord and ruler of the solar system by its immense gravitational attraction, almost 1000 times the mass of all other members of the system combined. Second, historically, and first in interest now, the Sun is the only example of those monstrous space generators that sprinkle space that is close enough for detailed study—the only available star. And, third, it is not only the ringmaster of the system, but almost certainly the place of origin of the other members; from it, the planets were almost certainly torn.

And that last is one of the most absorbing mysteries of all; for though dozens of theories have been advanced as to the mechanism of that creation, each has its difficulties, not the least of which is the absolute iron grip the Sun has on its surface matter. There are disruptive forces enough at work, space knows, but there is one titanic intergrative force at work that paralyzes them all. Heat, expansive power of superheated gas, the pressure of those driving floods of radiation, the wild, mad tornadoes of electromagnetic energy known as Sun spots, all tend toward disruption and dispersion.

But the gravitational grip of the Sun's enormous mass is not easily broken. Were the Sun as dense as Earth, the surface gravity would be even greater than it is, but with the low density of 1.41 times that of water, the surface gravity is still 28 times that of Earth. This high surface figure alone is not as important as the second fact, that at 2,500,000 miles, the gravitational force still exceeds Earth's surface gravity. Escaping matter must fight an intense field for millions of miles.

THE RESULT is that even driven by the wild heat motion of 6000°, hydrogen, lightest and most volatile of substances, is helplessly bound. Heat motion alone is incapable of lifting matter any great distance against that colossal, dragging force. But light pressure—the intense, driving force of light quanta—trapped by atoms and giving to the atom the momentum that would have permitted the light to escape. Riding on that jetting, almost tangible force atoms are carried up as individuals for millions of miles. Immense volumes of matter are sometimes caught up in a jetting blast of light and whirled out in immense prominence to distances of hundreds of thousands of miles. Calcium, hydrogen, helium, iron, sodium and other metallic atoms in gaseous state are hurtled out at speeds of a hundred or more miles a second.

Mice fleeing the cat's claws. Even should they attain 200—300 miles a second, the Sun's grip would be merely playing with them. 600 miles a second is the velocity required to escape that grip. Occasional bursts do reach immense speeds, approaching that velocity of escape sufficiently closely to recede to the distance of the planets before the burst of light that drove them outward fades away to normal intensity. It is these bits of matter, so driven out that, it is believed, may collect to form meteoric and cometary material. But it has not escaped from the Sun; it still must yield to his sway.

Those bursts of light that drive out the flaming, prevailing red eruptive prominences seem to be associated with Sun spots. A second, less spectacular type, the quiescent prominences, are not associated with those vast electromagnetic storms, but act more like Terrestrial clouds, vast incandescent masses of hydrogen, helium and calcium floating in the Sun's outermost, and strangest atmosphere, an atmosphere of light. Held up, apparently, by the steady drive

of light from the surface below, they hang quietly, without much motion, changing but slowly in form.

The Sun spots themselves range in size from the limit of observability with a telescope to monstrous holes 100,000 kilometers in diameter, easily visible with the eye shielded by smoked glass or layers of exposed camera film. The disturbed surrounding surface may have a diameter 2 or 3 times as great, making the total area of disturbance often 100 times the area of all Earth. The spots appear as black holes on the Sun's bright surface. That blackness is due to their far lower temperature, often as much as 1000 degrees below the general surface. The resulting less-intense radiation makes it appear black. So cold and dim is this Sun-spot area, in fact, that the positive crater of a carbon arc is in comparison about—say, twice as black. Black it may be against the Sun's incandescent surface, cold in comparison, but it is still far hotter than any source of light we use, on Earth.

When light moves through a magnetic field the spectrum lines are powerfully affected, depending on the relationship between direction of light and magnetic field; the light is plane or circularly polarized, and the lines of the spectrum are doubled or tripled. This gives a means of determining the nature and

strength of Sun-spot magnetic fields. The spectrum shows them to be enormous, and intense, and in a line perpendicular to the Sun. These magnetic fields are, apparently, caused by a vast whirlwind spinning of the ionized gases of the Sun.

These vast magnetic storms on the Sun (only a hundred diameters of that body from Earth) not unnaturally cause powerful disturbances on Earth, greater auroras, magnetic storms, and floods of electrons. Radio and all electrical communication is frequently violently disturbed. Fortunately, the huge cyclones act like immense gun barrels, squirting their disturbing influences in a definitely aimed direction. Only occasionally, in consequence, is one of the greater storms so situated as to point directly toward Earth, and then, due to the Sun's rotation, it is not long so situated.

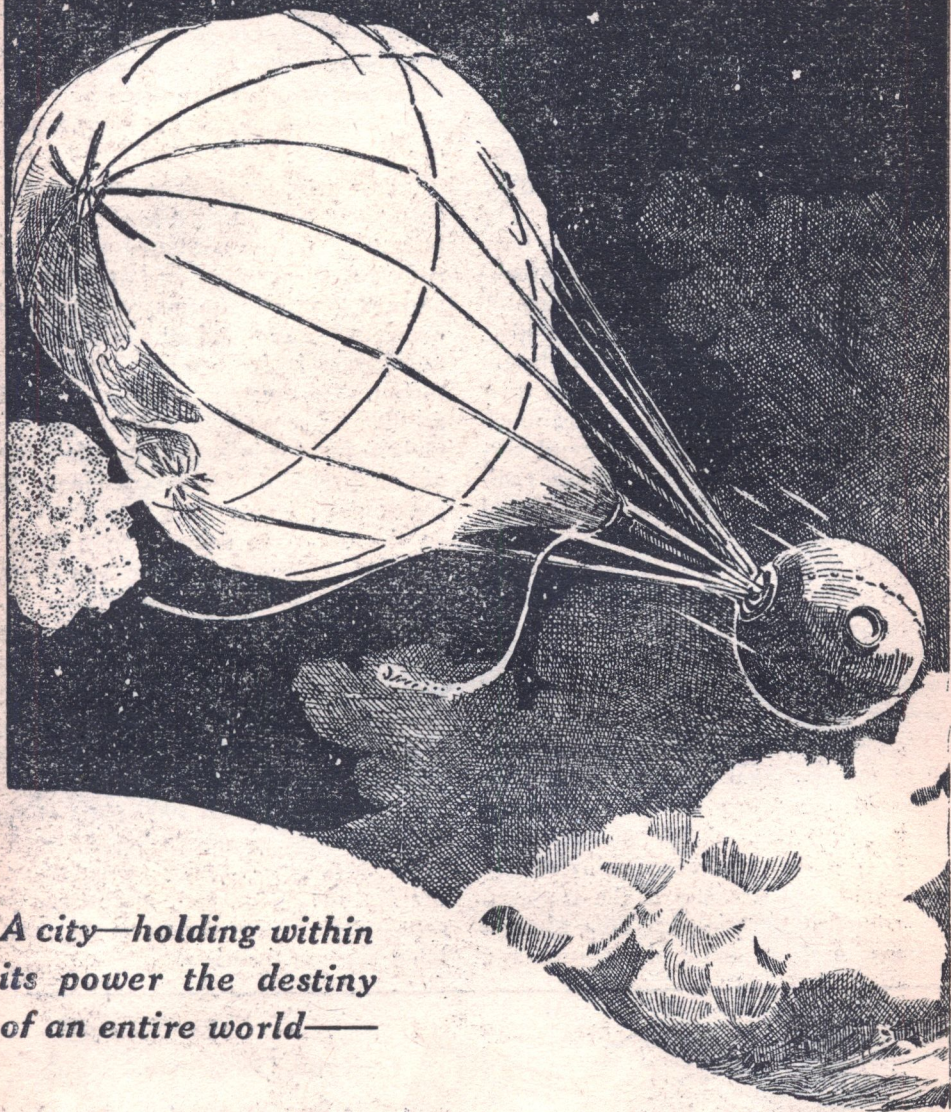
For the Sun rotates, and in that rotation, curiously, is one of the greatest stumbling blocks to theories that seek to explain creation. Once in 25 days at the equator, once in 34 at the poles. In consequence of this slow turning, the Sun, with 999 out of 1000 parts of the system's mass, possesses but 20 out of 1000 parts of the rotary momentum of the system! That fact, more than the constitution of the planets, is the stumbling block of theorists.



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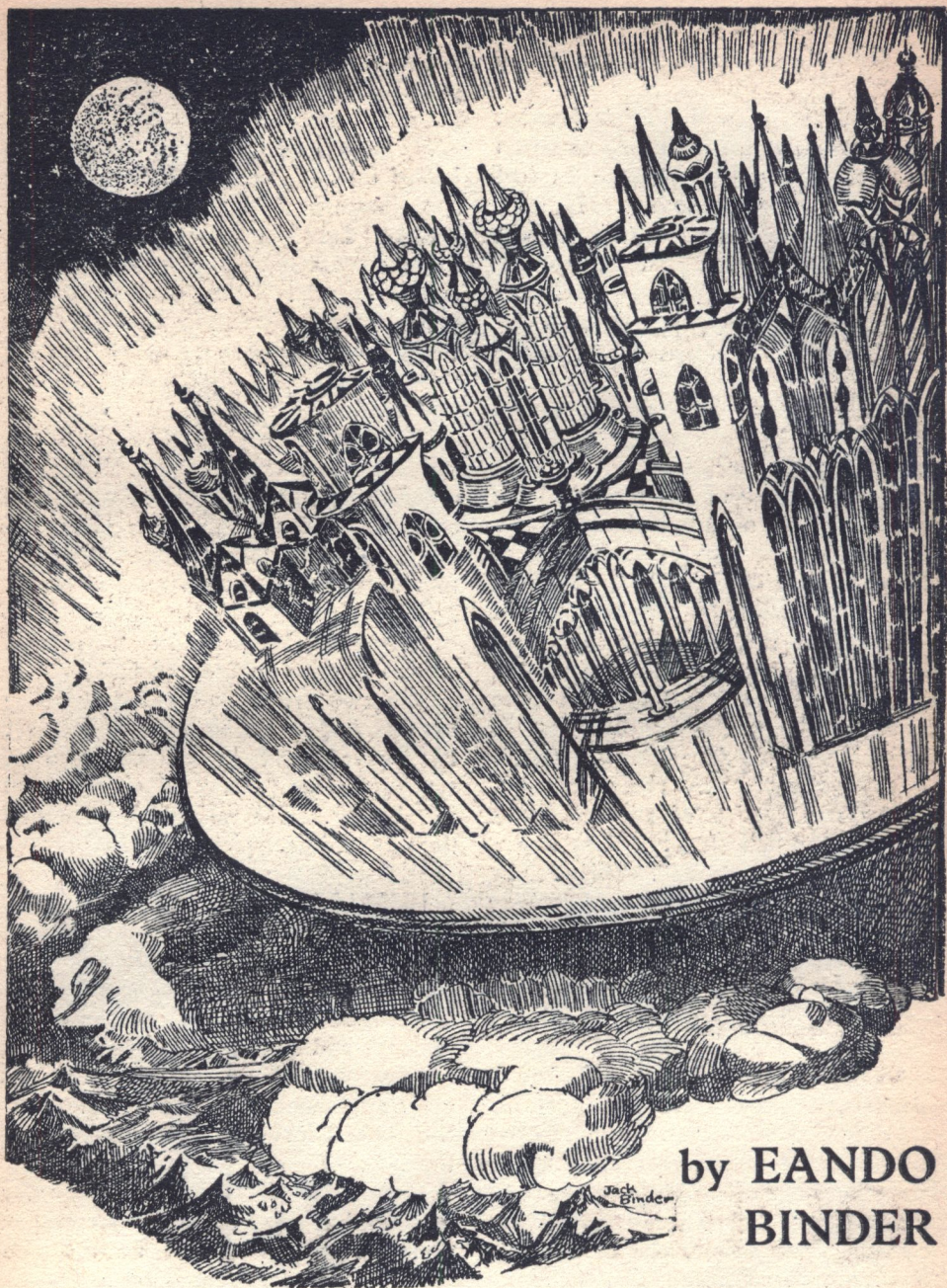
*A city—holding within
its power the destiny
of an entire world—*

QUEEN of the SKIES

IT WAS just before the last tank of compressed hydrogen had been released into the huge gas bag that the news came. Professor Dumont and Milo Gibson were standing together, watching the great balloon fill out and

strain at its tug ropes. They were thinking of the trip they were soon to make into the far stratosphere. They hoped to reach eighteen miles, higher than man had gone before.

"It won't be long now." Dumont said



by EANDO
BINDER

How could this tinsel and multihued city—that looked fragile enough to shatter at the first clap of thunder—exist here—eighteen miles above the Earth?

excitedly, working his sweaty hands together. His sensitive, thin, intellectual features showed the effort he was making to appear calm. He turned to his young companion. "Are you nervous, Milo?"

"Jimminy crickets!" exclaimed Milo, with boyish enthusiasm. "I can hardly wait!"

One of the ground officials hurried up. He appeared to be trying to strain ahead of his body, as though he had something important to say. He did. He said it in a voice whose inflections were all wrong, due to his agitation.

"Gentlemen, it's happened—war! War has been declared by the European Alliance on America. Heaven have mercy on us——"

Milo gripped his shoulder and squeezed it. "What are you saying, man? Are you sure of it? War!"

"Sure I'm sure of it," screeched the official of the meteorological bureau. "Didn't I just get it over the phone from our branch war office in the city? War, I tell you! Declared this morning at 4 a. m. over the American trading in African seaports, against the recent European Alliance's embargo. A mere excuse, of course. It's a plain war of aggression against America. But there's no help for it, for us. The general order for mobilization of all war forces has gone through already. Gentlemen, you can't go up, naturally. This is to be a war of science. All scientists, such as yourselves, must be subsidized for this national emergency."

Professor Dumont's thin, gaunt figure jerked. His deep-set eyes, usually calm, flashed fire.

"On the contrary," he said firmly, "we are going up! This is a scientific expedition. Science cannot stop for even war. All the instruments are packed. Everything is ready. We're going."

Young Milo looked at his superior admiringly. "Attā boy, chief," he said, "I'm with you. Up we go."

"You can't!" the official spluttered. "I—I forbid it!"

Dumont tapped his inside coat pocket, smiling. "I have the official order to go up. You can't stop me unless you have an official countermand from

Washington. It would take you at least three hours to get it. By then we'll be gone. Come on, Milo, I think we can get in the gondola."

He turned once more to the official's baffled face. "I've waited five years for this chance to fly into the stratosphere. I had to fight that long to get sufficient funds from a niggardly treasury." He smiled bitterly. "You don't think I'm going to let patriotism or a so-called national emergency stop me now? I would then be more of a pig-headed fool than you are."

The two meteorologists strode to the gondola. The official tagged along, like a barking dog, roundly abusing them as everything from traitors to rebels. Finally, in exasperation, Dumont turned around and tweaked his nose violently. Milo chuckled.

"All set!" Milo called to the ground crew. "Seal us in the gondola."

The two scientists crawled into the ten-foot ball of aluminum, the style set by Piccard, and made themselves as comfortable as they could on the hard metal floor. The men outside twisted the threaded door piece tight.

FINALLY, some of the ropes dropped and the gondola rocked gently. The straining gas bag was then released entirely and it jerked the gondola off the ground with enough force to throw Dumont and Milo in a tangled heap in the bottom. They picked themselves apart and shook hands, grinning. They had looked forward to this for a long time.

They were dressed in jumpers for warmth, but these could be taken off in a minute by the zipper runs at the sides and chest, in the event it became warm from the friction of air. Boxed and bolted to the walls and ceiling were their supplies and instruments. The oxygenated-air tanks were firmly anchored in a circle around the central floor space.

"We're probably swinging over the

city now," said Dumont, after he had seen that the barometer, thermometer and altimeter were working. These three instruments were attached to the outside hull, but their readings were mechanically rendered to their eyes inside. They were also equipped to make permanent records on charts, as were the other instruments, which would record ionization, magnetic strength, and the cosmic rays. Particularly the latter.

Their ascent continued smoothly, impelled by the giant balloon, a hundred feet above. They began to feel detached from Earth, as though they were going to another planet. Yet one thing was uppermost in their minds.

Finally Milo spoke of it. "War!" he said wonderingly.

Dumont shrugged. "It was inevitable. When the European Alliance was formed two years ago, war had already been planted as a seed. In its bald-faced aspect, the European Alliance was formed for one purpose: to conquer America and England, the English-speaking world.

"America, by which we include all of South and North America, is tremendously rich in resources. The British Empire is equally rich in lands. Thus land-and-resource-starved Europe saw how, in one bold stroke, it could have both these things. Instead of bickering among ourselves and taking land and resources from each other, they reasoned, why not unite our great war machines and attack the Western World, and at the same time disrupt the British Empire? It is deadly logic. The war now resulting will be a holocaust, a titanic struggle for world mastery. If the European Alliance wins, they will divide America and Britain like a pack of wolves tearing apart a deer.

"The European group of nations is a formidable line-up of bandits armed to the teeth. Their war forces are tremendous, more than a match, I think, for the English-speaking world's unag-

gressive forces. And South America is almost totally unprotected. They will conquer it first, and establish bases there from which to attack the northern strongholds."

Milo succeeded in establishing radio contact a little later.

"Latest report," came from below, "is that the Alliance has declared war on England. This was expected. But here's something unexpected. Japan has joined the Alliance, and has already been promised the State of California! America will be attacked from both sides!"

II.

AT TEN THOUSAND FEET, the flying expedition and ground radio again exchanged reports. The former mentioned only that they had turned on their compressed-air tank slowly. The news from below was that an English fleet had already engaged with one of the Alliance, in the first skirmish of the new war of the colossi. Obviously, the Alliance had maneuvered its forces into strategic positions long before actual war had been declared.

At twenty-six thousand feet, Milo said, "We are passing through thick veils of cirrus and cirrostratus clouds. Our observation ports are completely fogged. Temperature has dropped to forty-eight below. A strong lateral wind is carrying us westward, according to our compass."

The ground radio said, "Mobilization of defenses on all seacoasts of America is well on its way. Realizing the magnitude of the occasion, the President has ordered a general draft of all industry as well as man power in the United States. The English ambassador is already arranging for a meeting of English and American military authorities."

At seven miles, the voice from above said, "We are now leaving the troposphere and entering the stratosphere. Sky absolutely clear. Lateral wind has

died down. Balloon still rising steadily.”

The voice from below, “The English fleet is desperately defending the British coast. An armada of battle planes is reported to have been sighted on the way to South America. Japan has calmly taken over the Philippine Islands.”

At ten miles, Milo reported, “Sky getting very dark. Air is absolutely calm. Temperature uniform at sixty-five below. Our gauge outside shows an almost complete lack of water vapor. As with other expeditions, our gondola is very warm. We’ve taken off our jumpers. Everything fine.”

From the surface world, “Wish we could say the same down here. A Japanese fleet has been sighted steaming for the Hawaiian Islands. The entire naval forces of the European Alliance are being hurled against England in the attempt to invade her territory. Scattered reports from her colonies show that large bodies of troops secretly transported before war was declared are already invading India, Australia, and South Africa. No action yet on either of the American continents.”

At fourteen miles, the voice from above the clouds said, “We are now passing the previous record of height reached by man. The cosmic rays show an increase of intensity, proportional to the decrease in the air density. Sky is black-violet. Temperature has climbed again to fifty-eight below. We’re rising much more slowly now.”

The voice from the other side of the clouds said, “This war is progressing with the amazing rapidity of a bad dream. The Alliance fleet withdrew temporarily, unable to smash through the British line of capital ships. Shortly after, the first aerial engagement took place, over London. While the Alliance battle planes duelled the English air defense, bombers rained death and destruction on London. This is to be a war of civilian slaughter. Thousands are dead in London, and part of it is in

flames. Daring reporters with microphones are describing the terrible scenes of carnage, for broadcast by low wave. All the world will live this war every minute of the day.”

Up in the gondola, high above this Martian turmoil, Dumont and Milo looked sadly at one another, shaking their heads.

DUMONT became busy with his instruments. “From here on,” he said, “all our data will be first hand. So far it has merely been confirmation of what Piccard and others found, up to the height of thirteen and seven-tenths miles. But now, Milo, we are pioneers. It’s stuffy in here. Open the release cock a bit and then step up our fresh-air supply.”

Milo gingerly crawled on hands and knees around two tanks and reached for the release cock of the gondola. He twisted the valve cautiously. With a sharp hiss the warm, overcompressed air escaped out into the rarefied stratosphere. He carefully sealed the valve again, and set the air tank’s stream of gas at an increased rate.

They breathed deeply of the revivifying gas. It startled them suddenly to hear a dull roar and see a blinding object rush by their one window port.

“What was that?” asked Milo. He wondered if it were possible for an accidental shell to have been aimed up this way, from the war below.

“That was close!” exclaimed Dumont, wiping his forehead. “We nearly tangled up with a meteor. You know, up here where the air is thin, meteors are constantly flashing down at something like thirty miles a second, before they burn up completely. This one may have been no bigger than a peanut, but it could easily shear right through both sides of our hull.”

“Let’s give them the right o’ way,” said Milo, with an attempt at humor. He crawled to the professor’s side and

helped him set the octagonal beam aerial in its universal mounting. After hooking in another battery, they sent radio beams upward, in short signals, varying the wave length.

Bits of music and voices clipped short were heard, as Dumont spun the dial to get past the broadcast range of short waves. His hand hesitated as one voice rose compellingly, "—a shambles. So is Piccadilly Square, which is in my line of vision from this tower. Proverbially, not one stone is left on another. Smoke overhangs everything. It does not quite hide those silent, huddled shapes, though. Piccadilly Square was milling with afternoon crowds when the bombing began without warning. Women, children, babies, all were——"

Dumont wrenched the dial over savagely. "We're on a scientific expedition," he reminded himself.

At a little over eighteen and a half miles, Milo reported, "Sky now almost dense black with several of the brighter stars visible. Sirius is conspicuous. Temperature still constant. We've made tests of the radio wave mirrors of ionized gases. Layer D, reflecting long waves, seems to be no more than twenty-five miles up. Layer E, Kennelly-Heaviside, is at present fifty miles high. Layer F, Appleton, reflecting short waves, is one hundred and fifty miles. We are barely rising now, about ten feet a minute."

The ground radio blared, "England is being ringed in a formidable wall of armed forces. A French fleet is bombarding Liverpool. The German fleet is steaming down the coast of Scotland. The mixed Alliance air fleet is continuing the bombardment of London, but is meeting unexpected resistance from anti-aircraft defenses. So far over there it is a deadlock. In the Western Hemisphere, South America awaits attack. Brazil has mustered its aerial fleet. The United States naval fleet is patrolling both the Atlantic and Pacific coasts.

Plans are being made for the government's evacuation from Washington."

The gondola rose steadily but slowly. Dumont strained anxious eyes upward. The balloon was distended to giant size. When the altimeter indicated exactly nineteen miles, the upward motion ceased. Very gradually the balloon began to descend, drifting slightly to the west, though there was no wind. It was an effect of their own inertia against rotation, since at nineteen miles the arc of rotation was wider than at lower levels, coincident with the falling off of Earth's gravitational grip.

They took a last look at the world of nineteen miles' height. They might never see it again. It was a dark, somber region they saw through their ports, lighted by a few stars, almost airless and completely windless and cloudless. It had the eerie quality of a dream. Then, as though a curtain had been raised, all the stars winked into being, in a background of jet black. The sun had set. It was true night. Milo sighed, as though in relief. It didn't seem so weird now.

They put on their jumpers again, for the interior temperature had dropped considerably. Milo sat down with his back against a tank, hands folded over his knees. Dumont turned to see the altimeter reading.

AT THIS MOMENT the gondola jerked violently. Dumont turned ashen gray and attempted to rise, but a sudden downward plunge of the gondola threw him off his feet. Milo steadied himself with a grip on an instrument box bolted to the wall, and looked upward out of the port.

"Look!" he gasped. "Our balloon burst! Of all the rotten luck——"

Dumont had now succeeded in scrambling to his feet and looked out himself. The dark shape of the gas bag above, outlined by the lake of shimmering stars, was distorted into an ellipsoid,

with one side rapidly collapsing inward. Even as they watched, they could see it shrinking from loss of its precious contents.

Dumont's hand on Milo's shoulder squeezed so hard that Milo winced. "All this work gone for nothing," groaned Dumont hollowly. "We're facing death! My wife—my children—— Lord!"

"Take it easy, chief," admonished Milo, with a calmness he did not feel. He could not help thinking of his mother, patiently waiting his return.

"Eighteen miles, Milo!" cried the elderly scientist. "Good Lord, we'll fall for eighteen miles! Think of the terrific velocity we'll have by the time we reach ground. The gondola will split open like a ripe pod. We'll be crushed to pulp!"

"Maybe all the gas won't leak out," argued Milo unhopelessly. "Enough may remain to ease the gondola to Earth."

But their speed of descent kept increasing. He turned to the radio and switched it on with trembling fingers. "Hello, hello down there," whispered Milo. "We're falling. Balloon burst. Only miracle can save us."

And then the miracle happened.

There was a jarring crash that flung them to the floor like sacks of wet flour. Milo felt as though his spine had been driven up through his brain. Just before he lost consciousness, he reflected that it could not be the ground they had struck, for that was eighteen miles below. What, then, could it be?

When Milo Gibson recovered his errant senses, he found himself sick but otherwise unharmed. He tested his arms and legs, fingers and ribs, half fearfully, but the rude crash had not broken any bones.

He pulled himself erect and staggered to the nearest port. He gasped as he looked out. He saw nothing but abysmal emptiness, with the stars overhead. Yet their ship was resting solidly on

something. Was it invisible, or merely cloaked by the darkness? Peering out of the other port, his eyes widened and threatened to pop out of their sockets.

"Holy smoke!" His surprised exclamation rang like a pistol shot in the confined space.

Then he turned his attention to his companion. Professor Dumont lay crumpled against a tank, with one arm bent under him. A small trickle of blood ran from under his head to the center of the floor space. Yet not exactly in the center, for the gondola was tilted considerably.

Milo unlatched the supply box, took out a thermos bottle of cold water and splashed some in Dumont's face. The scientist groaned, turned over and opened his eyes wearily. He said nothing as the younger man bathed the cut at the side of his head and dressed it with salve, surgical gauze and tape from the first-aid kit. Milo helped him to his feet.

"Where are we, Milo?" asked Dumont. "Have you any idea?"

Milo did not answer till his companion had peered out of the port and seen the same incredible sight he'd seen. Then he said, "We're eighteen miles above ground; the altimeter still says so."

"But that—that city out there!" demanded Dumont, as though Milo must know. "What is a city doing eighteen miles in the air?"

Milo shrugged wearily. His eyes had a sort of dazed quality to them. The brain behind had been shocked to a state of lethargy. "I don't know, chief," he replied. "All I know is that we've been saved from death—that I'm very tired. Since we can't do anything about this, at least till daylight, let's have some sleep. Whatever that pipe dream is outside, it'll wait."

They both yawned. "You're right," agreed Dumont. They curled themselves up as comfortably as possible on the harsh metal and went quickly to

sleep, tired in mind as well as body. When Milo awoke again, rubbing the sleep out of his eyes, he saw Professor Dumont standing at the forward port.

"Good morning, chief," greeted Milo, feeling in good spirits.

"It's still there," said Dumont, standing aside so his companion could look out. "I thought maybe it had been a dream last night."

III.

THE RISING SUN somewhere to the back had lighted up the region to a certain extent. But the lights of the city were still on. It was revealed by them more than by the near gloom of dawn: It was like something out of the Arabian Nights. The buildings were as fanciful as symbolic art creations and as richly adorned as Chinese pagodas.

"Lord!" choked Milo. He breathed deeply, stunned. He could not take his eyes off the elfin city. How could it exist here, this tinsel and multihued city that looked fragile enough to shatter into a million flying crystals at the first clap of thunder? He must be dreaming. But at the same time he knew he wasn't.

Dumont was trying to signal Earth with the radio. "It's dead," he announced. "The landing must have wrecked it." He looked up. "Well, Milo, what do you think of it?"

"Gosh!" responded the young meteorologist. "I still can't believe my eyes. Question is, though, just what are we going to do now?"

Dumont opened the supply box and pulled out some sandwiches wrapped in waxed paper. "Maybe we can think better after we eat."

Just as they munched the last of the sandwiches, Milo started and peered more closely out of the window. He pointed to a black opening at the base of the nearest building, from which had emerged several figures. It was too far

away to distinguish them. They approached rapidly.

"A reception committee," said Milo. "I—I hope they're human!"

Dumont looked at him queerly but said nothing. Both of them wondered what sort of creatures could live in a mysterious floating city eighteen miles above ground, breathing air of a density ten times less than at Earth's surface, and existing in a uniform cold of sixty degrees below zero.

As the group approached, the meteorologists felt a queer sense of relief, for they were undeniably human beings—six men of deeply bronzed skin and curly, straw-colored hair. They looked like Nordics who had been exposed to a tropical sun. Their clothing consisted of baggy trousers coming together at the ankles, loose jackets tight around their waists and necks, and shoes of some soft material, all brightly colored. Their hands, faces and heads were exposed to the air.

The two watchers examined their faces as they came closer. It was quite apparent that they were of some race closely resembling the Nordics, with thin, straight noses, high foreheads and sky-blue eyes. They were tall and narrow-hipped, and walked with a jaunty step.

Dumont looked at his companion suddenly. "By Heaven, Milo, they look like your brothers!"

The group approached the gondola rather hesitantly, their faces puzzled. They showed no sign of fear. Yet, though they were obviously excited, not once did any of them move his lips to speak to the others. Suddenly, their gaze turned, as one, to the port out of which the two scientists were peering. For a minute the eyes of the meteorologists met those of the strange men, wonder on both sides.

"Evidently we're just as queer fish to them as they are to us," commented Milo. "And now what?"

THEY DID not have long to wait. One of them, older and more authoritative-looking than the rest, without saying a word to the others apparently, calmly strode up to the gondola. He passed out of the scientists' sight, but a moment later they heard him knocking on the door seal.

"Leaping lizards!" exclaimed Milo. "He wants to come in!"

That was a dilemma. If they opened the seal, all their air would rush out. "Yet it could be done," murmured Dumont thoughtfully. "We could let him in, close the seal again quickly, and open an air tank till the pressure builds up to normal. It shouldn't take more than a minute and wouldn't be any worse for us than holding our breaths under water for that long."

"Right, chief," said Milo eagerly. "These people look friendly and are absolutely unarmed. They can't have any harmful intentions. Let him in."

Dumont stationed himself beside the air tank while Milo worked at the seal plate. When he had turned the huge plate several times by means of the handles, there was a low hiss of escaping air. By the time he had unscrewed the seal entirely, all the air was gone. Milo held the plate aside and motioned frantically for the tall stranger to crawl in. Without hesitation, the bronzed man stepped in and Milo hastily screwed the seal in, with spots in front of his eyes from holding his breath.

Dumont closed the valve when pressure was normal. Then he and Milo looked curiously at the bronzed stranger who stood before them.

Milo grinned at the professor. "Now just what do we do?" he asked musingly. "Naturally, he doesn't know our language and we don't know his. About all we can do is smoke a pipe of peace—if we had a pipe."

The stranger smiled as though appreciating the joke. Milo looked startled. "One miracle has happened already,"

he muttered. "But we can't expect another. This chap couldn't understand English."

The visitor smiled still more broadly. "On the contrary," he said in perfect English, with a precise accent, "I do!"

Dumont asked: "You are human beings then? An Earth race?"

"Yes, of course," replied the stranger in some surprise. "Yet we have not been on Earth's surface for twelve thousand years! For that length of time have we lived in our sky city, isolated from the place of our origin. Our only connection with Earth's surface has been through long-range observation. Yet that was only a one-way connection, for I'm sure no one on Earth suspects our existence?"

"Decidedly not," agreed Dumont. He was slightly dazed. "Twelve thousand years!" he murmured, trying to assimilate that fact. A thousand questions popped into his mind with the rapidity of a machine gun.

Before he could ask even one of them, the visitor held up a hand. "Before we go into deeply involved explanations," said the bronzed man, smiling at their eagerness, "let us take care of certain immediate things. I assume that you have no way of getting back to the surface at present. Am I right?"

"Yes, we could get back," answered Milo, dryly. "But only in the form of badly mashed corpses, by the simple process of dropping eighteen miles. We're open to any alternative suggestions, Mr.—ah—"

The stranger took the hint. "My name of course. It is Valdesc Olo-Kwar." He inclined his head in a courtly gesture when Milo introduced himself and Dumont. Then he looked closely at Milo. "You resemble our people closely. You are of the Viking race, perhaps?"

"Well, not exactly that," amended Milo. "I'm from Scandinavian stock, though, which traces its ancestry back

to those Vikings, at least in part. Why do you ask?"

"All in good time," returned the stranger. "Now, if you will trust me, I want you both to take these little white pellets." He drew a small glass vial from his belt, containing a dozen tablets. "These," he went on to explain, "are a harmless compound which have the remarkable property of reducing the metabolism of the human body. It is a sort of self-renewing enzyme which inhibits the activity of the glands, and through them of the entire body processes, so that one lives at a lower tempo. It lowers the pulse, reduces blood heat, and cuts down the general katabolism of the body cells."

"I get it," said Milo. "Reduced metabolism means less need for oxygen in the blood, and therefore less breathing necessary. But will we actually be able to live on one tenth the supply of air at the surface?"

"Yes, through automatic compensation," put in Dumont. "The human body is remarkably adaptive. Our respiration rate will probably increase, and our lungs will inflate to their full extent with each breath. These, combined with the lowered metabolism, will enable us to exist in this rarefied atmosphere. O. K., Valdasc Olo-Kwar, we'll take those pills."

The sky dweller seemed pleased. "I'm glad you are so willing to put yourselves in our hands."

Dumont smiled whimsically. "There isn't much else we can do, to tell the truth."

SOMEHOW convinced that the sky man meant only well, the two men from Earth's surface carried out all his suggestions. He gave them each a pill, which was tasteless, and explained that one pill's effect lasted about a week. Then he took Milo's wrist in his hand and felt for the pulse. In keeping with the lowering of his heartbeat, Valdasc

Olo-Kwar valved air out of the gondola. Dumont had pointed out the valve to him.

It was a strange sensation. Milo felt a vague turmoil within his body. A subtle lethargy seemed to steal into every fiber of his being. He sensed that all the cells in his body were slowly and gradually cutting down their normal activity, smoothly and efficiently. He was surprised to find himself breathing more and more deeply, without any conscious effort on his part.

"There," said Valdasc Olo-Kwar finally, opening the release cock wide. The last hiss of escaping gas came to their ears, then was gone. "You are now breathing normally in an atmosphere ten times as tenuous as at the surface. You will probably feel tired and enervated for a time, but that feeling will pass."

"Do you people have to take these pills?" asked Dumont with the scientist's curiosity.

"We do," said the sky man. "Our body mechanism is attuned to surface conditions just like yours. Evolution has not been able to adapt us as a race in a paltry twelve thousand years. Come, shall we go out?"

"Miracle No. 3," murmured Milo.

He watched Valdasc unscrew the seal plate and finally lower it. They stepped out into the blinding brilliance of a risen Sun.

"No wonder these people are bronzed so deeply," said Milo. "This has California Sunshine beat a mile."

"We'd better not be out in the Sun too long at first," commented Dumont wisely, "or we'll come down with a blistered skin."

The Sunlight reflected so dazzlingly from the flat metal stretching around them that they could not see for a minute, and had to wipe their watering eyes. When Milo was able to see, he blinked and closed his eyes again, wondering if he were having hallucinations. He tried

again and realized the girl he saw was really there, and was not a figment of overtaxed optic nerves.

She had evidently come from the city while Valdasc Olo-Kwar had been with them in the gondola. Milo's eyes grew round. Tall and graceful, she might have been a Viking goddess, with her long tresses of blond hair offsetting a complexion of tawny gold. Her lips were red and full, her nose just the slightest bit upturned, and her eyes large and dreamy.

"My daughter," said Valdasc Olo-Kwar. "Daveena Olo-Kwarine." He introduced the two scientists. Milo impulsively bowed from the waist, caught her half-extended hand, and kissed it with archaic ceremony.

Dumont suddenly darted away to examine their torn gas bag, which lay in a crumpled heap fifty feet from the gondola. Milo followed and pursed his lips at the tremendous gash in the bag's top surface. "But it's not hopelessly beyond repair," said Dumont. "Perhaps later we can get these people to help us fix it in some way."

Both the gas bag and gondola had landed at almost the very edge of the enormous metal plate which upheld the city beyond. Dumont and Milo shuddered a bit at the thought of their narrow escape. Below, over the edge of the metal, ranged the dizzying vista of bottomless depths. Cloud banks were visible miles below. Beyond that was nothing but a hazy patchwork that seemed to be the face of a planet thousands of miles away. The two men drew away from the edge and rejoined Valdasc and his party.

VALDASC OLO-KWAR took Dumont by the arm and led the way to the city. Leaping to the opportunity, Milo fell in step with the girl Daveena. The rest of the party followed behind. Milo hardly noticed that they were traversing a smooth, unbroken surface of metal

that seemed to fringe the city on all sides, disappearing in his vision behind the buildings to right and left. He could not keep his eyes off the girl.

Milo wondered how to start a conversation, but the girl took the initiative. "You are from the surface world?" she asked, with a trace of wonder in her voice.

At her further questioning, Milo explained how they had penetrated to nineteen miles with their balloon and then met disaster, their death plunge miraculously broken soon after.

"We heard the noise of your landing last night," said the girl. "It was a dull thud. We had no idea what it was, though we thought it might be a meteor. Then this morning we looked down from the tower and saw your strange ship. We became quite excited, since it is the first time in our history that any one from the surface world has visited our city. It is quite thrilling to talk with you, knowing you to be from that great, strange world eighteen miles below us. We feel as though we are in a world of our own here."

"You really are. The surface world knows nothing of your beautiful city," said Milo gallantly. He went on daringly, "Nor does it know that one of the most beautiful women in the universe lives here!"

He had no idea how the girl would take this. She smiled pleasantly. "I like you," she said simply. Then she frowned a little. "Even though your people have such a bad reputation."

Milo had no time to ask for an explanation of this enigmatic statement. They had reached the nearest of the buildings. They passed through an archway of sparkling facets and on into a shaded corridor that was a relief from the burning Sun. The interior architecture was as bizarre as the exterior. The corridor curved smoothly and, by some wizardry of wall design, it seemed

to undulate up and down, though the floor was level underfoot. Softly glowing lights came from hidden niches.

Valdasc, in the lead, stopped in the middle of the hall. Milo noticed for the first time that all the others except Daveena were gone. Suddenly the floor underfoot moved. Milo involuntarily clutched for Daveena's hand, which she gave him smilingly. Dumont was being steadied by Valdasc. The two meteorologists vaguely realized that the ten-foot section of corridor in which they stood was rising rapidly and soundlessly, like an elevator.

"This is what may be called a levitating corridor," explained Valdasc. "All our buildings are equipped with them profusely. It is too complicated to explain now, but they are motivated by an antigravitational principle. You are being taken to a room where you will sleep, as I think you are tired."

Milo suddenly realized he was strangely tired, though he had just had a night's sleep in the gondola. Dumont's face also showed a haggard weariness.

"It is a reaction to the sudden change of metabolism," continued Valdasc. "After a long sleep, you will feel much better. Here we are."

The corridor section came to a smooth halt, rotated slightly on its shorter axis and settled snugly into place. It now connected at one end to a curving hall and at the other to a door whose latch Valdasc turned. He ushered them into a large, ornate room with two couches. He stepped to a small end table between them and called attention to two switches on it. One was for artificial light. The other controlled a mechanism in the walls which, like Venetian blinds, would either shut off outside light or admit it. The walls themselves were transparent. Then he pointed out a closet door and suggested that they try the clothing it held, next morning.

"We will leave you now to a needed rest," Valdasc said. "When you awaken,

pull the cord near the couches. Come, Daveena."

JUST BEFORE the door closed behind them, the girl turned to give Milo a flashing smile. Then the two men were alone. The room was unlike anything they had ever seen before. A gently curving ceiling, decorated in sylvan scenes, swept downward on all sides from a rounded apex. The floor, of some yielding composition, seemed to slope into a cup-shaped depression, though they knew it was only a trick of the lighting and their eyes. The several pieces of furniture to complete the bedroom motif were all of rounded and graceful lines.

"Evidently these people don't believe in straight lines," said Dumont. "They have a completely curvilinear architecture. Well, Milo"—he turned to the younger man—"what do you think of all this?"

"Chief, I was just thinking that to all intents and purposes we've died and gone to heaven!" Milo went on, half banteringly, "Heaven is supposed to be above Earth, and that's just where this is. It fits in other details. It's beautiful, spotlessly clean, and miracles happen here."

"Would you class Daveena as a miracle or an angel in this heaven?" asked Dumont slyly.

Milo flushed boyishly. Then he became serious. "Chief, just what do you make of all this?"

"I've found out a few things from Valdasc," responded Dumont. He continued as they began undressing, attracted by the invitation of the downy-covered couches, "First of all, the 'Kwar' part of his name corresponds to a title and rank of 'Prince.' Not a blood prince of the ruling family, but of a princely lineage. Thus Daveena—'Kwarine'—is a princess. They seem to have some sort of aristocracy here.

"There are just ten thousand souls on

this island in the sky, in a city of about a square mile of area. Their local means of conversation is by means of inarticulate telepathy. Speech, to them, is archaic. They are entirely self-sufficient in this sky city, and have lived here for twelve thousand years, as you have heard before. Thus their science comes from a period preceding recorded history. Their origin, if it is known at all, must be known to us only in fable."

Milo pondered this for a moment. "Do you mean the legend of Atlantis?" he asked breathlessly.

"That, or any other similar legend of lost races. We'll probably find out soon enough," said Dumont as he crawled beneath the sheets with a deep sigh.

Milo whistled. "Gosh, there's plenty of mystery here. How were we able to walk around in a temperature of sixty below zero without freezing? I didn't even feel the cold!"

"That's easier to answer," returned Dumont. "It's simple enough. It's the result of two important things: lack of water vapor and the thinness of the air. Dry cold, and also dry heat, are never felt so much as cold and heat in the presence of water vapor. Then the rare atmosphere conserves heat because it is a poor conductor. With our jumpers on here, and these people with their baggy clothing, body heat is amply conserved to prevent chilling."

"Bravo, chief!" exclaimed Milo admiringly.

Then both of them, enervated by the strange lassitude of their reduced metabolism went soundly to sleep.

IV.

WHEN MILO AWOKE, in the darkness, his thoughts were confused. Then he remembered, sighed, and turned on his back, feeling much refreshed. Wide awake, he mused on the strange adventure that had befallen him and his companion.

He heard the professor stir. "Milo, you awake?" came his voice. "Turn on the lights."

Milo reached for the studs on the end table and twisted one for the walls to let in outside light. They heard the slither of hidden mechanisms, but there was no change in the darkness.

"Must be night out," said Milo. He twisted the other switch. A soft glow came into being and brightened in imperceptible gradations till it was strong enough to reveal all their surroundings.

"It's four a. m.," said Dumont, consulting his watch, which he had carefully wound the night before. "We've had plenty of sleep." Out of curiosity, he felt for his pulse. He was almost alarmed at the slow thudding of his heart.

Milo was at the clothes closet, looking over the selection therein. He dragged out two complete suits of tight-fitting pants, military-cut jackets, and oriental slippers. Valdasc had gauged their sizes pretty well and they were both rather pleased at their appearances in the full-length mirrors against the wall, after they had dressed. They both felt much better than they had the day before and found themselves ravenously hungry.

"All we've had to eat since leaving Earth two full days ago is a few sandwiches and some coffee," grumbled Milo. He jerked the bell cord Valdasc had pointed out. A whir and a click somewhere to the side was followed by the opening of a wall panel. From out of the blank space revealed came a long tray holding several dishes of steaming foods. They were all jellylike substances, but of various colors and flavors, none familiar to their palate.

"Synthetic food of some kind," said Dumont, dipping a long-handled spoon into one after the other and sampling them. "Mm-m-m; this one's good." They ate gratefully.

It was while they were finishing that

a knock sounded on the door. Almost immediately it opened. They were surprised to see a stranger enter unceremoniously.

"Ah!" he exclaimed in the usual precise accent. "You are the two surface men." He bowed just a little. "I am Talscon Kaj-Zan, emissary of our ruler."

Dumont nodded slightly. "Where is Valdasc Olo-Kwar? Do you bring a message from him?"

"Oh, no," said the newcomer. "My business is not his business. One question: you will not be returning to your world very soon?"

"We see no possibility of it at present," replied Dumont. "Unless we can get our gas bag repaired and filled with gas."

The visitor nodded, smiled secretly, and left as suddenly as he had come in. "Whatever was that all about?" asked Milo, scratching his head.

They mentioned the incident to Valdasc when he and his daughter appeared a few minutes later.

A thoughtful, half-troubled look came into Valdasc's face. "I just wonder what that means," he mused to himself. Then, without offering any explanation, he led the way to a levitating corridor which took them upward.

THEY STEPPED OUT finally on a small hanging balcony perched like a crow's nest high on a tower wall. Milo gasped. They were a thousand feet above the pavement level. From this open point he saw, for the first time, the full extent of the city. It took his remaining breath away.

Like an opium creation of luminescent gossamer, it spread to every direction, glowing in all spectrum hues. The delicate spires and dainty minarets of the city lay washed in the magic glow of moonlight.

Milo sighed, gripped by some nameless ecstasy. It was as unreal as the

chimera castles of a dream. He looked up. Hanging low in the sky between the minarets of two tall structures, pale and faintly silvery in the deep gloom, was the full Moon. His eyes wandered around. There were other people on other balconies within range of vision, drinking in the exotic beauty of the night. Plaintive, soul-stirring music wafted at times on the wings of the wind. It was all utterly fantastic. Yet it was all undeniably real. Life here, he reflected, must be lived beautifully, to judge by the glorious surroundings.

Valdasc Olo-Kwar motioned them to cushioned chairs. They all sat down in comfort. "And now," he said, "I will answer your questions. That is"—he smiled—"if you have any!"

Milo nudged the professor as a signal for him to speak for them both. "First of all," queried Dumont, "how is it that you can speak our language, if you haven't had contact with the surface for twelve thousand years?"

"Through two things—radio and telepathy," answered the bronzed prince. "Before your science discovered and applied radio a few years ago, we did not know your languages, because we received only nonarticulate thought messages. We have telepathy instruments that pick up and amplify thought radiation in quite the same way that radio does electromagnetic vibrations. With a combination of radio and telepathy, it was easy, of course, to learn your Earth languages."

Dumont made a mental note of the fact that they had radio, with which he could later get in touch with the surface, then asked his next question: "This telepathy? Do you mean you're able to tell what is going on in the minds of surface people—and of us here?"

Valdasc laughed. "Have no fear. Telepathy is an art. We are not able to read your minds, simply because you have not learned to transmit them properly. It is a function of the subconscious

mind and takes much training to develop. Our people can converse with one another by telepathy because they have been so trained, for centuries. However, we would be able to read your thoughts with a telepathy amplifier, which instrument we use to pick up thought messages from the surface.

"It may surprise you to know that we've followed Earth's history, more or less as an amusement, by means of these amplifiers. And also visually, by use of telescopic instruments. For instance, we watched the Egyptian civilization flower through its many dynasties and finally decay. We watched the great Semitic upheaval that centered around Jerusalem. We marched with the Roman Legions, through mind and eye, as they carved out their great empire. After the dismal chaos of the Dark Ages, we followed the rise of science, saw it grow and blossom. We shuddered at the carnage of the World War. And now—there is another war!"

"You know about that?" exclaimed Dumont, half rising to his feet. "What is happening down on the surface? We must know!"

"Please be calm," admonished Valdesc. "I brought with me a radio receiver, knowing you would be anxious to hear the news." He extracted a small box from his belt. It had numbered dials on its face and these the sky man twisted slowly. Valdesc finally tuned in a commentator's voice, clear as a bell.

"LATEST NEWS from the war front. Since the defeat of Britain's naval fleet in the English Channel yesterday, England is open to invasion. Alliance troops have already been landed on the south coast and are marching inland. The bombing of London is still going on. The Alliance naval fleet is already steaming for the United States Atlantic seaboard. Japan's armada, after taking over Hawaii, set out for the Pacific

coast. South America, now in the hands of the Alliance, will be the starting point of the invasion of the stronger North America, which is now solidly massed against the Alliance."

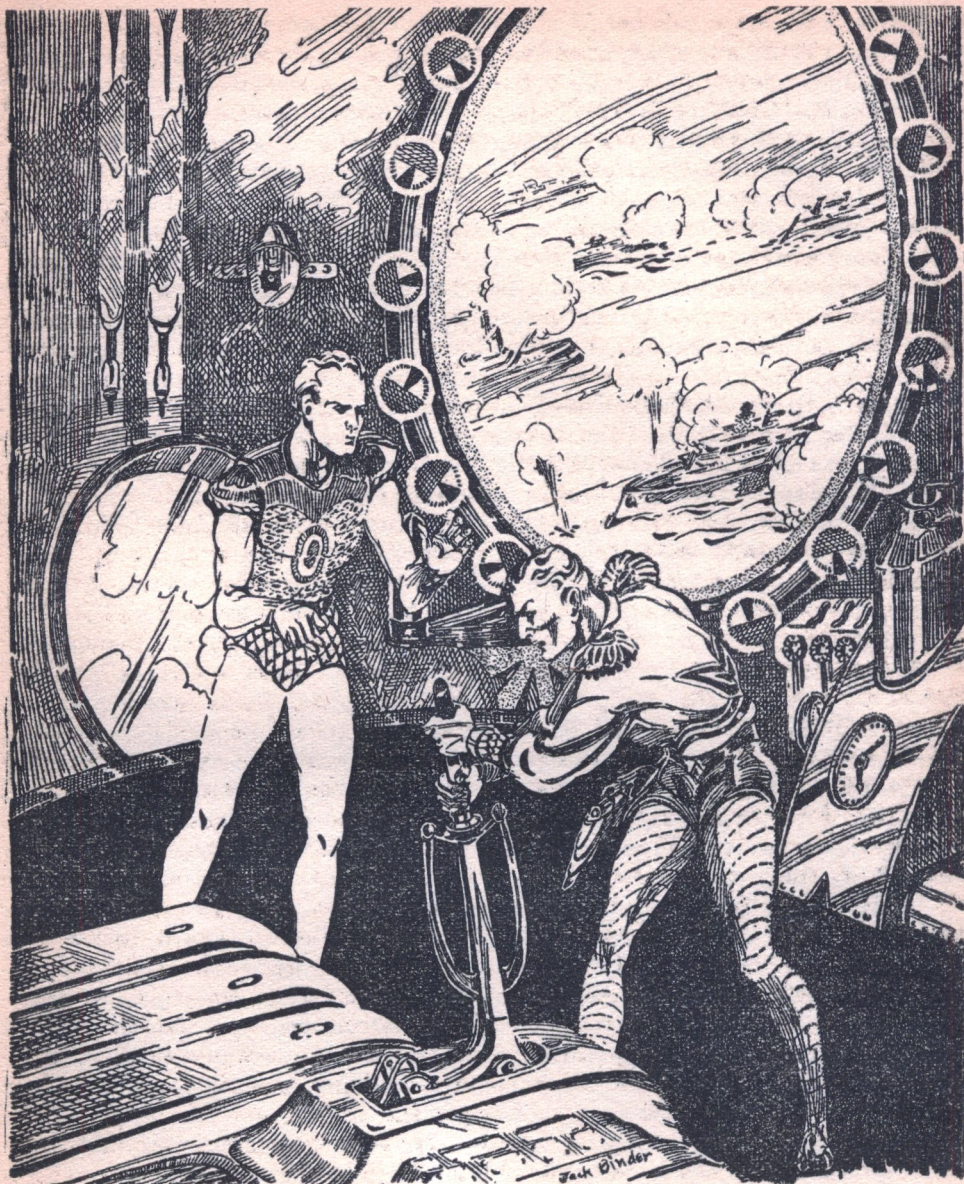
Dumont's face was gray, as Valdesc turned off the voice. "Confound it!" snapped Dumont. "An Alliance victory will mark the end of democracy of any sort. There will be military dictatorship after that, founded on European principles."

Valdesc Olo-Kwar had the wisdom of ages in his eyes as he said, "We have seen many and many a war from our perch in the sky. But they are only passing phases in the march of events. One must take a philosophic attitude. Viewed from up here, as a supernal god might view it, the history of Earth is a grand sweep toward eventual peace and true civilization. The world below has been a stage spread before our eyes, all people its actors, all stirring events its acts. We have been able to weigh and ponder and see the workings of fate. We have seen flashes of light in the darkness, ideas and schools of thought that are on the right track. These will grow and one day light the darkness of men's minds with a supernal brightness, like the rise of the Sun!"

As though he had conjured it up, the Sun rose, sending its first bright beams spearing across the city. Valdesc's low, even words had a soothing effect on the two men from the surface world. For a moment they caught the grandeur of this age-long watching from the sky. Truly the sky people must feel like gods, floating high above Earth's turmoil, upheld by some miracle of science.

"Just how," asked Dumont, "is your city able to float up here in the stratosphere, in defiance of natural laws? And where do you get food, power, and other necessities?"

"It is not a defiance of natural laws," responded Valdesc. "It is their application. Levitation against gravity is



They waited breathlessly—could this truly miraculous instrument do what they had said it could?

here produced by subtle warpings of what your Einstein calls space time. The terrific power to do this warping comes from utilization of the cosmic rays. The round metal plate on which this city rests, a mile in diameter, is sensitive to cosmic radiation. It absorbs this extra-

galactic energy and converts it into another energy which, to use a picturesque term, bends space time. Gravity is neutralized. Not completely, however, else we would fly away. Enough gravity drag is left to hold us eternally at this certain height above Earth.

"Food is quite a simple problem. Its elements exist in the very air around us: oxygen, nitrogen and carbon from carbon dioxide. This last is rather rare up here, but exists in collectable quantities. Our robot converters mold these three elements into the molecules of food. What small amounts of other elements are necessary—iron, sodium, calcium, phosphorus, etc.—are formed from the nitrogen atom by transmutation. Robot machines do that for us, also.

These same machines, motivated by the endless energy of cosmic radiation, create for us all metals and materials we need in quantity—aluminum, diamond, silicon, cellulose, etc.—all from the abundant nitrogen of the air. A host of other machines, chemical in nature, fashion these into usable products, such as the clothing we wear, and the building material we need for replacements."

DUMONT STIRRED and glanced at Milo, filled with conflicting thoughts. What couldn't this great science do on Earth? At last he asked, "This miraculous science—where and when did it originate? And your race?"

Valdasc's eyes grew dreamy. "Think of your fable of Atlantis. No, we are not Atlanteans. We are of the Viking race, the race the Atlanteans exiled to the skies. Our race twelve thousand years ago lived in the north, on an island just south of Iceland, called Vikia. The civilizations of Atlantis and Vikia grew up together, both growing mighty in science. A rivalry arose that burst into war. Atlantis, more powerful, set about to destroy Vikia utterly, to have Earth for itself. Doom was inevitable for Vikia.

"Our leaders tried to win a truce. The arrogant Atlanteans, power-mad, would not be merciful. They wanted Earth, all of it. They laughingly told Vikia it could have the sky. Our scientists pondered this and took the only

course left—to inhabit the sky! This city was meant to be only the first of many which would dwell forever in the stratosphere. But after this one had been launched, the great catastrophe occurred which sunk Atlantis, and with it Vikia. Thus, of those two great civilizations, only this remains."

The professor and Milo were deeply stirred by this story of ancient rivalry and war. Dumont was about to ask a further question, when a figure appeared in the tower doorway. It was Talscon Kaj-Zan, suave, smiling secretly. He made a low bow to Valdasc and Daveena and gave courtly nods to the two scientists.

"I have the honor," he said in silky tones, "of conducting the two surface men to the august presence of our ruler, the Kahn Zimini-Dar, at once."

Valdasc started. "But I was to bring them myself later——" He broke off and snapped, "I'm coming along, Talscon."

There was an electrical tension between the two sky men that the scientists could almost feel. Talscon shrugged and led the way. Milo looked questioningly at Daveena, but her eyes were on the floor. A levitating corridor took their entire party swiftly down, to the level where inclosed transportation tubes connected the various buildings. A soundless streamlined car, set in grooved tracks, carried them to the most magnificent building of all, in the center of the city.

Soon they were ushered into a resplendent chamber hung with chains of flashing jewels, which rotated slowly, bathing every corner in rainbow splendor. In the center of the room was an ivory throne, yellow with age. Valdasc, Daveena and Talscon stepped before the aged, wrinkled man seated there, inclined their heads and made a strange, weaving salute with their hands. Then they stepped aside and beckoned the meteorologists forward.

Milo and Dumont stood straight before this ruler of the sky people. They owed him no allegiance and therefore made no obeisance. He did not seem to notice.

"Welcome to Vikia," droned Kahn Zimini-Dar, in a hesitant English. "You are the first visitors to Vikia in twelve millennia. You are free to stay as long as you wish. Do you like our city?"

"We do," answered Dumont gravely. "We find your city the most magnificent we have ever seen or imagined. There is nothing like it on the surface world."

The kahn seemed pleased. Milo nudged Dumont. On the way there he had whispered something in his ear. Dumont went on, "We thank you for your hospitable welcome. However, we should return to our surface world as soon as possible. Our balloon, if repaired and filled with hydrogen gas, would again take us down."

The aged man on the throne nodded slowly. "Naturally, you wish to return to the world of your birth. We have already investigated the repairing of your balloon. It will take several days to accomplish this. In the meantime, we suggest that you allow us to further entertain you here in our city." The ruler turned his head toward Valdasc. "Talscon has requested the pleasure of our visitors' company. Yet I would not deprive you, who first discovered them, your rightful privilege. Therefore, you and Talscon will each be escort of our guests from the lower world on successive days. To-day is your day. Talscon will have to-morrow. It is my wish."

Valdasc bowed at the command. When he straightened, he shot a glance of suspicion at Talscon. The latter had a look of veiled triumph in his face. Milo already had an instinctive dislike for the man. And when, at the door, Talscon kissed Daveena's hand in part-

ing, with a lingering grasp, Milo felt his blood churning strangely.

Valdasc was frowning as they left the palace. Later he became more of the genial host as he and Daveena took the two scientists around the city.

V.

"DUMONT AND MILO began to get some insight into the lives of the sky people. Their social system was grounded in aristocracy, but it was of a benevolent sort closely approaching true democracy. The kahn, or king, was more a wise judge than a ruler. It developed that Valdasc Olo-Kwar and Talscon Kaj-Zan were the two next highest authorities in the city kingdom. The "Zan" of Talscon's name corresponded to "duke." There were perhaps a hundred other titular families, out of which the kahn appointed his various officials. These took care of affairs of state, while the rest of the "common" people served in all the lesser capacities that ran their unique little kingdom.

With an almost completely mechanized civilization, there was much leisure in Vikia. Wherever they went they found happy, smiling people engaged in various sports and recreations. There was a center of learning, where tremendous stores of telepathic records were available, teaching history, science, general knowledge. There was no money in Vikia. It would have been meaningless where all their resources were practically limitless. There was no open quarreling, fighting, poverty or suffering. A marvelous heritage of medical science had eliminated bacterial disease. Skilled methods of surgery and therapy kept other ailments in check. Their average of life before the final death from old age was one hundred and fifty years.

The most striking thing about these sky people was their uniformity. Hav-

ing inbred for twelve thousand years, they were as alike as brothers and sisters in physical appearance. Yet their facial expressions were so sensitive that there was not the monotony one might expect. In a higher ethical plane, they were as essentially varied as the grosser classes of Earth. A rigid system of birth control kept their death rate and birth rate exactly equal.

But the thing that most astounded Dumont and Milo was the giant auditorium wherein a packed audience viewed scenes of Earth's surface. Some miraculous device mirrored with startling clarity the details of Earthly scenes, with a remarkable magnification that could even reveal faces—faces eighteen and more miles away. Valdasc explained briefly that intricate telescopic devices, equipped to utilize ultra-violet and infra-red rays, were able to pierce the veils of clouds that generally overhung Earth's surface. There was also a telepathic attachment that gave the watchers a close mental rapport with the scenes viewed. It was a stupendous thing, this spying on a world.

DUMONT AND MILO caught their breath at some of the war scenes. Talscon, the next day, took them before a smaller television projector, in private, and picked up a complete series of war episodes. They saw a wave of invading gray on Britain's territory engulf the defending brown. There was hand-to-hand fighting, vicious, cruel. A phalanx of wasplike planes battered into a horde of craft flying the Union Jack. Behind lumbered giant bombers, to drop their destructive burdens into the heart of great London. The four-day intermittent bombing had not yet reduced that great city. Antiaircraft guns still spat venomously from camouflaged barricades, bringing down scores of the attacking wasps.

"Talscon," said Milo suddenly, "why are you showing us all this? Valdasc

has always dissuaded us from thinking or talking too much of the war. Why are you doing the opposite?"

"Valdasc!" said Talscon with a slight sneer. "We think differently, Valdasc and I. Valdasc says to let the war go on. I say to stop it!"

"But can you?" gasped Milo.

Talscon seemed about to say more, but instead shrugged his shoulders non-committally. The two scientists became more and more puzzled in the next six days. They inquired about their balloon and were told vaguely that it was being repaired, but was not yet ready. They were not allowed to see it. Nor were they allowed to use a radio transmitter, to inform their ground crew of their strange predicament. They began to realize that they were being caught up in something significant in the sky city.

Talscon, on the days he was their guide, seemed anxious to impress them with Vikia's power resources. He showed them the many humming machines which extracted energy from the cosmic rays. He pointed out with pride the robot converters which used for raw material the nitrogen atom and created from it countless products. He took them to control rooms where myriad clicking relays handled Gargantuan energies.

Valdasc, on the other hand, told them more and more of their smooth social system, their general happiness, their peace and quiet.

Each night when they went to bed, they talked over things, and were more puzzled over just what their presence meant in this city of the stratosphere. They began to get somewhat irked.

"Do you know, chief, the word 'guests' is a politer form of the word 'prisoners.?' stormed Milo the eighth night they were there. "We can't find out where our balloon is. We can't radio Earth. We can run all around the city, just so we run around with

appointed guides. What's behind it all? Are we sort of guinea pigs in the hands of a superrace?"

An hour later they were no closer to any reasonable explanation. As an afterthought, Milo said, "Another thing that beats me is why this big, lighted city hasn't been observed from Earth's surface."

Dumont was ready with an explanation. "Big though it is, it's only a pin point at eighteen miles. At night its lights shoot outward from Earth, only a faint diffused glow revealing itself Earthward. It must have been sighted in telescopes at various times by astonished people, but probably never twice in the same place, or by the same person. Besides, I have a faint suspicion they maneuver this thing around. I seem to sense a change in motion at times. Perhaps they always hide behind cloud banks."

"Why?" Milo was thoughtfully undressing.

"I don't know. But if they are averse to having their presence known on Earth, they'll have to take it and like it in a few years, when rocket ships are developed to fly the stratosphere."

Milo snapped his fingers suddenly. "Say, chief, I think you've hit something there. They're afraid, maybe, to have contact with Earth, but see they can't escape it. To-morrow I'm going to ask Valdasc an important question."

"Is it about Daveena?" asked Dumont. He knew that his young friend had fallen madly in love with her.

Milo growled a negative, but dreamed of the blond Viking girl.

VI.

TRUE TO HIS PROMISE, Milo asked Valdasc his question the next morning. "Have you any means of lowering, or controlling the motion of this city of yours, Valdasc?"

The prince of the sky people started.

"Has Talscon——" he began, and stopped. Abruptly, he changed the subject. "To-night," he announced, "we have an audience before the kahn. In the meantime, let me show you our astronomical observatory."

They had a telescope which probed deeply into the void. The daylight did not seem to affect it. Its incredible powers were able to pierce the thick mists of Venus and reveal scampering forms of savage life in the endless swamps. Mars and Jupiter were not in the sky, but Saturn revealed itself as an abode of life. Shining monsters that seemed to be armor plated with metals fought one another in demoniac ferocity. The rings were laid bare as a legion of Tom Thumb planetoids. The various moons showed few signs of life in their lunar jaggedness. The all-seeing eye showed Pluto next, as a bleak wilderness without end.

The two surface men were amazed at the revelations and realized more than ever what a superscience had built this city. They asked many questions, but Valdasc seemed preoccupied. Daveena did her best to make up for her father's negligence.

Milo began to tell her much about the surface world, and in the telling began to realize what a difference there was in the two civilizations. Here was peace, contentment and spiritual simplicity. Down below was struggle, chicanery and bawdiness. Life in Vikia was lived as beautifully as the city was beautiful.

They went to the kahn's palace after a meal together. He was in the same chamber and on the same throne. He looked the one hundred and fifty years of age he was. Talscon was there, crafty-eyed and smiling.

After a few polite inquiries into their health and enjoyment, the king cleared his throat, looked from Talscon to Valdasc, and spoke solemnly: "I have this day come to an important decision. For

twelve thousand years we have refrained from interfering in any way with surface affairs. Perhaps we have been wrong, since we had the power to stop war at any time. We will put it up to the two beings most affected of any of us in Vikia. Would you, Professor Dumont and Milo Gibson, wish to see the war that is now defiling your world stopped?"

Milo looked at Dumont, and Dumont looked at Milo. Then Milo yelled, "Whoopee! We certainly would, kahn, old boy!"

Dumont nodded his head vigorously, unable to trust his voice. They believed the sky people's ability to do this thing without question.

Valdasc's voice rang out suddenly. "I do not think that would be wise! My worthy friend Talscon may think so, but I do not. Such an act would be of questionable merit! Earth must fight its own battles!"

Valdasc and Talscon measured one another with fierce eyes. Then Talscon turned to the two meteorologists. "The king has asked you a question. Do you, or do you not, want the war stopped?"

Dumont gave Valdasc a frigid glance and stepped away from him.

Milo stood indecisively for a moment, glanced helplessly at Daveena, and then joined his companion. Valdasc's shoulders seemed to sag. Daveena avoided Milo's eyes.

"We certainly would want the war stopped," said Dumont. "It is a senseless, mad slaughter of human life and waste of human ingenuity. Victory on either side is meaningless. If you can stop the war, stop it!"

"Talscon," said the kahn imperiously, "to-morrow you will take the surface men to the ray chamber. Valdasc, you are not to interfere."

That was all. They filed out of the throne room silently. Valdasc and Daveena left with politely murmured farewells. Talscon conducted the visitors

to their room. "You see," he said before he left, "I have been your friend all the time. Valdasc would rather see your people kill each other for a month or so—for entertainment!" He left, smiling benignly.

Milo kicked off his slippers sullenly. "I don't believe that," he muttered, "about Valdasc. Nor do I trust Talscon. I wish we'd given Valdasc a chance to explain himself. Still," he said, "why should we oppose a humanitarian measure like that?"

Dumont shook his head. "No use trying to figure these people out, Milo. We can only be sure of one thing, that stopping the war—however they can do it, but I'm sure they can—is a great and wonderful thing. If some inexplicable fate landed us here just to bring about that one thing, we can be satisfied."

Yet Milo could not forget the hurt look in Daveena's eyes when he had deserted the side of her father.

DUMONT AND MILO did not try to understand the mysterious weapon that Talscon showed them the next day. It was contained in a chamber hung below the huge metal plate which upheld the city, like the gondola of a Zeppelin. Its entrance was in the courtyard of the castle, through a kiosk with a locked metal door for which Talscon had a key. A steel ladder took them ten feet below, to the roof entrance of the gondola. The powerful hum of some nameless energy sang through the room as Talscon applied his hands to the levers and controls.

"This weapon was originally made, twelve thousand years ago, to protect us from possible attack by our enemies, the Atlanteans, in case they revoked their grant of the sky to Vikia. It is simply a beam of energy that paralyzes a human being, to any degree wished. No enemy can approach Vikia from below, at least not without being paralyzed. Its range and power are almost limitless. It can

reach to any portion of Earth visible. With the weapon of peace, I will single out all warlike activities on Earth's surface and paralyze the combatants, for a full day. Now, how much paralysis would you suggest, and where shall I start? We are at present hovering over America's Pacific coast."

"Start right here," said Dumont. "Paralyze them to the extent that they can just barely crawl around. So that they can't handle guns, but can take care of their personal needs."

Talscon nodded and touched a stud, then a dial. On the silvery surface of a slowly revolving drum, a scene sprang into view, of dancing blue ocean. Talscon twisted the dial and they seemed to rush over the water. Then a cloud of smoke came into view. The telescopic eye pierced behind it and discovered a Japanese and American fleet, both visibly battered, still pounding away at one another. Talscon manipulated his controls, till the entire battle scene was contained in a numbered circle on the drum.

"Now!" he said, jerking a lever. A deep reactive hum sounded somewhere in the room, but that was all. Dumont and Milo waited breathlessly. Could this truly miraculous instrument do what it was supposed to do? Quite suddenly the cannon belchings stopped in that battle scene. In a few minutes the smoke began to clear away. The ships began to wallow aimlessly.

"That's that," said Talscon in deep satisfaction. "Now where? I can move our city anywhere you wish, using Earth's magnetic field as a medium of motion."

"To the Atlantic seacoast," sang Dumont. "We'll stop this bally war, we will!" He was elated at the thought.

Some Titanic power caught at the floating city and moved it eastward at an accelerating pace. Talscon had already sent a warning up to the city, so that no one would be caught out in the open

in a terrific wind. In two short hours the drum pictured the coastline of Cape Cod.

"Good Lord!" gulped Milo. "They're bombing New York!"

The Alliance fleet was hurling its shells into the cubistic mass of New York City. Several buildings were down. Milo could picture the mad scenes in its crowded streets.

"For Heaven's sake, hurry!" cried Dumont, shaking Talscon by the shoulder.

The sky man played with his magic weapon and put a stop to it in five minutes. It seemed like a dream to Milo and Dumont. They went next in the Caribbean and stopped the dueling of fleets there, then across the wide Atlantic to England. Here Talscon worked till dark, limning front after front in his circle of paralysis. Britain had been a beehive of invasion at every part of its coast, at noon. By dark it was as quiet as Sunday afternoon.

Talscon tuned in an Earth announcer after it was over. His voice a ragged shred from excitement, the commentator was saying, "Unbelievable, but true. No one knows why, but almost every unit of war on both sides of the Atlantic is mysteriously out of commission. It is rumored to be some sort of paralysis. Is this some dread plague, or epidemic, that has come in the wake of war? How long will it last? Will the powers rush fresh troops into action? No one knows!"

The next day, a close check-up with the vision instrument revealed that fighting had recommenced in various places. The belligerents had evidently taken it as a strange, but natural, event and ordered their now-recovered men back into action. Talscon snarled as he said, "This time I'll give them a dose that will last a week!" He went over the same ground he had the day before, in reverse order, again silencing the cannon, quieting the war forces. When he had finished this,

he straightened up with a terrible look in his eye. The two days of playing with godlike forces had brought something out in him.

"Those puny things!" he shouted. "I have them all under my thumb. If they dare to start their petty little war again now——"

He left it unfinished, but Dumont and Milo were glad to get out of his presence. They went to their rooms, rather stunned. They had seen something in these two days that shook their very souls: a demonstration of illimitable power.

THEIR NERVES were so fagged that they jumped when there was a soft knock on the door of their private room. Daveena stepped in. Milo stood, embarrassed.

"Well?" said Milo wonderingly.

The girl came forward. "Milo, listen to me. You've got to. You don't know what is going on. You were unfair not to let my father explain himself about this war matter. I've sacrificed my pride to come here, and we Vikings are very proud people. You must come and see my father. Perhaps this can be straightened out."

Milo answered the appeal in his heart more than in his mind. He dressed hurriedly. Dumont hesitated only a moment and then dressed also. As the three of them walked toward the door, it swung open. Talscon stood there, still with that strange look in his eye.

"So?" he drawled. "I find the princess keeping secret rendezvous with——"

That's all he said, for the rest was jarred out of him by Milo's fist on his jaw. Talscon's face became very surprised and then he bent at the knees and slowly crumpled.

"Come on!" said Milo grimly. "I want to get at the truth of this thing, and your father is the only one can give it. I see that now."

Levitating corridors took them to the

rooms of Valdasc Olo-Kwar in the same building: The prince of the sky people had been staring moodily out of a window. He turned in surprise as his daughter entered. Then his face changed and mirrored a frigid aloofness as he saw the two men behind her.

"What do you want of me?" he asked coldly. "I who allow your people to be slaughtered without lifting a finger?"

Dumont and Milo both flushed. "Maybe we're wrong about that," responded Dumont. "Knowing so little of things here, perhaps we have not seen things in their true light. We would like to hear the truth from you."

Valdasc looked from his daughter to the two meteorologists stonily. Milo went up to him and put a friendly hand on his shoulder. "We have wronged you, Valdasc," he said earnestly. "Forgive us. We do not trust Talscon. We have come to you."

Aware of their deep sincerity, Valdasc hesitated no longer. He waved them toward chairs, and began speaking when they were all seated.

"Talscon has apparently done a great and noble thing, stopping the surface war. But his motive behind it is not so altruistic. He wanted only a chance to test the paralysis weapon, which has never been used in our history before. He played upon the kahn's feelings, and upon yours, to get the chance to see how effective the weapon could be. Now he is sure it works. And now he is sure he can become the conqueror he wishes to become!"

Dumont and Milo started. "Conqueror?" they echoed.

"Yes," continued Valdasc, his eyes blazing suddenly. "Talscon dreams great dreams. I have detected his most secret thoughts. He realizes that with our superior science we could become rulers of Earth—but not beneficent rulers. In Talscon's conception of it, it would be tyranny! A worse tyranny

than any Roman or Hun overlordship was in history!"

Valdasc went on, groping for expression. "I have many things to say, and so few words to say them with. If you knew telepathy, it would be easier. However, we sky people have realized for a long time that we have a great moral responsibility toward Earth. We can bring it chaos or enlightenment. For twelve thousand years we have not taken a single step either way, content to take the easier course of nonintervention. But with the recent rise of science on Earth, it has come to mean an eventual meeting of our two civilizations."

He hesitated before he went on. "Therefore, it was imperative that we make a choice of procedure. In recent times, two factions have arisen here in Vikia. One faction, led by Talscon, believes in subjugation of Earth before it can become strong enough to threaten our safety and peace. The other faction, led by myself, hopes to affect a permanent alliance with Earth. The landing of your gondola here has become of great significance to us of Vikia. To Talscon and his group it means the threat of future struggle. To me it means that in a few more years, when your world has achieved regular stratosphere flight, perhaps in rocket ships, we will form a truce with Earth and distribute our science freely. And with it, our philosophy of peace, developed over a period of twelve thousand years. Thus we will benefit Earth and establish everlasting peace between us."

"I SEE!" breathed Dumont slowly. Milo stared from Valdasc's noble face to the lovely one of Daveena and wondered how he could ever have mistrusted them in the slightest.

"Do you see also," continued Valdasc tensely, "why I had to be heartless, as it seemed, about not stopping the war? Perhaps it would be a good thing, if it stopped there. But one thing leads to

another. I knew it would start a chain of events, and in the wrong direction. Talscon now knows the power in his hand. He is a strange, warped man, brilliant, but ruthless. He will now try to win favor to his scheme. He will glibly dupe thousands of others as he has his followers, and eventually swing Vikia toward his goal. When our present arbiter ruler dies, the succession will rest between—Talscon and myself! By popular choice! And Kahn Zimini-Dar, being very old, may die any day, any minute."

There was silence in the luxurious chamber for a while, as Dumont and Milo tried to grasp the implications of this tremendous situation—a situation unfolding eighteen miles above a world that did not even suspect the presence of anything above it—one that would echo down the halls of history, for better or for worse.

Here in this miracle city of superscience were two men of destiny: one who wanted to preach the beauty of life, as they knew it, to a chaotic, warring world, bringing it the peaceful philosophy of a mellowed civilization; another, who wanted to shackle Earth with the illimitable power within his grasp.

The two meteorologists were a trifle dazed. Suddenly Milo asked a question that had been bothering him: "Does Talscon have the means of lowering this city to Earth and carrying out his plans of conquest, if it so came about?"

"That great secret, because of its importance, has been recorded only in one place: in an indestructible belt worn by each kahn all through his life. I have been privileged to see it, but of course not the secret of its hidden pouch, which gives directions for finding and manipulating the secret controls, which can raise and lower our city. The belt passes from kahn to kahn. They are sworn never to give out the secret unless a sufficiently great emergency results. In twelve thousand years, such

an occasion has never arisen. But if Talscon succeeds to the throne——”

Valdasc broke off, sighing. “You see, my friends from the surface world, what problems weigh my mind. The crisis may not come for some time, perhaps not for years, till the kahn dies and Talscon and I match wits for succession to the throne. I——”

At that moment there was a hurried knock on the door. A wild-looking face looked in, caught sight of Valdasc, and hissed, “The kahn is—dead!”

Valdasc turned white beneath his bronze skin and swayed a little on his feet. He looked at each of the others as though wondering if they had heard the same thing. Then he turned, ran for the door, and was gone.

VII.

THE NEXT NIGHT Vikia, the city of the sky, was humming with excitement. There was something of the feeling, to Dumont and Milo, of a presidential election night in their world. For the choice of the people of Vikia was to determine who should be the next kahn. It was all conducted, however, without the general confusion of a similar Earthly occasion. There were no parades or demonstrations, no stump speeches, no meaningless babble. Vikia set about quietly and staidly to elect its next judge ruler, who would reign for the rest of his life. The celebrations and ceremonies would come later, after the important work was done. Talscon and Valdasc had long been the accepted successors. It remained only to choose between them.

But in that simple choice, strangely enough, rested the fate of Earth. The people of Vikia realized it, yet to them it did not make much difference. In the past decade or so, with the rapid rise of Earth science, it was realized quite generally that Vikia would have to tear away the cloak of isolation. It was just

a question as to how to go about it. And therein lay the choice between Talscon and Valdasc.

Besides Valdasc and Daveena, only Dumont and Milo knew of the critical situation. Before the evening's activities started, they spent an hour together on a high, hanging balcony. While Dumont and Valdasc discussed the situation gravely, Milo and Daveena looked together over the glory of the city. The bright moonlight sparkled from a hundred thousand facets and suffused the scene with a glow of prismatic color.

“I wish I lived here,” said Milo suddenly, sighing. He looked at Daveena. “May I ask a question?” he went on. “Does Talscon mean anything to you—as a suitor?” Milo felt he had to know about that, since he had noticed Talscon's attention to her and a certain air of intimacy.

Daveena's face held a queer look. “No,” she breathed. “And yes! I do not care for him, but he does for me and wishes to marry me. I can only say one thing more. If Talscon is elected kahn to-night, I will have to marry him, for my father's sake. For then, through me, he will perhaps be able to guide Talscon away from his most disastrous ventures.”

Milo's thoughts began to whirl. It all depended on the election, then! He could do nothing about it but wait. This personal matter of his had passed out of his hands as much as the meaning of their presence here in Vikia. Milo was quite bewildered at the way fate had twined the strings of their lives.

Presently their party went below, to a stately room of the palace, which was a broadcasting studio. Valdasc and Talscon were to be permitted each one hour to make a “campaign” speech, this night of the election, in accordance with custom.

Talscon, suave and confident as usual, smiled with seeming friendliness toward Valdasc as he rose. He gave a courtly

nod to the two meteorologists. Milo wondered that the man had no animosity for the blow he had given him the night before. Then Talscon turned before the vision-thought projector and began his "speech" in the intricate telepathy language of the sky people. Dumont and Milo sat there on pins and needles, wondering what strange thing was shaping itself here. All they could do was watch his expressions, which ranged from lofty exaltation to faint glimmerings of craftiness.

Valdasc seemed to get nervous after a while. Evidently, Milo surmised Talscon was making a very good speech with which to influence the voters toward himself.

SUDDENLY Talscon's voice burst out, "And now I will speak as well as telepathize, for the benefit of the two surface men who are here with me. I repeat that Vikia is all-powerful, as proved by the effectiveness of our paralyzing weapon. It is apparent also that the surface people do not know how to run their world. For several centuries these descendants of the Atlanteans, in central and southern Europe, and in America, have failed to bring any reasonable orders out of social chaos. They periodically drown their culture in their own blood. On the other hand, the Viking descendants of Scandinavia have proven their pacifism.

"It is our duty to our Earthly brethren, now that we have ended their petty but vicious little warfare, to guide them in the paths of future glory—the glory that was once Vikia's! We must go to Earth and become its rulers, for that is our rightful heritage, as well as our duty. That the surface people will welcome us has been exemplified by the two members of that race now present. For it was their request, to our late kahn, to stop the war which tore their hearts while it was tearing their world below.

"If I am elected, which rests in your

hands, people of Vikia, I promise to make immediate plans to descend to the surface world and undertake its reform!" Talscon sat down, eyes gleaming.

"Conquest, not reform, is the word he meant," whispered Valdasc. "He made a stirring speech. He was clever enough to play on their emotions with talk of Vikia's past glory. I think the man is a little mad now with the thought of power. Inkar protect us if he is the people's choice." He rose. "I go now."

Daveena pressed her father's hand, encouragement in her eyes. Dumont murmured heartfelt blessings. Milo said, "Good luck!"

For almost an hour only Valdasc's mobile, sensitive face was an indication that he was pouring out his soul into the ether. The two surface visitors never knew what he said, for none of it was spoken. Valdasc finished and then came a surprise. One of the broadcasting officials handed Valdasc a document. He looked it over. It turned out to be a telepathic petition, hastily recorded, from hundreds of sky people who wanted the two men from Earth to give their view of the matter. Valdasc told them about it with a hopeful smile.

Dumont did not seem to favor the idea and finally his shyness overcame him entirely. He declined to speak. But Milo strode up to the microphone with his jaw set grimly. "People of Vikia," he began, and thrilled to the thought that every soul in the city was listening. "You live in an incomparably beautiful city. And your manner of living is something approaching our Earthly ideal of life after death. Do not sacrifice this all of a sudden. If you plunge yourselves into the far different and actually primitive mode of life of the surface, either as conquerors or missionaries of a new life, you may destroy this ideal you have set up. Rather leave it as an example for Earth to follow.

"Let Earth come to Vikia, as a pil-

grim to a shrine. Earth people learn better by example than by force, as its history shows. The professor and I are only the first of future visitors from below. Others will come and be as astounded and pleased as we are at what we have discovered. I would like nothing better than to live here all the rest of my life. You will be a shining light to Earthly civilization. And that is what Earth needs, a light to guide its way. This is the better course of establishing relations with the surface world. Follow your prince—Valdasc Olo-Kwar!"

Valdasc thanked Milo profusely, as he returned from the microphone, but Milo's best reward was one of Daveena's sweetest smiles. Also the dark look he got from Talscon somehow made him feel gratified. If he had thrown a wrench into his plans, he had done well. Apparently he had.

THE "ELECTION" returns, carried by a super-rapid telepathic pick-up, were completely tabulated two hours later and showed a distinct victory for Valdasc Olo-Kwar. The prince of the sky people, now their elected king, smiled in a quiet, relieved way and then stepped to the microphone to give a short speech of gratitude for his people's faith and trust in him.

Talscon Kaj-Zan, the losing man, arose with studied indifference from his seat across the room. His face showed he had been under a terrific strain. Now he looked haggard. His face darkened as he looked across at Milo. He seemed about to approach him. Instead he left the room, darting him a venomous glance.

"That fellow's up to no good," said Dumont ominously. "He's got it in for you, Milo." Milo shrugged but felt vaguely uneasy.

When the few ceremonies of that night were over, Valdasc asked the two meteorologists to accompany him, if they

wished, to view the dead kahn's body. It was a time-honored custom for the newly elected kahn to pay homage to the body of the deceased ruler whom he was replacing. The room containing the body was one of the most magnificent the two scientists had yet seen. It had walls of golden metal and a lofty ceiling hung with beautiful flowing draperies of somber color. Soft, dirgelike music filled the air. Several dozen people were slowly filing past the silken-covered dais on which the body rested. At sight of their prince, however, the line broke, leaving a clear path for him.

Valdasc and Daveena bowed their heads before the dead king and murmured some ancient words appropriate to the occasion. Milo and Dumont, watched, feeling something of the sadness these people felt for a loved and honored ruler. Suddenly they saw Valdasc start. Then he straightened up and ordered every one out of the room, except his party and the official guardian of the body. When the people had filed out, mystified, Valdasc stepped on the dais and kneeled beside the body. He bent his face over and seemed to examine something closely. Then his fingers moved part of the rich clothing from the body's waist.

When Valdasc turned around, his face was a mask of fury. "The king was murdered!" he hissed. "There is a hypodermic mark in his neck! Talscon did this, thinking his plans were complete to become kahn. He was so sure he even took the kingly belt and replaced it with a false one." His face turned suddenly gray. "That means he, and he alone now, has the knowledge and means of controlling the lowering machine for the city, for it was contained in that belt!"

Valdasc was about to go on, but at that very moment they felt a distinct motion of the floor under their feet. It was a falling-away motion that each of them recognized immediately as a rapid

drop downward. The city was dropping toward Earth!

"Inkar save us!" cried Valdesc. "The madman is sending us all to our doom!"

"Quick, where is he?" asked Milo, grasping the prince by the arm. "He must be stopped."

"No one knows where he is!" wailed the sky man, wringing his hands. "That was the secret of the belt. The machine is probably in some secret room of the palace, but it may take hours to locate him. And by then——"

He broke off and shuddered, while they could all feel their underfooting falling swiftly away.

"Order the palace searched then!" shouted Milo, shaking the dazed sky man roughly. "No time must be lost."

VALDASC came out of a daze of fear and unclipped a tiny instrument from his belt. Into this he hurled telepathic instructions to the attendants of the palace. When he looked around for Milo again, he was gone. Somehow, Valdesc had wanted the young man near him in this hour of peril. Dumont, when questioned, could give no information except that Milo had dashed out the door and disappeared.

Milo had a hunch. It occurred to him that the logical place for a control as important as the one that lowered the city on its great support, of metal must be in the same housing that contained the great paralyzing ray and the magnetic forces that propelled the city forward over the face of Earth. Perhaps that was where Talscon, following instructions in the belt, was diverting the titanic forces of the floating city and allowing it to plunge Earthward.

Milo arrived at the entrance to the short shaft that led to the underside gondola of the city, in the courtyard of the palace. He found his way barred by the metal door, securely locked. He tossed his body futilely against it several times and then gave up. He was

about to rush back to the palace to find some one with keys to open the door, when he remembered something. That time Talscon had taken them to the housing he had mentioned that there was an emergency trapdoor in the metal plate that formed the ground of the city. This opening was directly over the gondola housing.

Milo bent his eyes to the metal at his feet and looked sharply around. Back of him he heard panic-stricken cries from the palace, as more and more of the people began to realize that their city was plunging toward destruction. At last he saw it, a round ring set flush with the surface. It had a ring handle. He grasped this and heaved with all his might. It took several more desperate heaves before the trapdoor came up with a clang. Milo looked down at the housing and saw illimitable space beyond it.

He kneeled down and grew dizzy looking at the awesome depths below. A strong draft came up through the orifice, attesting to the speed with which the city was dropping. But this was no time to hesitate. Milo swung himself over the edge of the aperture and let go, with a prayer. He landed ten feet below and rolled to the edge of the flat roof before he could stop himself. His eyes looked out into the tremendous vat of the lower atmosphere. He got to his hands and knees and jerked at the trapdoor of the gondola. It came up easier than the other had.

Without a moment's hesitation, Milo dropped himself through and into the interior of the gondola housing. He landed on the floor with stinging feet and instinctively flung up an arm. A thick bar of metal paralyzed it, wielded in Talscon's hands. But he had saved his head.

Milo dodged the next swing of the metal bar, shuddering at the demoniac rage in Talscon's face, and dived for his legs. He threw the sky man down,

pounced on him and began punching with his one good arm. He pounded at Talscon's face till the insanity in it was replaced by fear and pain. Then he yanked him to his feet, gave him a punch or two in the ribs to show him who was master, and roared for him to turn off the apparatus that was responsible for the city's downward plunge.

Talscon, like a whipped dog, dragged himself to one corner of the gondola and manipulated several levers. With a shudder that was felt through every atom of the entire city above, the metal city support cast off the fatal grip of gravity, in several stages. A few minutes later the city once more floated defiantly. Milo did not loose his grip on the traitor's arm till he was satisfied that all was right. Then he looked him over with scorn.

"Talscon," he growled, "I ought to strangle you for trying to destroy this great and glorious city on your own mad whim at being thwarted. In fact, I think I'll beat you up some more, just for the good of my soul."

The bronzed sky man, with blood smeared over his battered face, held up a hand. He smiled strangely. "There

is no need, man from the lower world. I was not trying to destroy Vikia; I meant to land the city on the surface and then destroy the levitating controls so that my people would have to do what I wanted—conquer the surface world. But you prevented me. You have won. And I have lost."

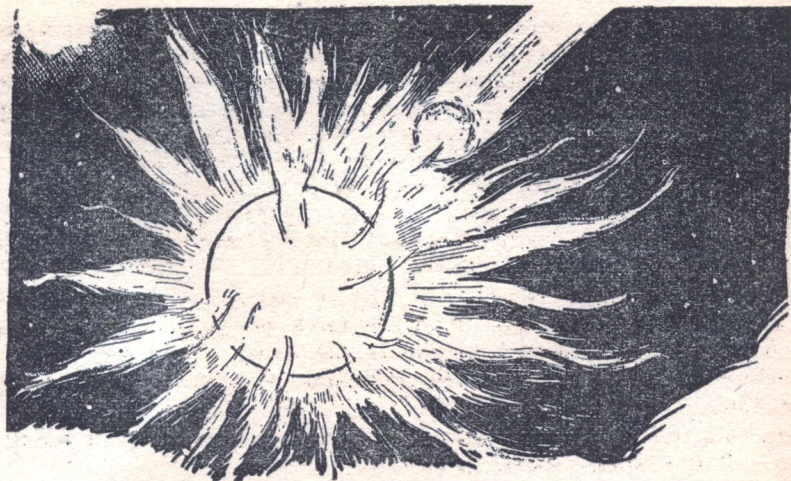
STILL with his strange smile, the sky man stepped to an open window at his back. He saluted Milo and calmly plunged himself head-first out of the opening. Milo leaned out and saw the body of Talscon Kaj-Zan, the first traitor Vikia had known in twelve thousand years, vanish in the mistiness below.

Later, when Milo told his story to an awed group of the sky people, a rousing cheer went up for him. Valdasc said, "You will be made a prince of Vikia for this!"

But Milo sought for his reward in the heaven-blue eyes of Daveena—and found it there.

"I'm afraid," he whispered to Dumont, "that you're going down to the surface alone."

Dumont grinned. "You're telling me?" he said, rather unnecessarily.



End of the World

An Editorial which appeared in the New York Times, August 24, 1937.

The Hayden Planetarium announces that it will show the awful end of the world. And the particular scenario that will be dramatized is to be found in the mathematical work of the late Sir George Darwin, amplified by the late Henri Poincaré. For inevitability and sheer terror there is no tragedy like it. For it deals with the destruction of the moon and the reduction of the earth to a lifeless world by forces that cannot be stayed.

Once upon a time the moon broke from the still plastic earth and spiraled away. The earth bulges slightly more than it should at the Equator because of the moon's early and powerful attraction, the poles are slightly flat, the moon is retreating, and tides are slowing down the earth's speed of rotation from what was once a few hours to what is now a day. Ultimately earth and moon will revolve relatively to each other like the balls of some colossal dumbbell tied together by an invisible rod. The earth's day will be longer than the month. It is then that the mechanism of the great tragedy will be set in motion.

Slowly the moon begins to spiral back to the earth. In 36 million years it appears twenty-five times larger than the sun and four times a year it raises tides 650 feet high. There are tremendous pulling strains when it comes within two-fifths of its present distance. Luna mountains topple. There are terrific avalanches. On the earth, cracks open in which the ruins of cities are engulfed. Terrible earthquakes shake the planet. The time comes when the moon covers a twentieth of the sky. Masses of rock a mile in diameter are attracted by the earth. They do not rain down on what is left of Europe and America, but travel around the earth in orbits of their own.

In the final act mountains crack on the moon and their fragments beat down relentlessly to streak across the terrestrial sky as meteorites. Those that are not wholly consumed by the permanence of an atmosphere bury themselves with loud explosions and heat the surrounding country to thousands of degrees. If any oceans are left, they boil away. The end comes when the moon is 20,000 miles away. The sky is ablaze with white-hot meteorites. On neighboring Venus, by that time a habitable globe, some astronomer explains to the audience of a Venusian planetarium: "The moon has fallen back to the earth. For centuries we have known it would happen. What a day in the history of the universe!"

Around the earth revolves a ring of meteorites like that of Saturn—all that is left of the moon. And the earth swims on—a blackened ball on which oceans once heaved, air made the azure sky a delight to the eye, green trees rustled in the wind, and man struggled up the long path of evolution.

Is this the end? Who knows but the old planetary cinder may bloom again? The cosmos has its cycles.

A Surgical Error

Sounds in terms of color—and light in terms of sound—

I CAME out of an endless void into a world of intense pain and discomfort. The stench of ether brought waves of nausea. Roaring noises and fantastic shades of color hovered about me and would not be shut out. The sharp prick of a hypodermic needle brought grateful oblivion.

I must have slept a long time, because all the shock and anæsthetic discomfort had gone. Except for my bandaged head and the dull ache in the region of my right ear, I felt exceptionally fit.

Bit by bit memory returned and with it came poignant relief—relief that I was alive. Apparently the operation was a success. The great neuro-surgeon had frankly given me only one chance in a thousand. That chance was worth taking because the rapidly growing tumor at the base of my brain was intimately associated with two of my cranial nerves, the optic and the auditory, and it would have been only a matter of short time until I would have been totally blind and deaf.

I, an instructor in the University of Medicine, and a technician in the physiology of special senses, afflicted with blindness and deafness—

You can understand, then, the tremendous reaction of relief that it was over, and the gratitude I felt for the skillful surgeon who had accomplished the impossible. Soon they would take the bandage from my eyes; my incision would heal, and I would be back at the university attending to my beloved routine and research.

I put my hands tentatively to my head and ran them over my bandages. A ghastly sinking sensation seized me.

There was nothing over my eyes! The shock of my discovery called desperately for human companionship—any one to reach out to from the Stygian depths of black despond!

I knew I was to have a special nurse with me after the operation, so I called to her feebly. Instantly a sickly green light drifted before me. I lay still, hardly daring to breathe. The green light frightened me, but it brought hope of returning sight.

I directed my sightless eyes toward the ceiling and visualized my hospital bed, the plain oak dresser by the door, and the leaky faucet in the white enameled wash basin—even the ceiling light with the long push cord slung to my bedside table.

Although I could not see, I knew the location of every piece of furniture in my room, and every crack and crevice in the wall paper. Why shouldn't I? Had I not spent the previous night rolling and tossing and staring feverishly at every object?

Strange phenomena began to intrude upon my consciousness. By my bed was a single window hung with a white Venetian blind. From that direction came a constant subdued murmur.

Another thing. Outside my room, over the door, I had seen a signal light when I entered the hospital. This signal light was a boxlike arrangement of frosted glass set in large letters and numbers that flashed silently on and off to notify the house physicians and supervisors when they were wanted. From the direction of this signal device came odd noises—not unlike those produced

by Walter Anton Coole, M. D.



What was wrong? My thought processes seemed to be functioning all right—but—

by an iron bar striking lightly on a steel ring!

I lay still and concentrated on the noises from this signal device. First, there would be a monotonous repetition of a sound tone. Then it would cease, only to begin again in another key.

Again I called to my nurse and again the sickly green light permeated my con-

sciousness and faded when I ceased to call. I became aware of splashes of subdued gray lights in the direction of the hall, growing brighter as they approached me.

SUDDENLY a realization chilled me and made me doubt my sanity. Those splashes of gray light came from out-

side my room and I could see them! I shrunk into my pillow as they came closer and closer, finally fading entirely at my bedside.

I felt the light touch of my nurse's hand on my forehead and was instantly startled by a soothing flow of delicate pastel colors of pale blue, interspersed with staccato shades of ethereal pink. The colors faded and her hand was withdrawn.

What the devil was wrong? My thought processes seemed to be functioning all right. Of course, there were peculiar sensations in the region of my eyes and ears, but I attributed these to shock from my operation. I couldn't be blind because I saw colors. I couldn't be deaf because I heard sounds. And most remarkable of all I could tell with great accuracy from where they came.

I groped with my left hand toward the light-switch cord on the bedside table and pressed the button experimentally. Instantly, the room was filled with a mighty roar. It came from every corner and beat relentlessly down upon me from the walls and ceiling, filling me with panicky terror.

I opened my mouth and screamed. A jagged splash of white lightning burned into my brain. I groped frantically for the light switch and pushed the button. Silence descended and I lay shivering in cold, clammy perspiration.

Again the splashes of subdued gray light entered my room, ceased at my bed, and once more came the soothing effect of the pastel blues and pinks followed by the sharp prick of the hypodermic. The subdued gray splashes of light receded in the distance, leaving me in a world of strange noises and sounds, fantastic beyond belief!

I fell asleep trying to fathom this perplexity and awoke refreshed and in better spirits. The splashes of gray lights approached again; the now-familiar pale blue and delicate pinks reappeared and I knew that my nurse was by my bed.

Another color appeared—a deep purple. These colors fluttered around me for some time and finally ceased.

My pillow was lifted, a spoonful of hot soup was placed to my lips. I was hungry and took my nourishment. I opened my mouth to thank my nurse, but only bizarre flashes of frosty white light came out. I stopped in a panic, but yielded to the soothing blues and pinks.

I grappled desperately with my problem. Surely, if I had enough intelligence to acquire a Ph.D. degree in physiology, I had enough to solve my own particular problem. I decided to tackle the thing rationally, as I did all my problems.

In the first place, what was my problem? There were those splashes of gray light when my nurse approached me. There was something strange, yet familiar, about those lights. What was it? It came to me suddenly; the *cadence* was familiar! They resembled footsteps! And what caused those pastel shades of pink and blue? Why the constant murmur from the window, and the clinking sounds from the light signal?

Perspiration popped out on my forehead. My hand came in contact with the light switch. I removed it hastily. What caused the mighty noise when I turned on the ceiling light?

Suddenly the whole thing fell together like pieces of a jig-saw puzzle. *I was seeing sounds and hearing light!* I sank back and tried to recall the phenomena of light and sound.

I KNEW that the stimulus for sound, successive air waves, is communicated to the special sense organ, the organ of Corti in the ear and conveyed back over the auditory nerve to the auditory center of the brain located in the temporal lobe.

Similarly, I knew that the rods and cones of the retina of the eye receive light or ether waves and are conveyed

by the optic nerve back to the occipital lobe of the brain.

Could it be possible that in some way the surgeon had caused a short circuit in such a manner that light waves instead of reaching the occipital lobe reached the temporal lobe and sound waves were shortcircuited to the occipital lobe?

Troubled as I was, I scoffed at this idea. I knew there could be no such scrambling of association centers without producing trauma to the brain and my brain was perfectly clear—or was it? Anyway, the tumor was not in the brain itself. The neurologist had told me that. It was outside my brain and intimately associated with the optic and auditory nerves.

Like a flash I had it! The surgeon, in trying to dissect out the tumor from these nerves, had cut them! In suturing them back in place he had connected one end of the optic nerve to the auditory and the other end of the auditory to the optic!

Thus, sound waves falling upon the organ of Corti were carried back over the mixed nerve to the center of sight and were interpreted as light. Similarly, light waves falling upon the retina were carried back over the mixed nerve to the center of hearing and interpreted as sounds. In other words, I was, literally, hearing lights and seeing sounds!

Even in my bewilderment my scientific training asserted itself and I felt a martyrlike sense of elation that my operation had disproved the ancient physiological law of specific nerve energy advanced by Johannes Müller, which stated that each sensory nerve gives rise to its own particular sensation, whatever may be the means by which it is excited. As a matter of fact the law had been under fire by several generations of physiologists, who pointed out that pain may result from stimulation of any sensory nerve, which fact tended to prove the improbability of this law.

Heretofore, there had been no experiment to prove the fallacy of the law of specific nerve energy, and to think my operation should be the means of disproving it! I was brought abruptly back to the realization that regardless of Müller or any other physiologist, I was in a predicament. How was I going to communicate with the outside world? It is true I could speak, but I had no means of knowing what I said. Bizarre flashes of color are poor substitutes for words.

When I contemplated the probability of transposing roaring noises into visual images, discouragement gripped me. I could tell the surgeon of my predicament, but would he believe me?

Even if he could understand my problem, could he undo his error?

I clinched my jaw tightly and made a decision. I would never let my brain be operated upon again! The tumor had been removed and I had escaped death. I had better let well enough alone.

The next best thing was to learn to live with my scrambled senses and school myself to interpret in them sufficient knowledge to cope with my environment. I was not worried about money matters. An inheritance from a distant relative had settled my economic difficulties. I drifted into a troubled sleep.

The next morning I was rudely awakened. My room was on the east side of the hospital and the sun rose shrieking against my window. My nurse was at my side because I could see the pastel shades of her voice. I shouted for her to put down the shade and the jagged white flash of my voice added to the bedlam of the sunrise roar. Suddenly, there was quiet as she adjusted the Venetian blind. I pulled myself together and went back to sleep.

THE DAYS dragged by. I piled up memories of sounds in terms of color and light in terms of sound. I learned to differentiate the howl of sunlight from the deep roar of artificial illumination. Water

produced colors of deep-red to bright-pink. For instance, the drip from the leaky faucet at the wash basin produced staccato flashes of blood-red. It was very annoying when I tried to sleep, because no matter how tightly I closed my eyes the flashes went on with deadly monotony. I solved the problem by pulling the pillow around my ears!

While my nurse's voice produced pastel shades of blue and pink, my doctor's voice was deep purple. Footsteps were all the same—subdued gray, varying only in intensity.

One day my nurse brought a radio to my room, thinking, perhaps, I might respond to the music. I suspected something unusual, because the pastel shades of her voice fluttered and took on deeper tints.

She placed the radio on my bedside table and connected it. I ran my hand over the familiar object and experimentally turned the dial. My first sensation was one of extreme distaste. As the tubes warmed and the customary static developed, horrible colors sprayed me with showers of muddy sparks.

After a while they faded completely and were replaced by a symphonic panorama of sheer mauve and old rose, through which there wove a gorgeous undertone of rich colors for which I had no name. I was spellbound and at the same time aware of a familiarity with the scheme of the symphony. Evidently my association centers must have been stimulated by the familiarity because the name "Chopin" came to my mind.

After a while the symphony of colors ceased and the intermission was made unpleasant by irregular splashes of unmatched colors. Surely, I thought, this is the announcer for the commercials.

The next musical selection must have been jazz. I have never been fond of jazz at its best, but this visual experience was a torturing ordeal. Mere sound is inadequate to express the sordidness and sensualism of jazz music. The selection

came gradually to my consciousness as a dull shade of blue that beat out a syncopated cadence with monotonous undulations. With a flare of primitive red that shook me from head to foot, the theme began. I shall never forget it. The depressing blue and raw red blended and twisted and scorched me with a relentless rhythm that made me writhe. I must have screamed, because there was the searing flash of jagged frosty lightning of my own voice and the colors abruptly ceased.

I was sure by this time that my nurse thought I was demented. Still there was no change in the color of her voice. It was as gentle and soothing as ever. It occurred to me that even if she did think I was demented, possibly I could enlist her help in learning objects through this new media. I decided to experiment. When she brought me a glass of water I drank the contents and held up the glass.

"What is this?" I said and tried to ignore my own voice.

There was a single flash of blue light. I said the word "glass" aloud.

Immediately I became elated. Although her voice was a delicate blue and mine a frosty white, there was something similar in the intensity. I groped for a spoon and held it up. Again the blue light—but I detected a subtle difference. I spoke the word "spoon" aloud and noted the similarity in intensity.

"So far so good," I thought. "It seems that every one's voice has a different tone which I interpret as color, but each word has a definite pitch which I interpret as intensity!"

I went to work and constructed for myself a vocabulary of light words. After a few weeks the meaningless flashes of color took on new significance. Carefully trained association centers came into play and it was only a question of repetition until I was able to transpose my knowledge of word sounds into word lights and vice versa.

MY NURSE was delighted when I was able to carry on a halting conversation. "I am glad to see you getting well again," she spoke simply. "For a while I was in terrible doubt."

I smiled bitterly to myself. When the surgeon called I had to study the purple tones of his voice carefully to understand him.

"Can't you see at all?" he asked anxiously.

"No!"

He left orders for me to be taken out on the lawn in a wheel chair.

Once outside a vast new world of sight and sound opened before me.

The warm sun roared about me. Across the street a peanut vender threw out queer little sparklets of cheerful amber from his vending machine. A passing motorman clanged his bell and yellow fingers of light stabbed me.

I pondered over the fact that in all the varied colors that came to me I had not experienced black except as a dark background. This was probably because black is not a color, but rather an absence of ether vibrations that give rise to the sensation of color.

We remained on the cool lawn until the sun sank. It must have been a glorious sunset, because to me it appeared as a vast semicircle of martial music without rhythm or cadence. The melody was endless in a variety of bell-like overtones through which there ran a tuneless obbligato of rich soprano.

Finally the sun went down and silence took its place, except for dull reverberations here and there followed by soft hummings, which I took to be electric lights springing up in twilight. My nurse was by my side, evidently studying my expression. I was conscious of the soothing flow of her pastel voice.

"Why do you study the sunset with such rapt attention—if you cannot see?"

"I just know it's there," I told her enigmatically.

She rolled me back to my room and I

went to sleep, worn out with my experience. Days passed and I still grappled with the problem of my strange environment—an environment turned upside down and wrong side out. Had it not been for the disciplinary training of my university career and the sympathy of my nurse I would have never conquered it to the extent that I did.

One evening she came to me. "A friend of mine has a car," she informed me, "and I have asked him to take you riding."

I felt a twinge of jealousy; and jerked myself up with the sudden realization that my liaison of blue and pink pastel and the small slender hand that stroked my forehead with such tender feminine solicitude meant a great deal to me.

She guided me down to the waiting car and propped me in the back seat with pillows. She seated herself by me while the young man started the car. Then began a strange journey.

I HAD ANTICIPATED a tremendous amount of color phenomena from the automobile, but I was surprised at the almost imperceptible glow from the engine. The motor must have been almost silent to them. As we drove along the quiet street in the suburban part of town where the hospital was located, I was disturbed only by the street lamps which came to me at regular intervals with dull thuds.

It was not until we reached the downtown district that my troubles began. Automobiles sped by, making phosphorescent stirs through the velvety darkness not unlike fish in tropical waters at night. A traffic officer blew his whistle and a thin streak of cold-blue quartz light leaped at me.

As we came closer to the congested business district the bedlam grew worse. Brilliantly lighted signs shrieked and snarled like angry cats. Noises and lights came so fast I could not interpret them. Detonations almost lifted me

from the seat. Searing lights leaped out at me.

I tried to block out the awful confusion. I screamed to my nurse and she put a soothing arm around me.

By the time we had reached the hospital I was somewhat quieter. My nurse led me to my room and I sank back on the bed exhausted. She was beside me, I knew, probably studying me and wondering what kind of mental case I had turned out to be. I felt an utter sense of defeat.

"Go on," I told her bitterly, "tell me I'm crazy!"

When she spoke, the blues and pinks were soothing as ever and the slender hand pushed the hair back from my forehead. There was a new color in the pastel shades of her voice that I had never seen before—a delicate lavender which almost took my breath by its exquisite luster.

The visual voice, I had found, held a far more subtle delineation of real meaning than the auditory one. Probably that was why I could not feel interested in radio plays. The monotonous flow of deadly color from the players was as uninteresting as listening to a child reading a lesson from a book.

On the other hand I could sometimes pick up spontaneous flashes of enchanting color from amateurs fluttering with ambition, and sometimes fading into the sickly, unhealthy yellow of discouragement.

So I scintillated between hope and the melancholy realization of my position.

"Won't you tell me what's the matter?"

"No!"

She left me and returned later with the surgeon. He examined me completely from head to toes. The next morning my nurse came in, but she brought no breakfast. Instead she picked up my arm and, before I knew what she was about, jabbed a hypodermic needle in my shoulder muscle. When I

had grown drowsy from the morphine, a stretcher was rolled into my room.

The next thing I knew I was in the operating room. The anæsthetist placed the rubber mask over my mouth and nose and strong arms restrained me. I screamed in protest, but only the white frosty light of my own voice mocked me. I was sinking—sinking—and then—

I came out of an endless void into a world of intense pain and discomfort. Again the stench of ether brought its nightmare of nausea. I winced from the sharp stick of the hypodermic needle and drifted off into semiconsciousness, aware only of a pale, distressed angel in white uniform fluttering about me.

AN ÆON of feverish time went by and I opened my eyes and searched the face of my nurse. I was not disappointed—she was lovely—and so concerned! Her voice was real this time, a tinkle of silvery chime, and tremulous with something that brought to mind the lustrous lavender.

"You are beautiful!" I told her, and started at the familiar tones of my own voice.

Light streamed in through the half-open window. The rising sun held a wealth of morning promise. It looked to me like the Golden Grail must have looked to the weary pilgrim. I stared at the white enameled wash basin and listened hungrily to the *drip-drip* of the leaky water faucet.

"You should have told us!" she scolded. "I would have never guessed if we hadn't taken the ride downtown. I told the doctor what I suspected and he admitted that he was worried that he had made an error."

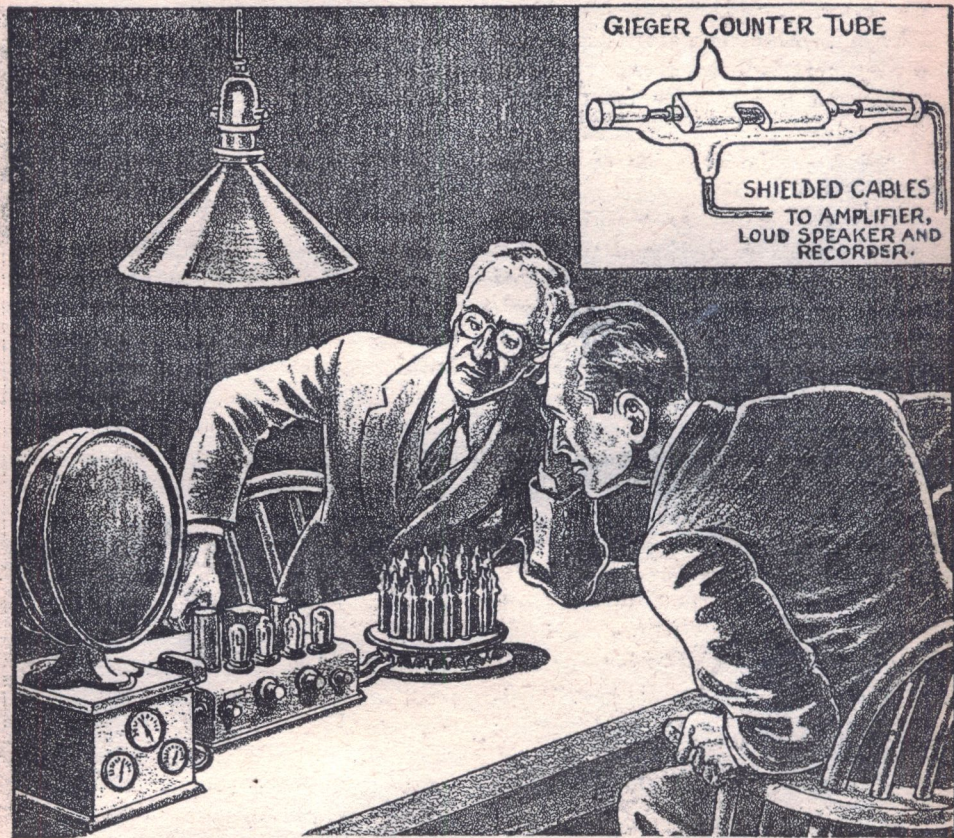
I groped for the slender hand—and found it. "And how did you guess?"

"Because you screamed that the light was killing you and *you held your hands to your ears!*"

Cosmic Ray Shields

A Scientific Article

by ARTHUR McCANN



If a cosmic-ray burst smashes a few atoms to ions, the discharge will start to give an instantaneous current.

FOR TWENTY YEARS and more, men have been studying the most mysterious of all the signals Earth receives from space; cosmic rays. High in the stratosphere, delicate instruments have been carried; they have been sunk hundreds of feet into the cold waters of lakes fed by melting glaciers, water thus known to be free of radioactive contamination. Lead

stripped from the roofs of ancient cathedrals has been hoarded to shield the delicate instruments. From Little America to the far north, to mountain peaks and crisscrossing over seas, by every possible means of travel the electroscopes and Gieger counters have been taken to plot the intensity and direction of those signals from outer space.

Cosmic rays—and in the last few years

it has become increasingly plain that *no one yet has really studied the true cosmic rays*. The energy trapped in the instruments has been, rather, that of secondary radiations, rays originating in our own atmosphere, and truly signals originating on Earth itself. We have been studying the mud and dust thrown up as a shell explodes, rather than the shell itself. And the worst of it is that the cosmic rays themselves may never be observed satisfactorily from Earth.

The existence of cosmic rays was first deduced from the behavior of electroscopes, one of the simplest yet most ultimately sensitive instruments in all the armory of modern physics. Basically it is no more than a ribbon of gold leaf three inches long and a third of an inch wide suspended at the center by a stiff, bent wire, and protected from air currents by a glass case. In its simplicity lies its sensitivity; the gold leaf, so thin as to be almost wholly without stiffness, and practically weightless, hangs down limply. But when a few electrons have been added to, or subtracted from it, it is charged, and the two ends being similarly charged are mutually repelled, so that the limp vanes stiffen out in an inverted V.

The technical instruments are electrically insulated to a wonderful degree; the charge, once placed on the gold leaf, cannot leak away, and the physicists knew that the instruments should remain with V'd vanes for days. But they did not; slowly they would collapse as the charge was dissipated; the mutual repulsion died away. In a sense radioactivity called to the attention of physicists that the charge did escape, for if a bit of radium be brought near the electroscope there is no slow leakage; the vanes collapse like a pricked balloon.

That was studied and the answer found easily enough. The radium was driving out three types of radiation: alpha particles, stripped helium nuclei;

beta rays, electrons moving at enormous velocity; and gamma rays, true electric vibration similar to, but far more potent than the X rays of the day. Each of these rays carried enormous energy potentials; each could so violently strike an atom as to blast electrons from it, ionize it. The ions so produced then carried away the charge of the electroscope. The effect could be beautifully controlled; a sheet of aluminum would stop the material particles, alpha and beta rays, and let only the gamma rays act. A sheet of lead would stop all three types, and prevent the collapse of the vanes—almost.

But—radioactivity, caused those vanes to collapse; vanes collapse when there is no radium, no radioactive matter around. Was there then some ionizing force continuously present, unvarying in intensity with day and night, season and year?

There was—and that force varied with altitude and with position on Earth. There was a new, hitherto unguessed force producing ions always, a force so potent that lead screening was almost entirely unable to affect it. It wasn't radioactivity, because electroscopes carried away from earth (and possible radioactive rocks) in balloons discharged *more* rapidly. Electroscopes shielded in radioactive-free lead* continued to discharge slowly, inevitably.

* Lead, being a decay product of radioactivity, the dead remains of radium and uranium, might well contain contaminating traces of these substances and their lower products. For instance: Radium B, a highly radioactive substance, is an isotope of lead, chemically inseparable. If that were present in the shielding lead, as it evidently could be, the shield would be the source of the rays it was supposedly stopping. However, slightly radioactive substances would have to be present in quantity; only highly active substances could, even in traces, produce effects. But highly active substances have, by definition, a very short life. (Radium B has a half life of but 26.8 minutes.) Very old metallic lead, then, would be nonactive. The source of this old lead is interesting. Lead roofs expand in summer heat, but weight directs expansion downward, toward the eaves. Winter cold contracts the metal, again downward, producing an annual creep from roof peak to eaves. The metal must be trimmed from the eaves and relayed at the peak after a time. An enduring metal, lead was used to roof cathedrals. Now a millenium old, the eaves trimmings are used as nonactive lead shielding.

SOMETHING, some enormously powerful radiation, was crashing its way through to Earth from outer space. A radiation infinitely more penetrative than the gamma rays of radium was being generated in outer space and penetrating to heavily shielded instruments. A radiation of such stupendous power that no hitherto-known energy approached its driving concentration. (The energy of the gamma rays of radium is measured in millions of volts; we now know that the least of the cosmic represents multiple billions.)

So fiercely powerful were those radiations that no adequate means of measuring their energy was apparent. Lead, capable of stopping the most powerful radiations hitherto known seemed wholly unable to affect this new giant-power ray. Certainly feet of lead would be needed to screen it out; how many feet no one knew. If an adequate screen could be found, and a measure of its penetrative energy thus made, there were formulas at hand that would enable investigators to calculate the probable energy potential of the new radiation.

Millikan did get an accurate estimate. Evidently, the use of lead was out of the question. Since the intensity increased gradually with elevation, the atmosphere appeared to have a screening effect, slight, but measurable. It appeared to show that the radiation came from outside. What was needed was a sufficiently thick layer of some nonradioactive matter.

Sea water would not do; it is faintly, but distinctly, radioactive. The best estimates indicate that there is the equivalent of 20,000 tons of metallic radium in the oceans of the Earth. But by sinking his instruments in the waters of a deep lake high in mountains, made of only very slightly radioactive rock (practically all rocks are somewhat active), a lake fed by the waters of melting glaciers, the effect was won.

Evidently the radiation from space

was not a uniform structure, but a wide spectrum of energy, for its intensity declined gradually as the instruments were lowered into the clear, icy water. Finally, there was a last fraction that penetrated the equivalent of 16 feet of metallic lead. The alpha rays of radium are stopped by an inch or so of air; the more penetrative gamma rays by a few inches of steel.

So much was known: an estimate of the immense penetrative power. It definitely declared one fact, at least: the new radiation was possessed of immense energy. But at once a question was raised: What were the rays, particles, or radiation like X rays or gamma rays of radium? Gamma rays are far more penetrative than either of the material particles given off by radium, electromagnetic radiation slides more readily through solid matter than do particles. It seemed inevitable that this new radiation must consist of an immaterial radiation of immensely shorter wave length than even the gamma rays.

BASING their calculations on the observed penetration of various other electromagnetic radiation, and the assumption that cosmic rays were of this type, a wave length was calculated for the new radiation. From the wave length, by quantum relations and Einstein's mass-energy conversion formula, a mass-and-energy figure was derived for the new radiation. A whole life history was drawn up. Sir James Jeans in his "The Universe Around Us" devoted a considerable section to the cosmic-ray picture as it then (1929) appeared. "The Handbook of Chemistry and Physics," for 1929, gave the wave length of cosmic rays as 0.00000005 microns. Jeans showed in his book that a quantum of the wave lengths assumed would have a mass slightly greater than that of a hydrogen atom.

And back of all this there was that large *if*. If the radiation was a true

electromagnetic energy, *then* these things were true—an unexpressed if in the mind of every scientist working with it, for it had not been proved. The cosmic rays might still be a high-velocity material particle, a super-super alpha or beta ray rather than a super gamma ray. Until that question was settled the whole story of cosmic rays rested on a shifting sand, an unsupported assumption made by theorists.

There work could go on contentedly, however, on many angles of the problem—observations particularly. For whatever the radiation might be, whether material or not, the observations were facts—hard, stubborn things the theories must fit, unaltered by any shift in theoretical opinion. Gradually data accumulated; new instruments came into use. The electroscope lacked in some respects; though exceedingly sensitive, and an accurate and fundamental measure of the intensity of the rays, it was not readily suitable to the important work of directional observation. Noises on a dark night are distorted out of familiarity and meaning by the loss of directional precision. In much the same way, the meaning of intensity measurements might be lost through lack of directional work.

The Gieger counter solved this difficulty. A glass tube $\frac{3}{4}$ of an inch in diameter and 1 inch long is filled with a gas (usually one of the inert gases, helium or argon) under low pressure. Two electrodes are placed in the tube, and a high potential impressed across them, a potential so high that the insulating qualities of the gas are almost broken down to permit a discharge through the tube—almost, but not quite high enough. However, the slightest additional impulse will start an instantaneous discharge. If a cosmic-ray burst, for instance, smashes a few atoms to ions, the discharge will start to give an instantaneous current. A delicate amplifier is connected to the tube, and the

minute current amplified to a husky impulse that readily works an ordinary Veeder counter. The observer can, then, read off the number of bursts (the intensity of the local bombardment) as digits neatly tabulated automatically.

That apparatus alone is not directional. But the next step is easy. A central Gieger counter tube is surrounded by a nest of similar tubes, each, say, $\frac{3}{4}$ of an inch in diameter and 10 inches long. They are arranged like a bundle of pencils clasped in the hand, lying side by side. The tubes are so interconnected that a discharge in *one* tube produces no effect on the counter. Only a simultaneous discharge in one of the outer ring of tubes and a discharge in the central tube—2 discharges at the same instant—can effect the amplifier, and hence the counter. Thus, a ray coming from directly overhead smashes through the top tube and the central tube, causing twin discharges—and the counter clicks out the information, "One burst from the zenith."

THE COSMIC RAYS have been made to tell their direction of origin. A mechanical observer of glass and metal, its relay clucking curiously like a well-contented hen, records faithfully the direction and intensity of the rays from beyond.

More information—another step for the observers, while theory still lagged in a fog of conflicting facts. Now notice this: 2 methods of detection have been described—the electroscope and the Gieger counter. Each depends for its action on the same power or property of cosmic rays; they smash atoms to ions. Neither detects the cosmic ray; each operates on the shattered debris its passage leaves behind. There is one other method of detection: the Wilson Cloud Chamber, the most powerful, single, analytical method available in the study of atomic structure and radiations. Again, it is a simple instrument, so little

and unspectacular as to pass unnoticed; yet the mighty Cyclotron, the huge Van de Graff generators, all the atom-smashing equipment, depends for analysis of their results on the Wilson Cloud Chamber and the electroscope.

The Wilson Cloud Chamber gave the first proof of transmutation of atoms at man's desire. Thanks to it, the positron was detected. By it, the penetrating power of alpha and beta particles is

measured. It consists of a pool of ink-stained water under a glass window, and a small pump. When a gas is compressed, its temperature is raised; when the gas expands, the temperature falls. When the temperature of water is raised, more vapor leaves its surface to enter the space above it; when its temperature falls the water vapor is no longer stable, but must recondense to liquid. The combination of those 2 simple principles,



The existence of cosmic rays was first deduced from the behavior of electroscopes.

plus 1 other equally simple—that water, vapor, to condense, must have a nucleus, some irregularity in the gas to condense on—makes possible one of the most powerful weapons of atomic physics. For ions—smashed atoms—will act as the needed irregularities for that condensation, so that a flying alpha particle, for instance, leaves a trail of ions behind it which immediately become coated with droplets of condensing water. The water droplets appear as a line of visible, white fog against a background of the black-stained water.

A cosmic-ray burst serves to do the same thing; the trail of smashed, flying atoms is marked by a thin line of the water droplets. The cosmic ray that cannot be photographed is made visible by a trail of water. But again notice—*not* the original cause, but only its effects, the ionic débris it leaves behind, is detected.

In 1930, nearly 2 decades after the first hints of cosmic rays, the great *if* remained: were the rays from outside electromagnetic radiation, or material particles? There was one hope of detecting the difference. If they were particles, and they were charges, then a method could be devised that might work. Neutral particles had not been detected up to that time—but very soon after, the neutron, an uncharged, massive particle was detected. Being uncharged, these particles could pass close to atomic nuclei without being seriously influenced, and, in consequence had, immensely greater penetrative power than an equally massive proton going at the same velocity. And, in consequence of this lack of charge, neutrons were far harder to detect. Cosmic rays might, then, be extremely high-velocity neutrons.

Yet the test remained a possibility; if an immensely powerful magnetic field of considerable dimensions were generated, charged particles entering it at high velocities would be deflected from their

paths. This deflection could be observed by means of the Wilson Cloud Chamber; negatively charged particles bending their course one way and positively charged particles shying the other.

A NUMBER of factors were involved in this twisting, however. The greater the field intensity, the greater the tendency for the charged particle—by interaction of its electric field with the man-generated magnetic field—to be turned aside. The longer the course the particle was forced to take through the magnetic field, the greater the total deflection, and the more readily measurable it would become. These 2 factors, then, should be made as great as possible, but each implied huge, and extremely costly apparatus.

Adverse factors were even more numerous. The higher the speed of the particle, the more difficult it became to deflect it. The greater the mass in ratio to its charge, the less easily it would react to the magnetic field. (Thus an electron and proton have equal though opposite charges. But a proton has 1800 times as great a mass, and is far less sensitive to magnetic deflection.) The demonstrable terrific energies of cosmic rays showed indisputably that, if they were particles, they were moving at immense speeds, and immense apparatus would alone have the slightest chance of appreciably distorting their flight tracks.

And finally, if they were either uncharged neutrons or true electromagnetic rays, they would be wholly unaffected by the most powerful, most intense fields imaginable. The evident conclusion was that a curved path, if obtained, proved something, but a straight path could still be interpreted in either of 3 ways: that the radiation was electromagnetic; that it consisted of undeflectable neutrons; or that it still consisted of charged particles, but parti-

cles moving too swiftly to be affected by the apparatus.

But the attempt was made, with the cyclotron-type magnet—an immensely powerful magnet of the requisite large dimensions. And one of the first results of the research was not cosmic-ray knowledge but the discovery of the positron.* Gradually however the data built up, and it became more and more clear that charged particles were giving the effects attributed to cosmic rays. And those particles moved with velocities at the far, faint upper edge of the gigantic magnet's effective range.

But elsewhere, other men had been working at the same problem from another angle. Every indication of cosmic-ray energy attained on Earth, whether electroscopes, Gieger counter or Wilson Cloud Chamber, depended on the blasting of Terrestrial atoms. Further, we must operate beneath the shielding, and perhaps interfering atmosphere. Magnetic field study was producing results, magnetic fields still surrounded and shielded by the atmosphere. The ideal research should be done with instruments and magnetic fields outside of Earth's atmosphere.

Remember that the magnetic field must have two factors: intensity and size. If you have enough size, intensity is less important. You don't need good brakes to stop if you have a clear road for 10 miles ahead. And, by the gods of space, there *was* a magnetic field that fulfilled, ideally, the conditions they wanted! Intensity it might not have, but size, size on a cosmic scale! A particle must travel 200,000 miles to cross it—200,000 miles of constantly increasing intensity, always low perhaps, but of what importance with such astronomic size. And, of course, that field was outside Earth's atmosphere, Earth's own immense magnetic field.

Easy and obvious—but for one thing. The particles might come from any of an infinity of directions, at any of an infinity of speeds, into a magnetic field that reached, theoretically, to infinity. 3 infinities in a row, mutually interacting in, literally, an infinity of ways. To be of any use whatever, the path of particles plowing into that field must be calculated, and properly understood, for we have only the end result to go by. There's no Wilson Cloud Chamber out there for us to work on.

IT TOOK a brand of mathematics so immensely complex that it was, literally, beyond human minds. We are only on the edge, an edge so thin that the greatest mathematicians of man are hopelessly paralyzed by the sheer immensity of the task. Recently, however, a mathematical weapon, as powerful in advancing results as the amplifier has been in its field, has come into use. The differential analyzer, developed at the Massachusetts Institute of Technology, has made possible a mathematical analysis of some of that infinitude of infinities—an electrical mathematician that can, and does think in infinities as men think in units. Calculus theoretically deals with an infinite number of infinitely small units; the differential analyzer *does* what calculus imagines. Its units are electrons, and it consumes and counts them only when they move in ordered billions.

It solved much of that problem, enough at least to show that charged particles, whether positive or negative, would be shunted away from Earth's equator by that magnetic field in curved paths. Only those moving with immense velocities would be able to drive through the resistance of the lines of magnetic force running from north to south pole at right angles to their course. The rest, more easily turned, would approach, curve, and recede from the planet as though Earth bore a tremen-

* See *What are Positrons*, by R. D. Swisher, *ASTOUNDING*, August, 1937, page 117.

dous, like electrical charge which repelled them.

At the poles, however, the magnetic lines of force are vertical to the surface of the planet, and parallel to the course of incoming particles. Cosmic-ray particles would slide down those lines of force unhindered. Thus, the mathematics predicted that the ray intensity would be a minimum at the equator, where the magnetic deflection permitted only the rare, extremely high-velocity particles through, and a maximum at the poles where any could enter. Between, there would be a smooth gradation of intensity.

For 20 years and more observations had been made over all Earth's surface; now these data came into their own. Examination would prove or disprove this theory. And examination showed that from the equator to 50° north and south the intensity declined as the mathematics predicted. From 50° on to either pole, there was almost no change whatever. The prediction didn't hold.

But a second part did. Almost 100,000,000 miles away, the immense atomic furnace of the Sun was active, and Earth lies almost exactly on its equator where the solar-magnetic field is most effective. And the Sun's magnetic field rules the solar system with a grip as firm in its way as the solar gravity is in its way. At 100,000,000 miles, the Sun's magnetic field equals the strength of Earth's local magnetic field at 50° from the equator. At 50° Earth's field is just strong enough to shunt away into space a charged particle of 2,000,000,000 volt energy, and at Earth's distance from the Sun, solar magnetic power can repulse a 2,000,000,000 volt particle. Naturally, then, there are none of lesser power to gain the easy entry offered by Earth's weaker polar defenses.

A horde of facts was clicking into place now about this new skeleton understanding. With particle energies at

last definitely measured (previous measures had been on the basis of penetrative power, a sort of second-hand estimate. Now, the magnetic-field method made possible a measurement on a basis of fundamental, directly applicable law) the great penetrative power the particles displayed took on a different appearance. Quantum mechanics had shown an interesting fact: the penetrative power of a particle increases with its velocity, of course; but at immensely high energies, and hence velocities, a new effect comes into play. The particle acquires a sort of "untouchability." It is far less apt to be hit, or to hit anything, than an exactly similar but slower-moving particle following the same course. At those extreme velocities, the penetrative power increases out of all proportion, since they very seldom hit anything to slow them, and the tables of penetration drawn up on the basis of radium-emanation particles are utterly inapplicable.

EVENTUALLY, it does hit, and when such a particle does collide with anything, the result is an explosion of energy beside which radium's interatomic energy is a mild and gentle kitten. The particles blasted from atoms struck by cosmic radiation are driven out with an energy, in turn, so immense that they too obey the quantum law of "untouchability," slash through space with an energy too great to hit other atoms.

And it is those secondary particles, blasted from Terrestrial atmospheric atoms, that have been studied for twenty years in Gieger counters, Cloud Chambers and electroscopes. The true cosmic rays have never been studied; they never reached our levels.

But we never thought we were studying cosmic rays; always we worked with Terrestrial ions generated by cosmic-ray energy. We knew we were indirectly studying the energy from space, and that is precisely correct; we did study the cosmic-ray energy, indirectly though

it might be. And since the secondary radiations carry, in their motions, a record of the direction of the original particles, and in their number a record of the original intensity, we have a correct and accurate record of both direction and intensity of the originals.

But since the Earth and the solar-magnetic fields work on the true, original particles, we have correct information now concerning them:

First: the fact that the magnetic fields deflect the particles proves that the true cosmic particles are charged.

Second: calculations on the intensity and distribution of the particles that do reach Earth gives us the energy of the originals, by a direct, fundamental method. The slowest that can reach Earth have a velocity corresponding to 2,000,000,000 electron-volt energy.

Third: since the secondaries that we can observe on Earth retain the direction of the primaries, and since even those primaries that reach our atmosphere have penetrated a deflecting magnetic field, the direction of the secondaries gives us the polarity of the primaries. They are bent from their course in such a way as to indicate that at least 70 per cent are positively charged.

Finally, we have this to consider: What intensity the cosmic rays may reach in outer space we have no way of guessing, for Earth receives only the few, strained and selected individuals

that have energies exceeding the immense potential of 200,000,000 volts. What, for instance, would be the intensity of bombardment on Pluto, so far from the Sun as to be beyond the shielding influence of the Sun's magnetic field, and quite possibly without a magnetic field of its own?

Cosmic rays destroy on Earth about one atom per cubic centimeter per second. If that atom happens to be part of the gene, the life determinant of a living animal, the inheritance of that animal's descendants will be altered, altered perhaps beyond recognition. On Earth, with the minute bombardment we receive, the chance is billions to one against it. Life has an incredible persistence, an ability to adapt itself to unbelievable rigors. There are forms of life that live in concentrated sulphuric acid, and others that live in near-boiling water. But whatever hardships life might overcome, one, surely, there is that it must succumb to. It can adapt itself to almost anything but this: the loss of the power to reproduce its kind.

Our atmosphere is a futile shield against the terrific power of cosmic particles. Only the invisible, intangible defenses of the Sun's vast magnetic field, and Earth's lesser one protect us, make it possible for human beings to have human children, and not give birth to monstrous, unnamable things.

That, by the grace of a magnetic field.

MANA

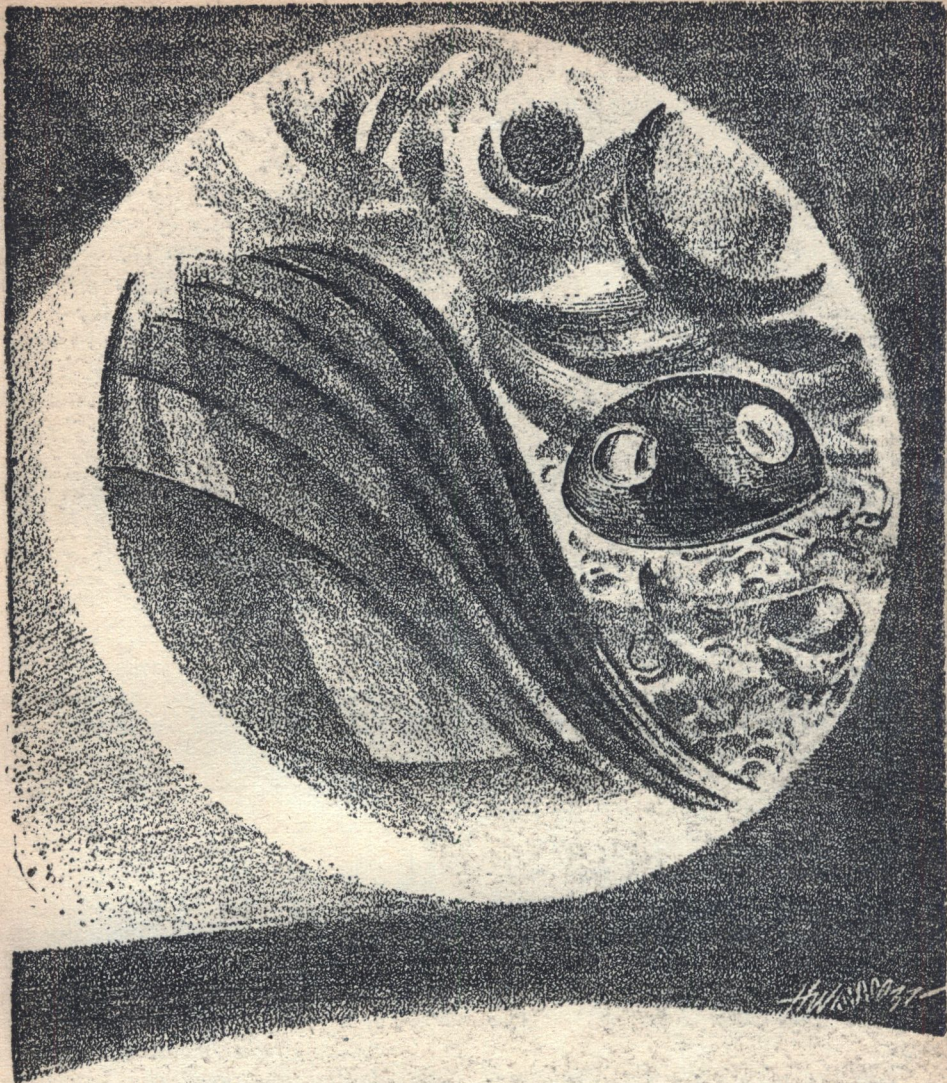
by Eric Frank Russell

which was originally scheduled for this issue, will appear in the
December issue.

DON'T MISS IT!



Although the "seeing" was very poor at this close range, the distortion was minimized—and the spy ray revealed the ground car just as it struck an eddy from the flap—



Galactic Patrol

Part III of a great science novel

by Edward E. Smith, Ph. D.

UP TO NOW:

Law enforcement lagged behind crime because the police were limited in their spheres of action, while criminals were

not. Therefore, when the inertialess drive was perfected and commerce throughout the galaxy became a commonplace, crime became so rampant as

to threaten civilization. Thus came into being the Galactic Patrol, an organization whose highest members, the Lensmen, are of unlimited authority and range. Each is identified by wearing the Lens, a pseudoliving, telepathic jewel matched to the ego of its wearer by those master philosophers, the Arisians. The Lens cannot be either imitated or counterfeited, since it glows with color when worn by its owner, and since it kills any other who attempts to wear it.

Of each million selected candidates for the Lens all except about a hundred fall before the grueling tests employed to weed out the unfit. Kimball Kinnison graduates No. 1 in his class, and is given command of the space ship *Brittania*, which is of a new type, using explosives. He is informed that the pirates, or Boskonians, are gaining the upper hand over the patrol because of a new and almost unlimited source of power, and is instructed to capture one of the new-type ships of the pirates, in order to learn the secret of that power.

Kinnison is successful in finding and defeating a pirate warship. Peter VanBuskirk leads the storming party of Valerians—men of remote human ancestry, but of extraordinary size, strength, and agility because of the enormous gravitation of their native planet—in wiping out those of the pirate crew not killed in the battle between the two ships.

Then the scientists get the information they want. It cannot be transmitted to Prime Base, however, because the pirates are blanketing all channels of communication. Boskonian ships are gathering, and the crippled *Brittania* can neither run nor fight. Therefore, each man is given a spool of tape bearing the information and they take to the lifeboats, after setting up a "director-by-chance" to make the *Brittania* pursue an unpredictable course in space, and after rigging bombs to explode her at the first touch of a pirate beam.

Kinnison and VanBuskirk land upon the planet Delgon, and are rescued from a horde of Catlats by Worsel, a winged reptile, native of Velantia, a neighboring planet. By means of improvements upon Velantian thought screens, the three destroy most of the Overlords of Delgon, a sadistic race of monsters who have been preying upon the other peoples of the system by sheer power of mind. Worsel accompanies the patrolmen to Velantia, all of whose resources are then devoted to preparing defenses against the expected Boskonian attack. Several others of the *Brittania's* lifeboats reach Velantia. Kinnison traces a communicator beam of Helmuth, who "speaks for Boskone," thus getting his first line upon Boskonian's Grand Base.

Six pirate vessels are captured. In the six ships, manned by Velantian crews and now blanketing the ether against the pirates' own communicators, the patrolmen set out for Earth and the Prime Base of the Galactic Patrol.

IX.

KIMBALL KINNISON sat at his controls, smoking a rare, festive cigarette and smiling, at peace with the entire universe. For this new picture was in every element a different one from the old. Instead of being in a pitifully weak and defenseless lifeboat, skulking and hiding, he was in one of the most powerful battleships afloat, driving boldly at full blast almost directly toward home. Instead of only two, the patrolmen were now three in number, and LaVerne Thorndyke, master technician, was a telling addition to their force. Also, they had under them almost a normal crew of alert and highly trained Velantians.

Best of all, the enemy, instead of being a close-knit group, keeping Helmuth informed moment by moment of the situation and instantly responsive to his orders, were now entirely out of com-

munication with each other and with their headquarters, groping helplessly. Literally, as well as figuratively, the pirates were in the dark—the absolute blackness of interstellar space. Then Thorndyke entered the room, frowning slightly.

"You look like the fabled Cheshire Cat, Kim," he remarked. "I hate to spoil such perfect bliss, but I'm here to tell you that we ain't out of the woods yet, by seven thousand rows of trees."

"Maybe not," the Lensman returned, blithely, "but compared to the jam we were in a while ago we're not only sitting on top of the world; we're perched right on the exact apex of the universe. They can't send or receive reports or orders, and they can't communicate. Even their detectors are mighty lame. You know how far they can get on electromagnetic detectors and visual apparatus. Furthermore, there isn't an identification number, symbol, or name on the outside of this buzz buggy. If it ever had one the friction and attrition have worn it off, clear down to the armor. What can happen that we can't cope with?"

"These engines can happen," the technician responded, bluntly. "The Bergenholm is developing a meter jump that I don't like a little bit."

"Does she knock? Or even tick?" demanded Kinnison.

"Not yet," Thorndyke confessed, reluctantly.

"How big a jump?"

"Pretty near two thousandths maximum. Average a thousandth and a half."

"That's hardly a wiggle on the recorder line. Drivers run for months with bigger jumps than that."

"Yeah—drivers. But of all the troubles anybody ever had with Bergenholms, a meter kick was never one of them, and that's what's got me guessing as to the whichness of the why. I'm

not trying to scare you—yet. I'm just telling you."

The machine referred to was the neutralizer of inertia, the *sine qua non* of interstellar speed, and it was not to be wondered at that the slightest irregularity in its performance was to the technician a matter of grave concern. Day after day passed, however, and the huge converter continued to function, taking in and sending out its wonted torrents of power. It developed not even a tick, and the meter jump did not grow worse. And during those days they put an inconceivable distance behind them.

During all this time their visual instruments remained blank; to all optical apparatus space was empty save for the normal tenancy of celestial bodies. From time to time something invisible or beyond the range of vision registered upon one of the electromagnetic detectors, but so slow were these instruments that nothing came of their signals. In fact, by the time the warnings were recorded, the objects causing the disturbances were probably far astern.

ONE DAY, however, the Bergenholm quit—cold. There was no laboring, no knocking, no heating up, no warning at all. One instant the ship was speeding along in free flight; the next she was lying inert in space. She was practically motionless, for any possible velocity built up by inert acceleration is scarcely a crawl, as free space speeds go!

Then the whole crew labored like mad. As soon as they had the massive covers off, Thorndyke scanned the interior of the machine and turned to Kinnison.

"I think we can patch her up, but it'll take quite a while. Maybe you'd be of more use in the control room—this ain't quite as safe as a church, is it, lying here inert?"

"Most of the stuff is on automatic

trip, but maybe I'd better keep an eye on things, at that. Let me know occasionally how you're getting along." And the Lensman went back to his controls—none too soon.

For one pirate ship was already beaming him viciously. Only the fact that his defensive armament was upon its automatic trips had saved the stolen battleship from practically instantaneous destruction.

As Kinnison had already remarked more than once, Helmuth was far from being a fool, and that new and amazingly effective blanketing of his every means of communication was a problem whose solution was of paramount importance. Almost every available ship had been, for days, upon the fringe of that interference, observing and reporting continuously. So rapidly was it moving, however, so peculiar was its apparent shape, and so contradictory were the directional readings obtained, that Helmuth's computers had been baffled.

Then Kinnison's Bergenholm failed and his ship went inert. In a space of minutes the location of one center of interference was known. Its coördinates were determined and half a dozen warships were ordered to rush that spot. The raider first to arrive had signaled, visually and audibly; then, obtaining no response, had anchored with a tractor and had loosed his bolts. Nor would the result have been different had every one aboard, instead of no one, been in the control room at the time of the signaling. Kinnison could have read the messages, but neither he nor any one else then aboard the erstwhile pirate craft could have answered them in kind.

Soon the two space ships attacking the turncoat became three, then four, and still the Lensman sat unworried at his board. His meters showed no overload; his noble craft was easily taking everything her sister ships could send.

Then Thorndyke stepped into the

room, no longer a natty officer of space. Instead, he was stripped to sweat-soaked undershirt and overalls. He was covered with grease and grime, and what of his thickly smeared face was visible was almost haggard with fatigue. He opened his mouth to say something, then snapped it shut, as his eye was caught by a flaring visiplate.

"Holy jumping rockets!" he exclaimed. "At us already? Why didn't you yell?"

"How much good would that have done?" Kinnison wanted to know. "Of course, if I had known that you were loafing on the job and could have snapped it up a little, I would have. But there's no particular hurry about this. It'll take more than four of them to break us down, and I was hoping that before they can overload us you'd have us traveling. What was on your mind?"

"I came up here—one, to tell you that we're ready to blast; two, to suggest that you hit her easy at first; and three, to ask if you know where there's any grease soap. But you can cancel two and three. We don't want to play around with these boys much longer—they play too rough—and I ain't going to wash up until I see whether she holds together or not. Blast away—and won't those guys be surprised!"

"I'll say so. We were, too, when the Velantians showed us how to compute a screen that would cut a tractor like so much cheese. Here she goes!"

THE LENSMAN twirled a couple of knobs, then punched down hard upon three buttons. As he did so the flaring plates became dark; they were again alone in space. To the dumfounded pirates, inert as they were and with their supposedly unbreakable tractors locked in full grip, it was as though their prey had slipped off into the fourth dimension. Their tractors gripped nothing whatever, their ravening beams bored unimpeded through the space occupied

an instant before by resisting screens. They did not know what had happened, or how; and, being deep in the field of interference, they could neither report to nor be guided by the master mind of Boskone.

For minutes Thorndyke, VanBuskirk, and Kinnison waited tensely for they knew not what would happen; but nothing happened and the tension gradually relaxed.

"What was the matter with it?" Kinnison asked, finally.

"Overloaded," was Thorndyke's terse reply.

"Overloaded—hooley!" snapped the Lensman. "How *could* they overload a Bergenholm? And, even if they could, why in all the nine hells of Valeria would they want to?"

"They *could* do it easily enough, in just the way they *did* do it—by banking accumulators onto it in series parallel. As to why, I'll let you do the guessing. With no load on the Bergenholm you've got full inertia, with full load you've got zero inertia—you can't go any farther. It looks just plain dumb to me. But then, I think all pirates are short a few jets somewhere. If they weren't they wouldn't be pirates."

"I don't know whether you're right or not. Hope so, but afraid not. Personally, I don't believe these folks are pirates at all, in the ordinary sense of the word."

"Huh? What are they, then?"

"Piracy implies similarity of culture, I would think," the Lensman said, thoughtfully. "Ordinary pirates are usually renegades, deficient somehow, as you suggested, rebelling against a constituted authority which they themselves have at one time acknowledged and of which they are still afraid. That pattern doesn't fit into this matrix at all, anywhere."

"So what? Now I say 'hooley' right back at you. Anyway, why worry about it?"

"Not worrying about it exactly, but somebody has got to do some thinking about it, or else——"

"I don't like to think; it makes my head ache," interrupted VanBuskirk. "Besides, we're getting away from the Bergenholm."

"You'll get a real headache there"—Kinnison laughed—"because I'll bet a good Tellurian beefsteak that the pirates were trying to set up a negative inertia when they overloaded the Bergenholm; and thinking about that state of matter is enough to make *anybody's* head ache!"

"I knew that some of the dippier Ph.D.'s in higher mechanics have been speculating about it," Thorndyke offered, "but it can't be done that way, can it?"

"Nor any other way that anybody has tried yet, and if such a thing is possible the results may prove really startling. But you two had better shove off; you're dead from the neck up. The Berg's spinning like a top—as smooth as that much green velvet. You'll find a can of soap in my locker, I think."

"MAYBE she'll hold together long enough for us to get some sleep." The technician eyed a meter dubiously, although its needle was not wavering a hair's breadth from the green line. "But I'll tell the cockeyed universe that that was a jury rigging we gave it, if there ever was one. You can't depend on it for an hour until after it's been pulled and gone over; and that, you know as well as I do, takes a real shop, with plenty of equipment. If you take my advice you'll sit down somewhere while you can and as soon as you can. That Bergenholm is in bad shape, believe me. We can hold her together for a while by main strength and awkwardness, but before very long she's going out for keeps—and when she goes out you don't want to find yourself fifty years from a machine shop instead of fifty minutes."

"I'll say not," the Lensman agreed. "But on the other hand, we don't want those birds jumping us the minute we land, either. Let's see, where are we? And where are the bases? Um—um—sector bases are white rings, you know, sub-sector bases red stars—" Three heads bent over charts.

"The nearest red-star marker seems to be in System 240-16-37," Kinnison finally announced. "Don't know the name of the planet—never been there and—"

"Too far," interrupted Thorndyke. "We'll never make it. Might as well try direct for Prime Base on Tellus. If you can't find a red closer than that, look for an orange or a yellow."

"Bases of any kind seem to be scarce out here," the Lensman commented. "Wish they had scattered them around a little thicker. Here's a violet star, but that wouldn't help us—just an outpost."

"Guess that purple one there's our best bet," concluded Thorndyke. "It's probably several breakdowns away, but maybe we can make it if we have to. Purples are pretty low-grade space ports, but they've got tools, anyway. What's the name of it, Kim—or is it only a number?"

"It's that very famous planet, Trencu," the Lensman announced, after looking up the reference numbers in the atlas.

"Trencu!" exclaimed Thorndyke in disgust. "The nuttiest, dopiest, wooziest planet in the galaxy! We *would* draw something like that to sit down on for repairs, wouldn't we? Well, I'm on minus time for sleep. Call me if we go inert before I wake up, will you?"

"I sure will; and I'll try to figure out a way of getting down to ground without bringing all the pirates in space along with us."

Then Thorndyke and VanBuskirk slept; Kinnison planned, and the mighty Bergenholm continued to hold the ves-

sel inertialess. In fact, all three men were thoroughly rested and refreshed before the expected breakdown came. And when it did come they were more or less prepared for it. The delay was not sufficiently long to enable the pirates to find them again.

THE sweating, grunting, swearing engineers made one seemingly impossible repair after another, by dint of what dodge, improvisation, and makeshift only the fertile brain of LaVerne Thorndyke ever did know. The master technician, one of the keenest and most highly trained engineers of the whole solarian system, was not used to working with his hands. Although young in years, he was wont to use only his head, in directing the labors and the energies of others.

Nevertheless, he was now working like a stevedore. He was permanently grimy and greasy—their one can of mechanics' soap had been used up long since. His finger nails were black and broken; his hands and face were burned, blistered and cracked. His muscles ached and shrieked at the unaccustomed effort, until now they were on the build. But through it all he had stuck uncomplainingly, even buoyantly, to his task. One day, during an interlude of free flight, he strode into the control room and glanced at the course-plotting goniometer, then stared into the "tank."

"Still on the original course, I see. Have you got anything doped out yet?"

"Nothing very good. That's why I'm staying on this course until we reach the point closest to Trencu. I've figured until my alleged brain back-fired on me, and here's all I can get:

"I've been shrinking and expanding our interference zone, changing its shape as much as I could with reflectors, and cutting it off entirely now and then, to cross up their surveyors as much as I could. When we come to the jumping-off place we'll simply cut off every-

thing that is sending out traceable vibrations. The Berg will have to run, of course, but it doesn't radiate much and we can ground out practically all of that. The drive is the bad feature. It looks as though we'll have to cut down to where we can ground out the radiation."

"How about the flare?" Thornydyke took the inevitable slide rule from a pocket of his overalls and began to work it.

"I've already had the Velantians build us some baffles—we've got lots of spare tantalum, tungsten, carballoy, and refractory, you know—just in case we should want to use them."

"Radiation—detection—decrement—cosine squared theta—um—call it Point 0038," the engineer mumbled, operating his calculator. "We'll have to cut down to about ten or twelve lights. Mighty slow, but we would get there sometime—maybe. Now about the baffles." And he went into another bout with his slide rule, during which could be distinguished a few such words as "temperature—inert corpuscles—velocity—fusion point—Weinberger's Constant—"

Then he said, "It figures that at about fourteen lights your baffles go out. Pretty close check with the radiation limit. QX, I guess—but I shudder to think of what we may have to do to that Bergenhalm to hold it together that long."

"It's not so hot. I don't think much of the scheme myself," admitted Kinnison frankly. "Probably you can think up something better before—"

"Who, me? What with?" Thornydyke interrupted, with a laugh. "Looks to me like our best bet. Anyway, ain't you the master mind of this outfit? Blast off!"

THUS it came about that, long later, the Lensman cut off his interference, cut off his driving power, cut off every mechanism whose operation generated vibrations which would reveal to enemy

detectors the location of his cruiser. Space-suited mechanics emerged from the stern lock and fitted over the still white-hot vents of the driving projectors the baffles they had previously built.

It is, of course, well known that all ships of space are propelled by the inert projection, by means of high-potential static fields, of nascent fourth-order particles or "corpuscles," which are formed inert, inside the inertialess projector, by the conversion of some form of energy into matter. This conversion liberates some heat, and a vast amount of light. This light, or "flare," shining as it does directly upon and through the highly tenuous gas formed by the projected corpuscles, makes of a speeding space ship one of the most gorgeous spectacles known to man; and it was this very spectacular effect that Kinnison and his crew must do away with if their bold scheme was to have any chance at all of success.

The baffles were in place. Now, instead of shooting out in telltale luminescence, the light was shut in—but so, alas, was approximately three per cent of the heat. And the generation of heat *must* be cut down to a point at which the radiation-equilibrium temperature of the baffles would be below the point of fusion of the refractories of which they were composed. This would cut down their speed tremendously; but, on the other hand, they were practically safe from detection and would reach Treneo eventually—if the Bergenhalm held out.

Of course, there was still the chance of visual or electromagnetic detection, but that chance was vanishingly small. The proverbial task of finding a needle in a haystack would be an easy one indeed, compared to that of seeing in a telescope or upon visiplat or magneplate a dead-black, lightless ship in the infinity of space. No, the Bergenhalm was their great, their only concern; and the engineers lavished upon that monstrous fabrication of metal a devotion

to which could be likened only that of a corps of nurses attending the ailing baby of a multimillionaire.

This concentration of attention did get results. The engineers still found it necessary to sweat and to grunt and to swear, but they did somehow keep the thing running—most of the time. Nor were they detected—then.

For the attention of the pirate high command was very much taken up with that fast-moving, that ever-expanding, that peculiarly-fluctuating volume of interference—utterly enigmatic as it was, and impenetrable to their very instrument of communication. Its center was moving toward the solarian system. In that system was the Prime Base of the Galactic Patrol. Therefore, it *was* the Lensman's work—undoubtedly the same Lensman who had conquered one of their superships and, after having learned its every secret, had escaped in a *lifeboat* through the fine-meshed net set to catch him! And, piling Ossa upon Pelion, this same Lensman had—*must* have—captured ship after unconquerable ship of their best and was even now sailing calmly home with them!

Therefore, using as tools every pirate ship in that sector of space, Helmuth and his computers and navigators were slowly but grimly solving the equations of motion of that volume of interference. Smaller and smaller became the uncertainties. Then ship after ship bored into the subethereal murk, to match course and velocity with, and ultimately to come to grips with, each focus of disturbance as it was determined.

Thus in a sense, and although Kinnison and his friends did not then know it, it was only the failure of the Bergenholm that was to save their lives, and with those lives our present civilization.

SLOWLY, haltingly, and, for reasons already given, undetected, Kinnison

made pitiful progress toward Trencó—impatiently cursing his ship, the crippled generator, its designer and its previous operators as he went. But at long last Trencó loomed large beneath them and the Lensman used his Lens.

"Lensman of Trencó space port, or any other Lensman within call!" he sent out clearly. "Kinnison of Tellus—Sol III—calling. My Bergenholm is almost out and I must sit down at Trencó space port for repairs. I have avoided the pirates so far, but they may be either behind me or ahead of me, or both. What is the situation there?"

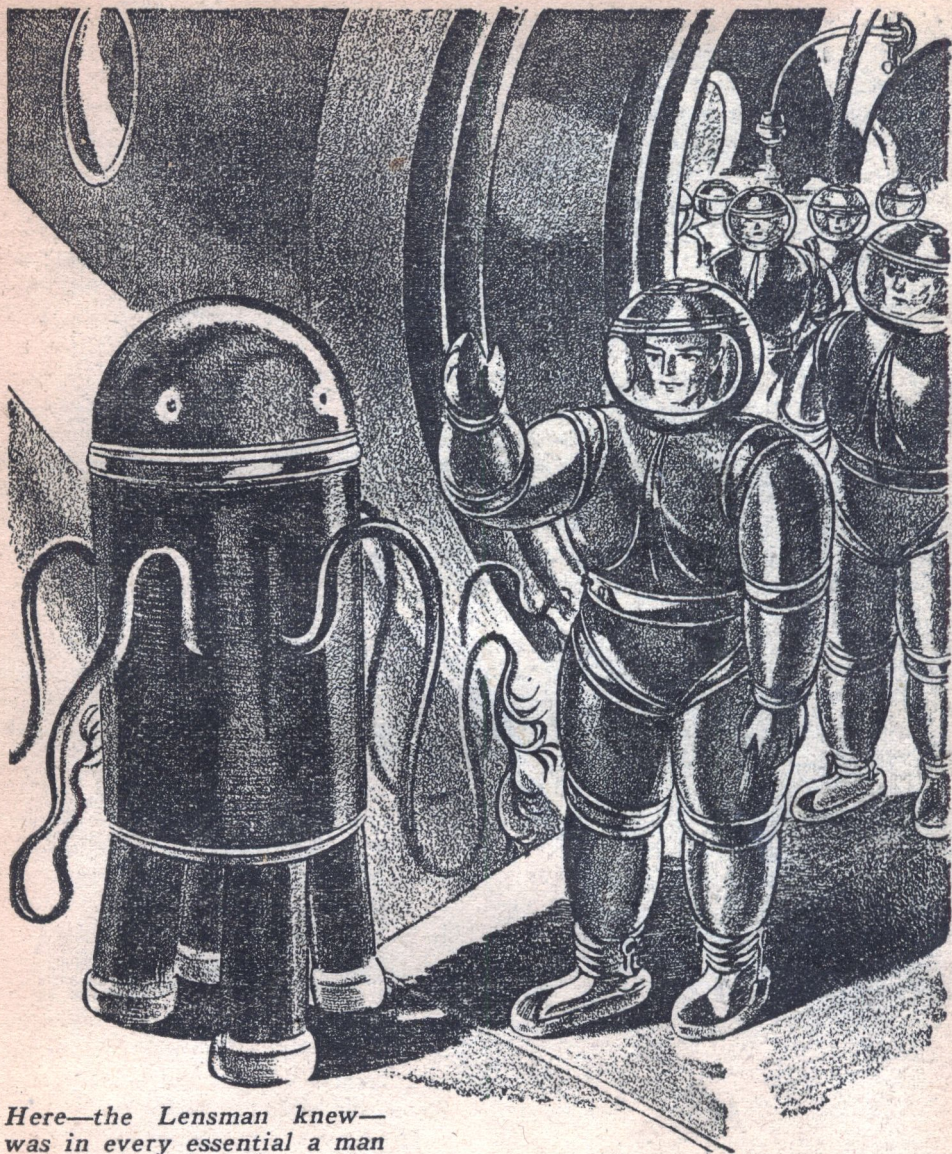
"I fear that I can be of no help," came back a weak thought, without the customary identification. "I am out of control. However, Tregonsee is in the——"

Kinnison felt a poignant, unbearably agonizing mental impact that jarred him to the very core: a shock that, while of sledge-hammer force, was still of such a keenly, penetrant timbre that it almost exploded every cell of his brain.

Communication ceased, and the Lensman knew, with a sick, shuddering certainty, that while in the very act of talking to him a Lensman had died.

X.

JUDGED by any Earthly standards, the planet Trencó was—and is—a peculiar one indeed. Its atmosphere, which is not air, and its liquid, which is not water, are its two outstanding peculiarities and the sources of most of its others. Almost half of that atmosphere and by far the greater part of the liquid phase of the planet is a substance of extremely low latent heat of vaporization, with a boiling point such that during the daytime it is a vapor and at night a liquid. To make matters worse, the other constituents of Trencó's gaseous envelope are of very feeble blanket-ing power, low specific heat, and of high permeability, so that its days are in-



*Here—the Lensman knew—
was in every essential a man
—and probably a superman.*

tensely hot and its nights are bitterly cold.

At night, therefore, it rains. Words are entirely inadequate to describe to any one who has never been there just how it does rain during Trencu's nights. Upon Earth one inch of rainfall in an hour is a terrific downpour. Upon Trencu that amount of precipitation

would scarcely be considered a mist; for along the equatorial belt, in less than thirteen Tellurian hours, it rains exactly forty-seven feet and five inches every night—no more and no less, each and every night of every year.

Also there is lightning. Not in Terra's occasional flashes, but in one continuous, blinding glare which makes

night as we know it unknown there—in nerve-wracking, battering, sense-destroying discharges which make ether and subether alike impenetrable to any ray or signal short of a full-driven power beam. The days are practically as bad. The lightning is not so violent then, but the bombardment of Trencó's monstrous sun, through that outlandishly peculiar atmosphere, produces almost the same effect.

Because of the difference in pressure set up by the enormous precipitation, always and everywhere upon Trencó there is wind—and what a wind! Except at the very poles, where it is too cold for even Trenconian life to exist, there is hardly a spot in which or a time at which an Earthy gale would not be considered a dead calm; and along the equator, at every sunrise and at every sunset, the wind blows from the day side to the night side at the rate of a trifle over eight hundred miles an hour!

Through countless thousands of years wind and wave have planed and scoured the planet Trencó to a geometrically perfect oblate spheroid. It has no elevations and no depressions. Nothing fixed in an Earthly sense grows or exists upon its surface; no structure has ever been built there able to stay in one place through one whole day of the cataclysmic meteorological phenomena which constitute the natural Trenconian environment.

THERE LIVE upon Trencó two types of vegetation, each type having innumerable subdivisions. One type sprouts in the mud of the morning; flourishes flatly, by dint of deeply sent and powerful roots, during the wind and the heat of the day; comes to full fruit in late afternoon; and at sunset dies and is swept away by the flood. The other type is free-floating. Some of its genera are remotely like footballs; others resemble tumbleweeds; still others thistledown; hundreds of others

have not their remotest counterparts upon Earth. Essentially, however, they are alike in habits of life. They can sink in the "water" of Trencó; they can burrow in its mud, from which they derive part of their sustenance; they can emerge therefrom into the sunlight; they can, undamaged, float in or roll along before the ever-present Trenconian wind; and they can enwrap, entangle, or otherwise seize and hold anything with which they come in contact which by any chance may prove edible.

Animal life, too, while abundant and diverse, is characterized by three qualities. From lower to very highest it is amphibious; it is streamlined; and it is omnivorous. Life upon Trencó is hard, and any form of life to evolve there must of stern necessity be willing, yes, even anxious, to eat literally *anything* available. And for that reason all surviving forms of life, vegetable and animal, have a voracity and a fecundity almost unknown anywhere else in the galaxy.

Thionite, the noxious drug referred to earlier in this narrative, is the sole reason for Trencó's galactic importance. As chlorophyll is to Earthly vegetation, so is thionite to that of Trencó. Trencó is the only planet thus far known upon which this substance occurs, nor have our scientists even yet been able either to analyze or to synthesize it. Thionite is capable of affecting only those races who breathe oxygen and possess warm blood, red with haemoglobin.

However, the planets peopled by such races are legion, and very shortly after the drug's discovery hordes of addicts, smugglers, peddlers, and out-and-out pirates were rushing toward the new bonanza. Thousands of these adventurers died, either from each other's ray guns or under an avalanche of hungry Trenconian life; but, thionite being what it is, thousands more kept coming. Also came the patrol, to curb the evil traffic at its source by beaming

down ruthlessly any being attempting to gather any Trenconian vegetation.

Thus between the patrol and the drug syndicate there rages a bitterly continuous battle to the death. Arrayed against both factions is the massed life of the noisome planet, omnivorous as it is, eternally ravenous, and of an individual power and ferocity and a collective aggregate of numbers none of which is to be despised. And eternally raging against all these contending parties are the wind, the lightning, the rain, the flood, and the hellish vibratory output of Trencos enormous, malignant, blue-white sun.

THIS, then, was the planet upon which Kinnison had to land in order to repair his crippled Bergenholm—and in the end how well it was to be that such was the case!

“Kinnison of Tellus, greetings. Trengonsee of Rigel IV calling from Trencos space port. Have you ever landed on this planet before?”

“No, but what—”

“Skip that for a time; it is most important that you land here quickly and safely. Where are you in relation to this planet?”

“Your apparent diameter is a shade under six degrees. We are near the plane of your ecliptic and almost in the plane of your terminator, on the morning side.”

“That is well; you have ample time. Place your ship between Trencos and the sun. Enter the atmosphere exactly fifteen G-P minutes from . . . check . . . at twenty degrees after meridian, as nearly as possible on the ecliptic, which is also our equator. Go inert as you enter atmosphere; for a free landing upon this planet is impossible. Synchronize with our rotation, which is twenty-six points two G-P hours. Descend vertically until the atmospheric pressure is seven hundred millimeters of mercury, which will be at an altitude

of approximately one thousand meters. Since you rely largely upon that sense called sight, allow me to caution you now not to trust it. When your external pressure is seven hundred millimeters of mercury your altitude will be one thousand meters, whether you believe it or not. Stop at that pressure and inform me of the fact, meanwhile holding yourself as nearly stationary as you can. Check so far?”

“QX. But do you mean to tell me that we can't locate each other at a *thousand meters*?” Kinnison's amazed thought escaped him. “What kind of—”

“I can locate you, but you cannot locate me,” came the dry reply. “Every one knows that Trencos is peculiar, but no one who has never been here can realize even dimly how peculiar it really is. Detectors and spy rays are useless, electromagnetics are practically paralyzed, and optical apparatus is distinctly unreliable. You cannot trust your vision here. Do not believe all that you see. It used to require days to land a ship at this port. But with our Lenses and my “sense of perception,” as you call it, it will be a matter of minutes.”

Kinnison had flashed his ship to the designated position.

“Cut the Berg, Thorndyke, we're all done with it. I've got to build up an inert velocity to match the rotation, and land inert.”

“Thanks be to all the gods of space for that.” The engineer heaved a sigh of relief. “I've been expecting it to blow its top for the last hour, and I don't know whether we'd ever have got it meshed in again or not.”

“QX on location and orbit,” Kinnison reported to the as yet invisible space port a few minutes later. “Now, what about that Lensman? What happened?”

“The usual thing,” came the emotionless response. “It happens to altogether too many Lensmen who can see, in spite

of everything we can tell them. He insisted upon going out after his zwilniks in a ground car, and, of course, we had to let him go. He became confused, lost control, let something—possibly a zwilnik's bomb—get under his leading edge, and the wind and the Trencos did the rest. He was Lageston of Mercator V—a good man, too. What is the pressure now?"

"Five hundred millimeters."

"Slow down. Now, if you cannot conquer the tendency to believe your eyes, you had better shut off your visiplates and watch only the pressure gauge."

"Being warned, I can disbelieve my eyes, I think." For a minute or so communication ceased.

AT A STARTLED OATH from VanBuskirk, Kinnison glanced into the plate. It needed all his self-control to keep from wrenching savagely at the controls. For the whole planet was tipping, lurching, spinning, gyrating madly in a frenzy of impossible motions.

"Sheer off, Kim!" yelled the Valerian.

"Hold it, Bus," cautioned the Lensman. "That's what we've got to expect, you know. I passed all the stuff along as I got it. Everything, that is, except that a zwilnik is anything or anybody that comes after thionite, and that a Trencos is anything, animal or vegetable, that lives on the planet. QX, Tregonsee—seven hundred, and I'm holding steady—I hope!"

"Steady enough, but you are too far away for our landing bars. Direct a thought, rotating the prime axis of your Lens while inclining it somewhat downward. . . . Stop! Mark that line on your circles. Now think of the alignment of your ship in relation to that line. Swing your prow away from that line, clear around, to approach it from the other side . . . slow . . . hold it! Apply normal acceleration. . . ."

In a few minutes the crew felt a gen-

tle, snubbing shock, and Kinnison again translated to his companions the stranger's thoughts: "We have grasped you with our landing bars. Cut off all your power and set all controls in neutral. Do nothing more until I instruct you to come out."

Kinnison obeyed; and, released from all duty, the three visitors stared in fascinated incredulity into the visiplate. For that at which they stared was and must forever remain impossible of duplication upon Earth, and only in imagination can it be even faintly pictured. Imagine all the fantastic and monstrous creatures of a delirium-tremens vision incarnate and actual. Imagine them being hurled through the air, borne by a dust-laden gale more severe than any the great American "dust bowl" or Africa's Sahara Desert ever endured. Imagine this scene as being viewed, not in an ordinary, solid, distorting mirror, but in one whose falsely reflecting contours were changing constantly, with no logical or intelligible rhythm, into new and ever more grotesque warps. If imagination has been equal to the task, the resultant is what the three patrolmen tried to see.

At first they could make nothing whatever of it. Upon nearer approach, however, the ghastly distortion grew less and the flatly level expanse of sun-baked mud took on a semblance of rigidity. Directly beneath them they made out something that looked like an immense, flat blister upon the otherwise featureless terrain. Their ship was drawn toward this blister.

A PORT OPENED, dwarfed in apparent size to a mere window by the immensity of the structure. Through this port the vast bulk of the space ship was wafted upon the landing bars, and behind it the mighty bronze-and-steel gates clanged shut. The lock was pumped to a vacuum; there was a hiss of entering air; a spray of vaporous

liquid bathed every inch of the vessel's surface, and Kinnison felt again the calm voice of Tregonsee, the Rigellian Lensman.

"You may now open your air lock and emerge. If I have read aright, our atmosphere is sufficiently like your own in oxygen content so that you will suffer no ill effects from it. It may be well, however, to wear your armor until you have become accustomed to its considerably greater density."

"That'll be a relief!" growled Van-Buskirk's deep base, when his chief had transmitted the thought. "I've been breathing this thin stuff so long I'm getting light-headed."

"That's gratitude!" Thorndyke retorted. "We've been running our air so heavy that all the rest of us are thick-headed now. If the air in this space port is any heavier than what we've been having, I'm going to wear armor as long as we stay here!"

Kinnison had opened the air lock, found the atmosphere of the space port satisfactory, and now stepped out, to be greeted cordially by Tregonsee, the Lensman.

This—this apparition was at least erect, which was something. His body was the size and shape of an oil drum. Beneath this massive cylinder of a body were four short, blocky legs upon which he waddled about with surprising speed. Midway up the body, above each leg, there sprouted out a ten-foot-long, writhing, boneless, tentacular arm, which toward the extremity branched out into dozens of lesser tentacles, ranging in size from hairlike tendrils up to mighty fingers two inches or more in diameter. Tregonsee's head was merely a neckless, immobile, bulging dome in the center of the flat, upper surface of his body—a dome bearing neither eyes nor ears, but only four equally spaced toothless mouths and four single, flaring nostrils.

But Kinnison felt no qualm of repug-

nance at Tregonsee's monstrous appearance, for embedded in the leathery flesh of one arm was the Lens. Here, the Lensman knew, was in every essential a *man*—and probably a *superman*.

"Welcome to Trenc, Kinnison of Tellus," Tregonsee was saying. "While we are near neighbors in space, I have never happened to visit your planet. I have encountered Tellurians here, of course, but they were not of a type to be received as guests."

"No, a zwilnik is not a high type of Tellurian," Kinnison agreed. "I have often wished that I could have your sense of perception, if only for a day. It must be wonderful indeed to be able to perceive a thing as a whole, inside and out, instead of having vision stopped at its surface, as is ours. And to be independent of light or darkness, never to be lost or in need of instruments, to know definitely where you are in relation to every other object or thing around you—that, I think, is the most marvelous sense in the universe."

"Just as I have wished for sight and hearing, those two remarkable and to us entirely unexplainable senses. I have dreamed; I have studied volumes, on color and sound: color in art and in nature; sound in music and in the voices of loved ones. But they remain meaningless symbols upon a printed page. However, such thoughts are vain. In all probability neither of us would enjoy the other's equipment if he had it, and this interchange is of no material assistance to you."

IN FLASHING THOUGHTS Kinnison then communicated to the other Lensman everything that had transpired since he left Prime Base.

"I perceive that your Bergenholm is of Standard 14 Rating," Tregonsee said, as the Tellurian finished his story. "We have several spares here; and, while they all have regulation patrol mountings, it would take much less time to

change mounts than to overhaul your machine."

"That's so, too. I never thought of the possibility of your having spare machines—and we've lost a lot of time already. How long will it take?"

"One night of labor to change mounts—at least eight to rebuild yours enough to be sure that it will get you home."

"We'll change mounts, then, by all means. I'll call the boys——"

"There is no need of that. We are amply equipped, and neither of you humans nor the Velantians could handle our tools." Tregonsee made no visible motion nor could Kinnison perceive a break in his thought, but while he was conversing with the Tellurian half a dozen of his blocky Rigellians had dropped whatever they had been doing and were scuttling toward the visiting ship. "Now I must leave you for a time, as I have one more trip to make this afternoon."

"Is there anything I can do to help you?" asked Kinnison.

"No," came the definite negative. "I will return in three hours, as well before sunset the wind makes it impossible to get even a ground car into the port. I will then show you why you can be of little assistance to us."

Kinnison spent those three hours watching the Rigellians work upon the Bergenholm; there was no need for direction or advice. They knew what to do and they did it. Those tiny, hair-like fingers, literally hundreds of them at once, performed delicate tasks with surpassing nicety and dispatch; when it came to heavy tasks the larger digits or even whole arms wrapped themselves around the work and, with the solid bracing of the four blocklike legs, exerted forces that even VanBuskirk's giant frame could not have approached.

As the end of the third hour neared, Kinnison watched with a spy ray—there were no windows in the Trencos space

port—the leeward groundway of the structure. In spite of the weird antics of Trencos's sun—gyrating, jumping, appearing and disappearing—he knew that it was going down. Soon he saw the ground car coming in, scuttling crabwise, nose into the wind but actually moving backward and sidewise. Although the "seeing" was very poor, at this close range the distortion was minimized and he could see that, like its parent craft, the ground car was in the shape of a blister. Its edges actually touched the ground all around, sloping upward and over the top in such a smooth reverse curve that the harder the wind blew the more firmly was the vehicle pressed downward.

The ground flap came up just enough to clear the car's top and the tiny craft crept up. But before the landing bars could seize her the ground car struck an eddy from the flap—an eddy in a medium which, although gaseous, was at that velocity practically solid. Earth blasted away in torrents from the leading edge; the car leaped bodily into the air and was flung away, end over end. But Tregonsee, with consummate craftsmanship, forced her flat again, and again she crawled up toward the flap. This time the landing bars took hold and, although the little vessel fluttered like a leaf in a gale, she was drawn inside the port and the flap went down behind her. She was then sprayed, and Tregonsee came out.

"Why the spray?" thought Kinnison, as the Rigellian entered his control room.

"Trencos. Much of the life of this planet starts from almost imperceptible spores. It develops rapidly, attains considerable size, and consumes anything organic it touches. This port was depopulated time after time before the lethal spray was developed." Now turn your spy ray again to the lee of the port."

DURING the few minutes that had elapsed the wind had increased in fury to such an extent that the very ground was boiling away from the trailing edge in the tumultuous eddy formed there, ultra-streamlined though the space port was. And that eddy, far surpassing in violence any storm known to Earth, was to the denizens of Trencu a miraculously appearing quiet spot in which they could stop and rest, eat and be eaten.

A globular monstrosity had thrust pseudopodia deep into the boiling dirt. Other limbs now shot out, grasping a tumbleweedlike growth. The latter fought back viciously, but could make no impression upon the rubbery integument of the former. Then a smaller creature, slipping down the polished curve of the shield, was enmeshed by the tumbleweed. There ensued the amazing spectacle of one half of the tumbleweed devouring the newcomer, even while its other half was being devoured by the globe!

"Now look out farther—still farther," directed Tregonsee.

"I can't. Things take on impossible motions and become so distorted as to be unrecognizable."

"Exactly. If you saw a zwilnik out there, where would you shoot?"

"At him, I suppose. Why?"

"Because if you shot at where you think you see him, not only would you miss him, but the ray might very well swing around and enter your own back. Many men have been killed by their own weapons in precisely that fashion. Since we know, not only what the object is, but exactly where it is, we can correct our beams for the then existing values of distortion. This is, of course, the reason why we Rigellians and other races possessing the sense of perception are the only ones who can efficiently police this planet."

"Reason enough, I'd say, from what I've seen."

Silence fell. For minutes the two Lensmen watched, while creatures of a hundred kinds streamed into the lee of the space port and killed and ate each other. Finally, something came crawling upwind, against that unimaginable gale—a flatly streamlined creature somewhat resembling a turtle, but shaped as was the ground car.

Thrusting down long, hooked flippers into the dirt it inched along, paying no attention to the scores of lesser creatures who hurled themselves upon its armored back, until it was close beside the largest football-shaped creature in the eddy. Then, lightninglike, it drove a needle-sharp organ at least eight inches into the leathery mass of its victim. Struggling convulsively, the stricken thing lifted the turtle a fraction of an inch—and both were hurled instantly out of sight; the living ball still eating a luscious bit of soil.

"Good Lord, what was that?" exclaimed Kinnison.

"The flat? That was a representative of Trencu's highest life form. It may develop a civilization in time. It is quite intelligent now."

"But the difficulties!" protested the Tellurian. "Building cities, even homes and—"

"Neither cities nor homes are necessary, nor even desirable, here. Why build? Nothing is or can be fixed on this planet, and since one place is exactly like every other place, why wish to remain in any one particular spot? They do very well, in their own mobile way. Here, you will notice, comes the rain."

The rain came—forty-four inches per hour of rain—and the lightning. Such rain and such lightning must be seen to be even dimly appreciated; there is no use in attempting to describe the indescribable. The dirt first became mud, then muddy water being driven in fiercely flying gouts and masses.

The water grew deeper and deeper, its upper surface now whipped into

frantic sheets of spray. The structure was now afloat, and Kinnison saw with astonishment that, small as was the exposed surface and flatly curved, yet it was pulling through the water at frightful speed the wide-spreading steel sea anchors which were holding its head to the gale.

"With no reference points how do you know where you're going?" he demanded.

"We know not, nor care," responded Tregonsee, with a mental shrug. "We are like the natives in that. Since one spot is like every other spot, why choose between them?"

"What a world—*what* a world! However, I am beginning to understand why thionite is so expensive." And, overwhelmed by the ever-increasing fury raging outside, Kinnison sought his bunk.

MORNING CAME, a reversal of the previous evening. The liquid evaporated; the mud dried; the flat-growing vegetation sprang up with shocking speed; the animals emerged and again ate and were eaten.

And eventually came Tregonsee's announcement that it was noon, and that now, for an hour or so, it would be calm enough for the space ship to leave the port.

"You are sure that I would be of no help to you?" asked the Rigellian, half pleadingly.

"Sorry, Tregonsee, but you would fit into my matrix just as I would into yours here. But here's the spool I told you about. If you will take it to your base on your next relief you will do civilization and the patrol more good than you could by coming with us. Thanks for the Bergenholm, which is covered by credits, and thanks a lot for your help and courtesy, which can't be covered. Good-by." The now entirely spaceworthy craft shot out through the

port, through Trencos's noxiously peculiar atmosphere, into the vacuum of space.

XI.

"Shapley holds that these (star) clusters, under the gravitative control of the larger system, vibrate back and forth through the galaxy."
Fath, *"Elements of Astronomy,"*
p. 297.

AT SOME DISTANCE from the galaxy, yet shackled to it by the flexible yet powerful bonds of gravitation, the small but comfortable planet upon which was Helmuth's base circled about its parent sun. This planet had been chosen with the utmost care, and its location was a secret guarded jealously indeed. Scarcely one in a million of Boskone's teeming millions knew even that such a planet existed; and of the chosen few who had ever been asked to visit it, fewer still by far had been allowed to leave it.

Grand Base covered hundreds of square miles of that planet's surface. It was equipped with all the arms and armament known to the military genius of the age; and in the exact center of that immense citadel there arose a glittering metallic dome.

The inside surface of that dome was lined with visiplates and communicators, hundreds of thousands of them. Miles of catwalks clung precariously to the inward-curving wall. Control panels and instrument boards covered the floor in banks and tiers, with only narrow runways between them. And what a personnel! There were Solarians, Crevenians, Sirians. There were Antareans, Vandemarians, Arcturians. There were representatives of scores, yes, hundreds of other solar systems of the galaxy.

But whatever their external form they were all breathers of oxygen and they were all nourished by warm, red blood.

Also, they were all alike mentally. Each had won his present high place by trampling down those beneath him and by pulling down those above him in the branch to which he had first belonged of the "pirate" organization.

Kinnison had been eminently correct in his belief that Boskone's was not a "pirate outfit" in any ordinary sense of the word, but even his ideas of its true nature fell far short indeed of the truth.

It was a tyranny, an absolute monarchy, a despotism not even remotely approximated by the dictatorships of earlier ages. It had only one creed: "The end justifies the means." Anything—literally *anything at all*—that produced the desired result was commendable; to fail was the only crime.

Therefore, no weaklings dwelt within that fortress; and of all its cold, hard, ruthless crew far and away the coldest, hardest, and most ruthless was Helmuth, the "speaker for Boskone," who sat at the great desk in the dome's geometrical center. This individual was almost human in form and build, springing as he did from a planet closely approximating Earth in mass, atmosphere, and climate. Indeed, only his general, all-pervasive aura of blueness bore witness to the fact that he was not a native of Tellus.

His eyes were blue; his hair was blue; and even his skin was faintly blue beneath its coat of ultra-violet tan. His intensely dynamic personality fairly radiated blueness—not the gentle blue of an Earthly sky, not the sweetly innocuous blue of an Earthly flower; but the keenly merciless blue of a deltra ray, the cold and bitter blue of a Polar iceberg, the unyielding, inflexible blue of chilled and tempered steel.

NOW a frown sat heavily upon his arrogantly patrician face, as his eyes bored into the plate before him, from the base of which were issuing the words

being spoken by the assistant pictured in its deep surface:

"—the fifth dived into the deepest ocean of Corvina II, in the depths of which all rays are useless. The ships which followed have not as yet reconnected. No trace of the sixth has been found, and it is therefore assumed that she was destroyed upon Velantia——"

"Who assumes so?" demanded Helmuth, coldly. "There is no justification whatever for such an assumption. Go on!"

"The Lensman, if there is one, must therefore be in the fifth ship, since he was not in any of the four which we have retaken."

"Your report is neither complete nor conclusive. I do not at all approve of your intimation that the Lensman is simply a figment of my imagination. That there is a Lensman is the only possible logical conclusion. None other of the patrol forces could have done what has been done. Postulating his reality, it seems to me that instead of being a rare possibility, it is highly probable that he has again escaped us, and again in one of our own vessels—this time in the one you have so conveniently 'assumed' to have been destroyed. Have you searched the line of flight?"

"Yes, sir. Everything in space and every planet within reach of that line has been examined with care; except, of course, Velantia and Trencó."

"Velantia is, for the time being, unimportant. It will be reduced later. Why Trencó?" and Helmuth pressed a series of buttons. "Ah, I see. To recapitulate, one ship, the one which in all probability is now carrying the Lensman, is still unaccounted for. *Where is it?* We assume that it left Velantia. We know that it has not landed upon or near any solarian planet. Incidentally, we must see to it that it does not so land. Now, I think, it has be-

come necessary to have that planet Trencu combed, inch by inch."

"But sir, how——" began the anxious-eyed underling.

"When did it become necessary to draw diagrams and make blue prints for you?" demanded Helmuth, harshly. "We have ships manned by Rigellians and other races having the sense of perception. Find out where they are and get them there at full blast!" He flipped over two double-throw switches, thus replacing the image upon his plate by another.

"It has now become of paramount importance that we complete our knowledge of the Lens of the patrol," he began, without salutation or preamble. "Have you traced its origin yet?"

"I believe so, but I do not certainly know. It has proved to be a task of such difficulty——"

"If it had been an easy one I would not have made a special assignment of it to you. Go on!"

"Everything seems to point to a planet named Arisia, but of that planet I can learn nothing definite whatever except that——"

"Just a moment!" Helmuth punched more buttons and listened. "Unexplored—unknown—shunned by all spacemen——"

"Superstition, eh?" he snapped. "Another of those haunted planets?"

"Something more than ordinary spacemen's superstition, sir, but just what I have not been able to discover. By combing my department I managed to make up a crew of those who either were not afraid of it or have never heard of it. That crew is now *en route* there."

"Whom have we in that sector of space? I find it desirable to check your findings."

The department head reeled off a list of names and numbers, which Helmuth considered at length. !

"Gildersleeve, the Valerian," he an-

nounced finally. "He is a good man, coming along fast. Aside from a firm belief in his own peculiar gods, he has shown no signs of weakness. You considered him?"

"Certainly." The henchman, as cold as his icy chief, knew that explanations would not satisfy Helmuth, therefore he offered none. "He is raiding at the moment, but I will put you on him if you like."

"Do so." And upon Helmuth's plate there appeared a deep-space scene of rapine and pillage.

THE convoying patrol ships, two of them, had already been blasted out of existence; only a few idly drifting masses of debris remaining to show that they had ever been. Needle rays were at work, and soon the merchantman hung inert and helpless. The pirates, scorning to use the emergency inlet port, simply blasted away the entire entrance panel. Then they boarded, an armored swarm, flaming DeLameters spreading death and destruction before them.

The sailors, outnumbered as they were and overarmed, fought heroically—but uselessly. In groups and singly they fell; those who were not already dead being callously tossed out into space in slitted space suits and with smashed motors. Only the younger women—the stewardesses, the nurses, the one or two such among the few passengers—were taken as booty; all others shared the fate of the crew.

Then the ship plundered from nose to after jets and every article or thing of value trans-shipped, the raider drew off, bathed in the blue-white glare of the atomic bombs that were destroying every trace of the merchant ship's existence. Then and only then did Helmuth reveal himself to Gildersleeve.

"A good, clean job of work, captain," he commended. "Now, how would you like to visit Arisia for me—for *me*, direct?"

A pallor overspread the normally ruddy face of the Valerian and an uncontrollable tremor shook his giant frame. But as he considered the implications resident in Helmuth's concluding phrase he licked his lips and spoke.

"I hate to say no, sir, if you order me to and if there was any way of making my crew do it. But we were near there once, sir, and we—I—they—it — Well, sir, I *saw* things, sir, and I was—was *warned*, sir!"

"Saw what? And was warned of what?"

"I can't describe what I saw, sir. I can't even think of it in thoughts that mean anything. As for the warning, though, it was very definite, sir. I was told very plainly that if I ever go near that planet again I will die a worse death than any I have dealt out to any other living being."

"But you will go there again?"

"I tell you, sir, that the crew will not do it," Gildersleeve replied, doggedly. "Even if I were anxious to go, every man aboard will mutiny if I tried it."

"Call them in right now and tell them that you have been ordered to Arisia!"

THE CAPTAIN did so. But he had scarcely started to talk when he was stopped in low uncertain fashion by his first officer—also, of course, a Valerian—who pulled his DeLameter and spoke savagely: "Cut it, chief! We are not going to Arisia, nor anywhere near there. I was with you before, you know. Point course within a quadrant of that accursed planet and I flash you where you sit!"

"Helmuth, speaking for Boskone!" ripped from the headquarters' speaker. "This is rankest mutiny. You know the penalty, do you not?"

"Certainly I do. What of it?" the first officer snapped back.

"Suppose that I *tell* you to go to Arisia?" Helmuth's voice was now soft

and silky, but instinct with deadly menace.

"In that case *I tell you* to go to hell—or to Arisia, a million times worse!" snapped the officer.

"What? You dare speak thus to *me*?" demanded the archpirate, sheer amazement at the fellow's audacity blanketing his rising anger.

"I so dare," declared the rebel, brazen defiance and unalterable resolve in every line of his hard body and in every lineament of his hard face. "All you can do is kill us. You can order out enough ships to blast us out of the ether, but that's all you *can* do. That would be a clean, quick death and we would have the fun of taking a lot of the boys along with us. If we go to Arisia, though, it would be different—very, very different, believe me. No, Helmuth, and I say this to your face: If I ever go near Arisia again it will be in a ship in which you, Helmuth, in person, are sitting at the controls. If you think this is an empty dare and don't like it, you don't have to take it. Send on your dogs!"

"That will do! Report yourselves to Base D under——" Then Helmuth's flare of anger passed and his cold reason took charge. Here was something utterly unprecedented; an entire crew of the hardest-bitten marauders in space offering open and barefaced mutiny—no, not mutiny, but actual rebellion—to him, Helmuth, in his very teeth. And not a typical, skulking, carefully planned uprising, but the immovably brazen desperation of men making an ultimately last-ditch stand.

Truly, it must be a powerful superstition, indeed, to make that crew of hard-boiled hellions choose certain death rather than face again the imaginary—they *must* be imaginary—perils of a planet unknown to and unexplored by Boskone's planetographers. But they were, after all, ordinary spacemen, of little mental force and of small real

ability. Even so, it was clearly indicated that in this case precipitate action was to be avoided. Therefore, he went on calmly and almost without a break. "Cancel all this that has been spoken and that has taken place. Continue with your original orders pending further investigation." Helmuth switched his plate back to the department head.

"I have checked your conclusions and have found them correct," he announced, as though nothing at all out of the way had transpired. "You did well in sending a ship to investigate. No matter where I am or what I am doing, notify me instantly at the first sign of irregularity in the behavior of any member of that ship's personnel."

NOR was that call long in coming. The carefully selected crew—selected for complete lack of knowledge of the dread planet which was their objective—sailed along in blissful ignorance, both of the real meaning of their mission and of what was to be its ghastly end. Soon after Helmuth's unsatisfactory interview with Gildersleeve and his mate, the luckless exploring vessel reached the barrier which the Arisians had set around their system and through which no uninvited stranger was allowed to pass.

The free-flying ship struck that frail barrier and stopped. In the instant of contact a wave of mental force flooded the mind of the captain, who, gibbering with sheer, stark, panic terror, flashed his vessel away from that horror-impregnated barrier and hurled call after frantic call along his beam, back to headquarters. His first call, in the instant of reception, was relayed to Helmuth at his central desk.

"Steady, man; report intelligently!" that worthy snapped, and his eyes, large now upon the cowering captain's plate, bored steadily, hypnotically into those of the expedition's leader. "Pull your-

self together and tell me exactly what happened. Everything!"

"Well, sir, when we struck something—a screen of some sort—and stopped, something came aboard. It was— Oh—ay-ay-e-e!" his voice rose to a shriek. But under Helmuth's dominating glare he subsided quickly and went on. "A monster, sir, if there ever was one. A fire-breathing demon, sir, with teeth and claws and cruelly barbed tail. He spoke to me in my own Crevenian language. He said—"

"Never mind what he said. I did not hear it, but I can guess what it was. He threatened you with death in some horrible fashion, did he not?"

The coldly ironical tones did more to restore the shaking man's equilibrium than reams of remonstrance could have done. "Well, yes, that was about the size of it, sir," he admitted.

"And does that sound reasonable to you, the commander of a first-class battleship of Boskone's fleet?" sneered Helmuth.

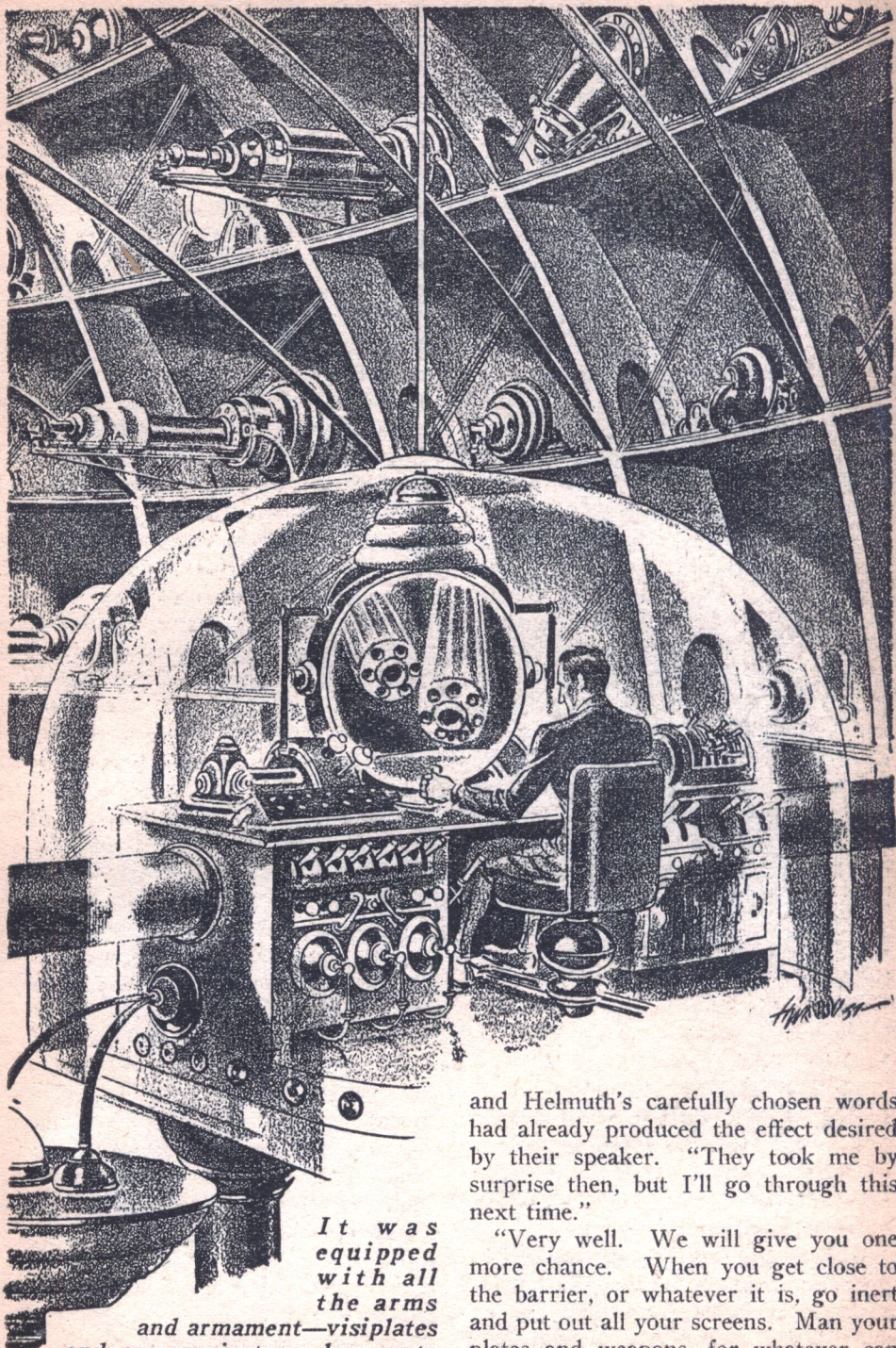
"Well, sir, put in that way, it does seem a bit far-fetched," the captain replied, sheepishly.

"It is far-fetched." The director, in the safety of his dome, could afford to be positive. "We do not know exactly what caused that hallucination, apparition, or whatever it was. You were the only one who could see it, apparently; it certainly was not visible on our master plates here at base. It was probably some form of suggestion or hypnotism; and you know as well as we do that any suggestion can be thrown off by a definitely opposed will. But you did not oppose it, did you?"

"No, sir, I didn't have time."

"Nor did you have your screens out, nor automatic recorders on the trip. Not much of anything, in fact. I think that you had better report back here, at full blast."

"Oh, no, sir—please!" He knew what rewards were granted to failures,



*It was
equipped
with all
the arms*

*and armament—visiplates
and communicators—known to
the military genius of the age.*

and Helmuth's carefully chosen words had already produced the effect desired by their speaker. "They took me by surprise then, but I'll go through this next time."

"Very well. We will give you one more chance. When you get close to the barrier, or whatever it is, go inert and put out all your screens. Man your plates and weapons, for whatever can hypnotize can be killed. Go ahead at

full blast, with all the acceleration you can get. Crash through anything that opposes you, and beam anything that you can detect or see. Can you think of anything else?"

"That should be sufficient, sir." The captain's equanimity was completely restored, now that the warlike preparations were making more and more nebulous the sudden, but single, thought wave of the Arisian.

"Proceed!"

THE PLAN was carried out to the letter. This time the pirate craft struck the frail barrier inert, and its slight force offered no tangible bar to the prodigious mass of metal. But this time, since the barrier was actually passed, there was no mental warning and no possibility of retreat.

Many men have skeletons in their closets. Many have probias, things of which they are consciously afraid. Many others have them, not consciously, but buried deep in the subconscious, specters which seldom or never rise above the threshold of perception. Every sentient being has, if not such specters as these, at least a few active or latent dislikes, dreads, or outright fears. This is true, no matter how quiet and peaceful a life the being has led.

These particular pirates, however, were the scum of space. They were beings of hard and criminal lives and of violent and lawless passions. Their hates and conscience-searing deeds had been legion, their count of crimes long, black, and hideous. Therefore, slight indeed was the effort required to locate in their conscious minds—to say nothing of the noxious depths of their subconscious ones—visions of horror fit to blast stronger intellects than theirs.

And that is exactly what the Arisian guardsman did. From each pirate's total mind, a veritable charnel pit, he extracted the foulest, most unspeakable dregs, the deeply hidden things of which

the subject was in the greatest fear. Of these things he formed a whole of horror incomprehensible and incredible, and this ghastly whole he made incarnate and visible to the pirate who was its unwilling parent; as visible as though it were composed of flesh and blood, of copper and steel. Is it any wonder that each member of that outlaw crew, seeing such an abhorrent materialization, went instantly mad?

It is of no use to go into the horribly monstrous shapes of the things, even were it possible; for each of them was visible to only one man, and none of them was visible to those who looked on from the safety of the distant base. To them the entire crew simply abandoned their posts and attacked each other, senselessly and in insane frenzy, with whatever weapons came first to hand. Indeed, many of them fought bare-handed, weapons hanging unused in their belts, gouging, beating, clawing, biting until life had been rived horribly away. In other parts of the ship De-Lameters flamed briefly; bars crashed crunchingly; knives and axes sheared and trenchantly bit. And soon it was over—almost. The pilot was still alive, unmoving and rigid at his controls.

Then he, too, moved, slowly, haltingly, as though in a trance. Without touching the controls of the Bergenholm, he nursed his driving projectors up to maximum, spun his ship and steadied her on course; and when Helmuth read that course even his iron nerves failed him momentarily. For the ship, still inert, was pointed, not for its own home port, but directly toward Grand Base, the jealously secret planet whose spatial coordinates neither that pilot nor any other creature of the pirates' rank and file had ever known!

HELMUTH snapped out orders, to which the pilot gave no heed. His voice—for the first time in his career—rose almost to a howl. But the pilot

still paid no attention. Instead, eyes bulging with horror and fingers curved tensely into veritable talons, he reared upright upon his bench and leaped as though to clutch and to rend some unutterably appalling foe. He leaped over his board into thin and empty air. He came down a-sprawl in a maze of naked, high-potential busbars. His body vanished in a flash of searing flame and a cloud of thick and greasy smoke.

The busbars cleared themselves of their gruesome "short" and the great ship, manned now entirely by corpses, bored on.

"—stinking klebots, the lily-livered cowards!" the department head, who had also been yelling orders, was still pounding his desk and cursing. "If they're *that* afraid—go mad and kill each other without being touched—I'll have to go myself—"

"No, Sansteed," Helmuth interrupted, curtly. "You will not have to go. There is, after all, I think, something there—something that you may not be able to handle. You see, you missed the one essential key fact." He referred to the course, the setting of which had shaken him to the very core.

"Let be," he silenced the other's flood of question and protest. "It would serve no purpose to detail it to you now. Have the ship taken back to port."

Helmuth knew now that it was not superstition that made spacemen shun Arisia. He knew that, from his standpoint at least, there was something very seriously amiss.

XII.

HELMUTH sat at his desk, thinking—thinking with all the coldly analytical precision of which he was capable.

This Lensman was, in truth, a foeman worthy of his steel. The cosmic-energy drive, developed by the science of a world which the patrol did not know existed, was Boskone's one great item of superiority. If the patrol could be

kept in ignorance of that drive the struggle would be over in a year; the culture of the iron hand would be unchallenged throughout the galaxy. If, however, the patrol did manage to learn the secret of power, to all intents and purposes unlimited, the war between the two cultures might well be prolonged indefinitely. This Lensman knew that secret and was still at large, of that he was all too certain. Therefore, the Lensman must be destroyed. And that brought up the Lens.

What was it? A peculiar bauble indeed, simple of ultimate quantitative analysis, but actually impossible of duplication because of some subtlety of intra-atomic arrangement. Also, it was of peculiar and dire potentiality. Not a man of his force could even wear one; he had watched several of them die horribly in attempting to do so. It must account in some way for the outstanding ability of the Lensmen, and it must tie in, somehow, both with Arisia and with the thought screens. This Lens was the one thing possessed by the patrol which his own forces did not have. He must and would have it, for it was undoubtedly a powerful arm. Not to be compared, of course, with their own monopoly of cosmic energy—but that monopoly was now threatened, and seriously. That Lensman *must be destroyed*.

But how? It was easy to say "Comb Trencó, inch by inch," but doing it would prove a Herculean task. Suppose that the Lensman should again escape, in that volume of so fantastically distorted media? He had already escaped twice, in much clearer ether than Trencó's. However, if this information should never get back to Prime Base, little harm would be done. Ships could and would be thrown around the solarian system in such numbers that not even a grain-of-dust meteorite could pass that screen without detection. Nothing—nothing whatever—would be

allowed to enter that system until this whole affair had been settled. There were other patrol bases, of course, but with the Prime Base isolated, nothing really serious could happen. So much for the Lensman. Now about getting the secret of the Lens.

Again, how? There was something upon Arisia, and that something was connected in some way with the Lens and with thought—possibly also with the new thought screens. Whatever it was, it had mental power, of that there was no doubt. Out of the full sphere of space, what was the mathematical probability that the pilot of that death ship would have set, by accident, his course so exactly upon this planet? Vanishingly small. Treachery would not explain the facts. The pilot had been insane when he had laid the course. As an explanation, mental force alone seemed fantastic, but none other as yet presented itself as a possibility. Also, it was supported by the unbelievable, the absolutely definite refusal of Gildersleeve's normally fearless crew even to approach the planet. It would take an unheard-of mental force so to affect such crime-hardened veterans.

Helmuth was not one to underestimate an enemy. Was there a man beneath that dome, save himself, of sufficient mental caliber to undertake the now necessary mission to Arisia? There was not. He himself had the finest mind on the planet; else that other had deposed him long since and had sat at the control desk himself. He was sublimely confident that no outside thought could break down *his* definitely opposed will—and besides, there were the thought screens, his own personal property as yet. Of no other will could he say the same; no other would he trust with those screens. Of all his force, he was the only one whom he could be *sure* of. Therefore, he would go himself.

It has already been made clear that

Helmuth was not a fool. No more was he a coward. If he himself could best of all his force do a thing, that thing he did, with the coldly ruthless efficiency that marked alike his every action and his every thought.

HOW should he go? Should he accept that challenge, and take Gildersleeve's rebellious crew of cutthroats to Arisia? No. In the event of an outcome short of complete success, it would not do to lose face before that band of ruffians. Moreover, the idea of such a crew going insane behind him was not one to be relished. He would go alone.

"Wolmark, come to the center," he ordered. When that worthy appeared, he went on, "Be seated, as this is a serious conference. I have watched with admiration and appreciation, as well as some mild amusement, the development of your lines of information, particularly those covering affairs which are most distinctly not in your department. They are, however, efficient. You already know exactly what has happened." A definite statement this, is no wise a question.

"Yes, sir," Wolmark said quietly. He was somewhat taken aback, but not at all abashed.

"That is the reason you are here now. I thoroughly approve of you. I am leaving the planet for approximately twenty days, and you are the best man in the organization to take charge in my absence."

"I suspected that you would be leaving, sir."

"I know you did. But I am now informing you, merely to make sure that you develop no peculiar ideas in my absence, that there are at least a few things which you do not suspect at all. That safe, for instance," Helmuth said, nodding toward a peculiarly shimmering globe of force anchoring itself in air. "Even your highly efficient spy system

has not been able to learn a thing about that."

"No, sir, we have not—yet," he could not forbear adding.

"Nor will you, with any skill or force known to man. But keep on trying; it amuses me. I know, you see, of all your attempts. But to get on. I now say, and for your own good I advise you to believe, that failure upon my part to return to this desk will prove highly unfortunate for you."

"I believe that, sir. Any man of intelligence would make some such arrangement, if he could. But sir, suppose that the Arisiāns—"

"If your 'if he could' implies a doubt, act upon it and learn wisdom," Helmuth advised him coldly. "You should know by this time that I neither gamble nor bluff. I have made arrangements to protect myself, both from enemies, such as the Arisiāns and the patrol, and from friends, such as ambitious youngsters who are making arrangements to supplant me. If I were not entirely confident of getting back here safely, my dear Wolmark, I would not go."

"You misunderstood me, sir. Really, I have no idea of supplanting you."

"Not until you get a good opportunity, you mean. I understand you thoroughly; and, as I have said before, I approve of you. Go ahead with all your plans. I have kept at least one lap ahead of you so far, and if the time should ever come when I can no longer do so, I shall no longer be fit to speak for Boskone. You understand, of course, that the most important matter now in work is the search for the Lensman, of which the combing of Trencō and the screening of the solarian system are only two phases.

"Yes, sir."

"Very well. I can, I think, leave matters in your hands. If anything really serious comes up, such as a development in the Lensman case, let me

know at once. Otherwise do not call me. Take the desk." Helmuth strode away.

He was whisked to the space port, where his special speedster awaited him.

FOR HIM the trip to Arisia was neither long nor tedious. The little racer was fully automatic, and as it tore through space he worked as coolly and efficiently as he was wont to do at his desk. Indeed, more so, for here he could concentrate without interruption. Many were the matters he planned and the decisions he made, the while his portfolio of notes grew thicker and thicker.

As he neared his destination he put away his work, actuated his special mechanisms, and waited. When the speedster struck the barrier and stopped, Helmuth wore a faint, hard smile; but that smile disappeared with a snap as a thought crashed into his supposedly shielded brain.

"You are surprised that your thought screens are not effective?" The thought was coldly contemptuous. "Wherever, think you, originated those screens? We did not foresee your theft of them from Velantia, but think you that we would allow to remain at large a thing which we could not neutralize?"

"Know, fool, once and for all, that Arisia does not want and will not tolerate uninvited visitors. Your presence is particularly distasteful, representing as you do a despotic, degrading, and antisocial culture. Evil and good are, of course, purely relative, so it cannot be said in absolute terms that your culture is evil. It is, however, based upon greed, hatred, corruption, violence, and fear. Justice it does not recognize, nor mercy, nor truth except as a scientific utility. It is basically opposed to liberty. Now liberty—of person, of thought, of action—is the basis and the goal of civilization to which you are opposed, and with which any

really philosophical mind must find itself in accord.

"Inflated overweeningly by your warped and perverted ideas, by your momentary success in dominating your handful of minions, tied to you by bonds of greed, of passion, and of crime, you come here to wrest from us the secret of the Lens—from us, who were already an ancient race when the remotest ancestors of your own were still wriggling in their planet's primordial slime.

"You consider yourself cold, hard, ruthless. Comparatively you are weak, soft, tender as a child unborn. That you may learn and appreciate that fact is one reason why you are living at this present moment. Your lesson will now begin."

Then Helmuth, starkly rigid, unable to move a muscle, felt delicate probes enter his brain. One at a time they pierced his innermost being, each to a definitely selected center. It seemed that each thrust carried with it the ultimate measure of exquisitely poignant anguish possible of endurance, but each successive needle carried with it an even more keenly unbearable thrill of agony.

Helmuth was not calm and cold now. He would have screamed in wild abandon; but even that relief was denied him. He could not even scream; all he could do was sit there and suffer.

Then he began to see things. There, actually materializing in the empty air of the speedster, he saw, in endless procession, things he had done, either in person or by proxy, both during his ascent in his present high place in the pirates' organization and since the attainment of that place. Long was the list, and black. As it unfolded his torment grew more and ever more intense; until finally, after an interval that might have been a fraction of a second or might have been untold hours, he could stand no more. He fainted, sinking beyond the reach of pain into a sea of black consciousness.

HE AWAKENED white and shaking, wringing wet with perspiration and so weak that he could scarcely sit erect, but with a supremely blissful realization that, for the time being at least, his punishment was over.

"This, you will observe, has been a very mild treatment," the cold Arisian accents went on inside his brain. "Not only do you still live, you are even still sane. We now come to the second reason why you have not been destroyed. Your destruction by us would not be good for that struggling young civilization which you oppose.

"We have given that civilization an instrument by virtue of which it should become able to destroy you and everything for which you stand. If it cannot do so, it is not yet ready to become a civilization and your obnoxious culture shall be allowed to conquer and to flourish for a time.

"Now go back to your dome. Do not return. We well know that you will not have the temerity to do so in person. Do not attempt to do so by any form whatever of proxy."

There were no threats, no warnings, no mention of consequences; but the level and incisive tone of the Arisian put a fear into Helmuth's cold heart the like of which he had never before known.

He whirled his speedster about and hurled her at full blast toward his home planet. It was only after many hours that he was able to regain even a semblance of his customary poise, and days elapsed before he could think coherently enough to consider, as a whole, the shocking, the unbelievable thing that had happened to him.

He wanted to believe that the creature, whatever it was, had been bluffing—that it could not kill him, that it had done its worst. In a similar case he would have killed without mercy, and that course seemed to him the only logical one to pursue. His cold reason, however, would not allow him to enter-

tain that comforting belief. Deep down he knew that the Arisian could have killed him as easily as it had slain the lowest member of his band, and the thought chilled him to the marrow.

What could he do? What *could* he do? Endlessly, as the miles and light years reeled off behind his hurtling racer, this question reiterated itself; and when his home planet loomed close it was still unanswered.

SINCE Wolmark believed implicitly Helmuth's statement that it would be poor technique to oppose his return, the planet's screens went down at Helmuth's signal. His first act was to call all the department heads to the center, for an extremely important council of war.

There he told them everything that had happened, calmly and concisely, concluding: "They are aloof, disinterested, impartial to a degree I find it impossible to understand. They disapprove of us on purely philosophical grounds, but they will take no active part against us as long as we stay away from their solar system. Therefore, we cannot obtain knowledge of the Lens by direct action, but there are other methods which shall be worked out in due course.

"The Arisians do approve of the patrol, and have helped them to the extent of giving them the Lens. There, however, they stop. If the Lensmen do not know how to use their Lenses efficiently—and I gather that they do not—we shall be allowed to conquer and to flourish for a time. We will conquer, and we will see to it that the time of our flourishing will be a long one indeed.

"The whole situation, then, boils down to this: our cosmic energy against the Lens of the patrol. Ours is the much more powerful arm, but our only hope of immediate success lies in keeping the patrol in ignorance of our cos-

mic-energy receptors and converters. One Lensman already has that knowledge. Therefore, gentlemen, it is very clear that the death of that Lensman has now become absolutely imperative. We *must* find him, if it means the abandonment of our every other enterprise throughout the galaxy. Give me a full report upon the screening of the solarian system."

"It is done, sir," came quick reply. "That system is completely blockaded. Ships are spaced so closely that even the electromagnetic detectors have a five-hundred-per-cent overlap. Visual detectors have at least two-hundred-fifty-per-cent overlap. Nothing as large as one centimeter in any dimension can get through without detection and observation."

"And how about the search of Treneo?"

"Results are still negative. One of our ships, a Rigellian, with papers all in order, visited Treneo space port openly. No one was there except the regular force of Rigellians. Our captain was in no position to be too inquisitive, but the missing ship was certainly not in the port and he gathered that he was the first visitor they had had in a month. We learned on Rigel IV that Tregonsee, the Lensman actually there, has been there for a month and will not be relieved for another month. He was the only Lensman there. We are, of course, carrying on the search for the rest of the planet. About half the personnel of each vessel to land has been lost. But they started with double crews and replacements are being sent."

"The Lensman Tregonsee's story may or may not be true," Helmuth mused. "It makes little difference. It would be impossible to hide that ship in the Treneo space port from even a casual inspection, and if the ship is not there the Lensman is not. He may be hiding somewhere else on the planet, but I doubt it. Continue to search, neverthe-

less. There are many things he may have done. I will have to consider them, one by one."

But Helmuth had very little time to consider what Kinnison might have done, for the Lensman had left Trencol long since. Because of the flare baffles upon his driving projectors his pace was slow; but to compensate for this condition the distance to be covered was short. Therefore, even as Helmuth was cogitating upon what next to do, the Lensman and his able crew were approaching the far-flung screen of Boskonian war vessels investing the entire solar system.

To approach that screen undetected was a physical impossibility, and before Kinnison realized that he was in a danger zone six tractors had flicked out, had seized his ship, and had jerked it up to combat range. But the Lensman was ready for anything, and again everything happened at once.

WARNINGS screamed into the distant pirate base and Helmuth, tense at his desk, took personal charge of his mighty fleet. On the field of action Kinnison's screens flamed out in stubborn defense; tracers and tractors snapped under his slashing shears; the baffles disappeared in an incandescent flare as he shot maximum blast into his drive; and space again became suffused with the output of his now ultra-powered multiplex scrambler.

And through that murk the Lensman directed a thought toward Earth, with the full power of mind and Lens.

"Port Admiral Haynes—Prime Base! Port Admiral Haynes—Prime Base! Urgent! Kinnison calling from the direction of Sirius—urgent!" he sent out the fiercely-driven message.

It so happened that at Prime Base it was deep night, and Port Admiral Haynes was sound asleep. But his ever-vigilant Lens received the message, and

like the trigger-nerved old space cat that he was, the admiral came instantly awake. Scarcely had an eye flicked open than his answer had been hurled back: "Haynes acknowledging. Send it, Kinnison!"

"Coming in, in a pirate ship—Van-Buskirk, Thorndyke, and I, and a crew of Velantians. All the pirates in space are on our necks. But we're coming in, in spite of hell and high water! Don't send up any ships to help us down. They could blast you out of space in a second, but they can't stop us. Get ready. It won't be long now!"

Then, after the port admiral had sounded the emergency alarm, Kinnison went on: "Our ship carries no markings, but there's only one of us, and you'll know which one it is. We'll be doing the dodging. They'd be crazy to follow us down to base, with all the stuff you've got, but they act crazy enough to do almost anything. If they do follow us down, get ready to give 'em everything you've got. Here we are!"

Pursued and pursuers had touched the outermost fringe of the stratosphere; and, slowed down to optical visibility by even that highly rarefied atmosphere, the battle raged in incandescent splendor. One ship was spinning, twisting, looping, gyrating, jumping, and darting hither and thither—performing every weird maneuver that the fertile and agile mind of the Lensman could improvise—to shake off the horde of attackers.

The pirates, on the other hand, were desperately determined that, whatever the cost, that Lensman should not land. Tractors would not hold and the inertialess ship could not be rammed. Therefore, their strategy was that which had worked so successfully four times before in similar case—to englobe the ship completely and thus beam her down. And while attempting this englobement they so massed their forces as to drive the Lensman's vessel as far as possible away from the grim and tremendously

powerful fortifications of the patrol's Prime Base, almost directly below them.

BUT those four other patrol-manned pirate ships which the pirates had recaptured had not been driven by Lensmen; and in this ship Kinnison, the Lensman, was now calling upon his every resource of instantaneous nervous reaction, of brilliant brain and of lightning hand, to avoid that fatal trap. And avoid it he did, by series after series of fantastic maneuvers never set down in any manual of space combat.

Powerful as were the weapons of Prime Base, in that thick atmosphere their effective range was less than fifty miles. Therefore the gunners, idle at their controls, and the officers of the superdreadnaughts, chained by definite orders to the ground, fumed and swore as, powerless to help their battling fellows, they stood by and watched in their plates the furious engagement so high overhead.

But slowly, so slowly, Kinnison won his way downward, keeping as close over base as he could without being engulfed. Finally he managed to get within range of the gigantic projectors of the patrol. Only the heaviest of the fixed-mount guns could reach that mad whirlpool of ships, but each one of them raved out against the same spot at precisely the same instant. In the inferno

which that spot instantly became, not even a full-driven wall shield could endure, and a vast hole yawned where pirate ships had been. The beams flicked off, and, timed by his Lens, Kinnison shot his ship through that hole before it could be closed, and arrowed downward toward base at maximum blast.

Ship after ship of the pirate horde followed him down in madly suicidal last attempts to blast him out, down toward the terrific armament of the base. Prime Base itself, the most dreaded, the most heavily armed, the most impregnable fortress of the Galactic Patrol! Nothing afloat could even threaten that citadel. The overbold attackers simply disappeared in brief flashes of coruscant vapor.

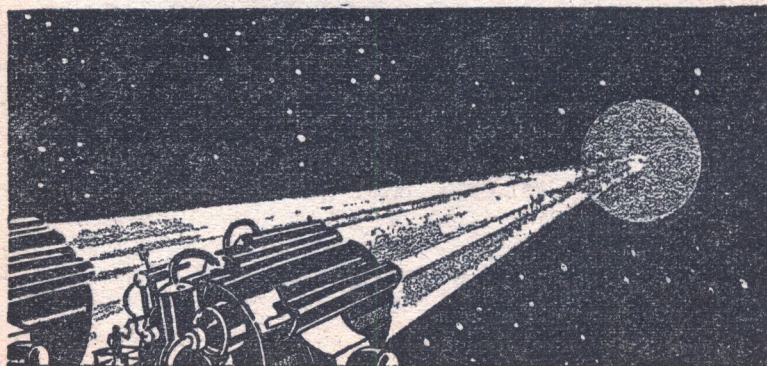
Kinnison flashed to ground in a free landing and called his commander.

"Did any of the other boys beat us in, sir?" he asked.

"No, sir," came the curt response. Congratulations, felicitations, and celebration would come later; he was now the port admiral receiving an official report.

"Then, sir, I have the honor to report that the expedition has succeeded." And he could not help adding informally, youthfully exultant at the success of his first real mission, "We've brought home the bacon!"

(To be Continued.)



WE GROW

And as we grow, we learn.

Italian scientist, Mario Marcini, makes persons invisible under electric rays, in Milan demonstration.

Discovery of electrons heavier than any hitherto known to science, reported by Dr. Carl D. Anderson and Professor Seth Neddermeyer of the California Institute of Technology.

A truly scientific mind which understands the integrating factors in the universe cannot help believing in God, according to Dr. Robert A. Millikan, Nobel Prize Winner and internationally distinguished scientist.

James Cuffery, of the Harvard Observatory, reports a newly revealed subsystem in the universe, contributing important new clues to the structure of the Milky Way.

Encke's Comet, a periodic visitor every three years since its discovery in 1786, is due again—but since it never comes closer than the 13th magnitude we won't be apt to see it!


Wonders in the world of science are continuous and ever-present. Man's discovery of them, or of new facts concerning them, is unbelievably constant. No one, whose brain is capable of absorbing the record of progress as it is recorded, can fail to be spellbound when he contemplates the unutterable vastness of the planned and integrated universe—"the glory which is the heavens!"

I wanted to call your attention to these facts, because though they represent the progress of a single earth month in part, they suggest clearly that motivated, logical science-fiction is not sensational; rather it is conservative delineation of humanized and emotionalized scientific discovery and conjecture.

Who of us ever read a more vivid science-fiction plot than the editorial, reprinted from the New York Times on Page 105 of this issue of Astounding Stories?

Brass Tacks is back! See it? Just four letters this time, letters which explain why. I'm just as anxious to see your "brickbats and flowers" back again, as you are to send them. We won't discard "Science Discussions"—it's too popular—but as always, I bow to YOUR will as soon as I'm convinced. Now it's up to you. How do you like the stories in this issue? Brass Tacks is yours. Fill it! I hope you are enjoying "Galactic Patrol" as much as I did when I read it. But tell me anyway—and give me your suggestions. Between us we'll boost Astounding to an all-time high in 1938.

The Editor.



SCIENCE DISCUSSIONS

AN OPEN FORUM OF CONTROVERSIAL OPINION

Effects of Gravitation.

Dear Editor:

I disagree with C. T. C.'s theories about effects of different gravitation, as expressed in his letter in your magazine.

If the inhabitant of the planet 1,000 times earth's size visited our planet and jumped 100 feet into the air, he would fall according to the formula $v^2 = u^2 + 2fs$ (where "v" is the final velocity, "u" the initial velocity, "f" the acceleration and "s" the distance covered), regardless of his weight.

Since we are considering his fall, his initial velocity is zero and "u" is neglected. Thus, as acceleration due to our gravity is 32 ft. per sec. per sec., we have:

$$v^2 = 6400 \text{ (distance 100 ft.)}$$

$$\text{or } v = 80 \text{ ft. per sec.}$$

The man then hits the ground at 80 ft. per sec. Now, on his planet, "g" is presumably 32,000 ft. per sec. per sec., therefore, substituting for same "v."

$$80^2 = 64,000 \text{ s.}$$

$$\frac{6,400}{64,000} = \text{s.}$$

Therefore, the speed at which he hits the ground from 100 ft. on earth is the same speed at which he hits his planet's surface from 1/10 ft. And if he can't take a drop of 1/15 inch on his own planet—poor chap. (This neglects air resistance, of course.)

Similarly, an earthman on the moon, although able to jump 6 times higher, would accelerate 6 times slower, in descent, than on earth.

I have also a rather interesting problem. If a clock of immense size were sent out on a certain day at the speed of light at noon on that day, from earth, would the hands always seem to point to 12 o'clock to us? (Neglecting Einstein, of course.)

My idea is that after an hour it would be one light hour away from earth and the light

we saw would have left it one hour before, or at noon. Similarly, after a year, the light we saw would leave it a year before, as it would be one light year away. If any one can spot a flaw in the reasoning, I'll be surprised.—W. Hooper, 77 Taylor Lane, Denton, Manchester, England.

Interchange of Personalities.

Dear Editor:

I feel the urge to pen a hasty comment on the story *Frontier of the Unknown* by Norman L. Knight, concerning the interchange-of-personalities idea. First of all, as the author himself suggests in the story, it would seem queer if two personalities were to interchange when, by the laws of chance, they would be most likely to do their jumping at random, so that if Wilkes became Oglethorpe, then Oglethorpe might become Jones or even Sing Lo.

He says that transplanting brains is beyond modern surgery, yet I believe that this would be a minor operation compared with the changing of memories from one brain to another. Consider the multitudinous pictures on a man's memory, each one recorded by an optical process of far greater intricacy than the confessedly cumbersome television process. The personalities might change, but hardly the memories.

Given this reservation, I will say that transmigration, interchange, or what not, is not only possible, but highly probable. I might suggest situations where it would seem likely but am afraid it might stir up a hornet's nest, so will allow you to do your own guessing.—H. A. Harris, 740—19th Street, Merced, Calif.

Explaining "Spirit Rapping"?

Dear Editor:

Oliver Saari's story, *Time Bender*, has induced me to do a little theorizing.

Let us say that there is, at a certain time,

"x" amount of matter in the universe, and "e" amount of energy. Then if a man of "n" mass travels backward in time to this particular instant aforementioned, the total amount of matter is then "x" plus "n" while, if no other such mass changing occurrences take place, the amount of matter in that future is "x" minus "n."

Only a corresponding loss and gain respectively in the amount of energy could explain this conservation of energy and matter, advocates say what they may. But you can't rob or add energy to a universe nilly-willy! Or perhaps time doesn't enter in on the matter. Perhaps you can add matter to a universe provided you take it away on some future date. Come on, fellows, send in your letters!

And now Dr. Clark! You say the space represented by $(e/n)^{00}$ would be a world of light with no velocity, while $(e/n)^{-00}$ space is one wherein light would have infinite velocity. But any mathematician will tell you because of the nature of the tangent graph (as the angle of a triangle "A" approaches 90° the tangent of the angle approaches infinity, when it becomes greater than 90° the tangent decreases from minus infinity) that on this graph, plus and minus infinity coincide somewhere and so must be equal. Then light traveling at infinite velocity would, by this token, also have no velocity?

To go to still another topic, science has always looked upon so-called "supernatural" phenomena with great scorn. But one must admit that the mind is in some way linked with matter and energy. When the process of thinking takes place, or a sensory impulse is sent along the nerves, energy is no doubt released. Could it not be possible for certain gifted individuals to accomplish, because of the ability to liberate thought energy in large quantities, "supernatural" acts?

I do not see why a powerful mind should not be able to produce hallucinations that make a house haunted or a person seem cursed, or even go so far as to be able to move matter, accounting for spirit rapping, etc.—Rudolph Castown, 42 Amity Place, Staten Island, N. Y.

Food for Thought.

Dear Editor:

For some time I have been reading in your magazine of the "bitter cold of outer space," and of people "frozen instantly and drifting forever in airless space." These phrases are continually coming up in interplanetary stories and I can find no reason for them.

To begin with, heat, as I understand it, is nothing but wave motion in the "ether" of the particular frequency that affects the heat-sensitive nerves of the body. It is no different from other wave motion in space, except in wave length and certain properties which are the result of its wave length. When the frequency of heat becomes high enough, it does not act upon the heat-sensitive nerves, but upon the nerves of the eye, making us to see the color red. Both light and heat have power to stimulate chemical reactions; both can be reflected, absorbed or radiated; only the body makes a difference between the high and low frequency and calls them light and heat. Now with this similarity in mind let us make an imaginary flight out into space.

We are out in the void millions of miles from the nearest solid body; let us examine the "bitter cold of outer space." As the only appreciable radiation comes from the sun, one half of our ship appears black, the other half in darkness. Remember that this darkness is not only a light shadow but a heat shadow as well. Take some suitable type of thermometer and hold it in the shadow of the ship. The temperature drops slowly to near absolute zero. Of course it drops slowly—think of the inner container of a thermos bottle, both of them suspended in a vacuum. It is kept above absolute zero by the

faint radiation of the ship and the stars—not by the sun. So this is the temperature of space. But wait! We say a body is hot when it is radiating heat. Can space radiate anything? No. Only matter can radiate. So space itself has no temperature. If we place our thermometer on the sunny side and insulate it against radiation on its dark side, the temperature would rise. The surface of the moon rises to terrific temperatures at its noon, although it is actually in the "bitter cold of space." Naturally, a man in space in the shadows of some planet would freeze—but so would a man on earth were not the air here to warm him. The only difference between a man in space and a man on earth is: the man in space gets his heat directly from the sun; the man on earth gets his indirectly, but more evenly, from the sun.

Thus we see that space is neither hot nor cold; the temperature of a body in it depends entirely on its ability to absorb and hold heat. Also, that a man in shadow in space does not "freeze instantly" but slowly radiates heat. As a matter of fact, a man in cold water would lose heat more quickly for the first few degrees than a man in the vacuum of space.

Among other fallacies in connection with "the bitter cold of space" is the one of the space ship with walls like a thermos bottle. The only difference this would make is to increase the surface of radiation by increasing the diameter of the ship. The ship is already in a vacuum. Why put another wall around it?

If the air were suddenly let out of a ship by a puncture of the outer wall, the temperature would drop rapidly by the cooling effect of the expansion of the air. In this case the temperature (absolute) varies in proportion to the absolute pressure ($P/T = P'/T'$). All that would be necessary to keep out "the bitter cold of space" would be to keep the air in, not to use a heat insulator as well.

There seems to be some argument about the reaction of rockets in a vacuum. Mr. C. Fine's suggestion that rockets are propelled by a kick like a fire hose has always been taken for granted by laymen much the same as the "apple fell just because it was down, not because of gravity." I think that if Mr. Fine will read my arguments he will see that Mr. Yerke was right, after all.

Think of a rocket tube (closed—a cylinder will do) under internal pressure of, say a ton to the square inch, on both ends and on the curved sides. So far nothing has happened. Now remove one of the ends. The pressure is now on the curved walls, but only on one end. The cylinder has pressing against one end a pressure of a ton to the square inch. The opposite end is open, so there is no opposing pressure. The tube leaps away from the open end because of the pressure on the closed end. In a rocket ship the pressure is constantly maintained by burning (consequently expanding) gases. The efficiency of a rocket ship depends on the difference of pressure of the two ends. If the difference is lowered by preventing the escape of the gas by closing it as before, or by operating the rocket in air, some of its efficiency is lost. Examine these two equations for a rocket ship operating at one ton to the square inch:

$$\begin{aligned} & \text{Difference in air:} \\ 2000 & - 14.7 = 1985.3 \text{ per square inch} \\ & \text{Difference in vacuum:} \\ 2000 & - 0.0 = 2000.0 \text{ per square inch} \end{aligned}$$

This and air resistance make rockets more efficient in a vacuum. Being somewhat of a cynic, I wonder what would happen to a man such as in *Seeker of To-morrow* that stepped into a vacuum with nothing but an oxygen tank. What about all the air dissolved in his blood at fifteen pounds pressure. Have you ever heard what happened to divers who come up too fast to allow it to bubble out; or have you ever seen carbonated water when the pressure is removed? Think it over.—Gib Breton, 316 11th Street East, North Vancouver, B. C.

Identical Twins.

Dear Editor:

In his letter Mr. C. B. Loomis gives the following statement: "One identical twin is precisely like the other, unless they be of opposite sexes." Evidently Mr. Loomis does not know much about what determines the sex of an individual or he would have known that identical twins cannot be of opposite sexes. I will try to make this fact clear to Mr. Loomis.

To begin with, I will state some commonly known principles of reproduction. Most of the lower plants and animals reproduce by asexual means, that is without the union of sex cells. Some of the sexual means of reproduction are binary fission, budding and vegetative propagation. Some animals reproduce accidentally by regeneration, as when a starfish is cut in two each of its parts develop into a new, complete starfish.

But the higher plants and animals reproduce by sexual means, that is by the union of sex cells. The male sex cells are called sperms and the female sex cells are called egg cells. Each of these contain half the chromosomes found in every other cell in the individual's body, that is, if every cell in an organism's body has ten chromosomes then there are five chromosomes in the sperm cell and five chromosomes in the egg cell. The chromosomes, by the way, are the bearers of hereditary qualities.

During the process of fertilization the sperm and egg unite and form a normal cell of ten chromosomes. This normal cell divides by binary fission and produces a many-celled embryo which develops into an individual organism.

It is commonly known that man has forty-eight chromosomes, but more recent investigations have proven that women have forty-nine chromosomes. The reason for this is that there are two kinds of sperm cells. One type of sperm cell has twenty-four chromosomes and the other type has twenty-five. All egg cells have twenty-four chromosomes only. When a sperm cell of the first type unites with an egg cell the result is forty-eight chromosomes and the embryo develops into a male individual. But when a sperm cell of the second type fertilizes an egg cell the result is forty-nine chromosomes which develops into a female organism.

Now we will see how these principles apply to twins. There are two different kinds of twins. The first type is the result of two different sperms uniting with two different egg cells and so producing two different individuals. These twins may be of opposite sex or the same sex, depending upon the types of sperms. These twins will not have the same heredity and may differ vastly from one another; therefore, they will not be identical twins.

The second type of twins is the result of one sperm uniting with one egg. When the fertilized egg cell divides into two cells to begin the production of the embryo, the two cells sometimes drift apart and produce two embryos. The result is identical twins, for they both have the same heredity and both are the same sex, either male or female, depending upon the type of sperm cell involved. I hope that I have made this clear to Mr. Loomis.—Frank DeSua, 310 Donner Avenue, Monessen, Pa.

Antigravity.

Dear Editor:

Regarding Atlantis: No one seems to have mentioned the finding of many cities beneath the waters of the Mediterranean or that the remains of sea algae and shellfish have been found near the top of the Great Pyramid.

Regarding time travel: I believe it is possible to travel in time—but only into the past. Remember the *Einstein Express* and the jingle quoted by its leading character? However, to me time travel is not a matter of attaining a speed greater than light—it is a frequency—a vibration—a series of factors tuned slightly

above the frequency of the speed of light. With the finding of a substance to vibrate with these factors, an independent source of power within a vehicle is built of this substance—time travel.

Regarding space travel: I do not see the need for the tremendous "escape velocity" so often quoted. We already have elevators moving at one thousand feet per minute. Do we need speed greater than that?

What about the stratosphere plane? Why can't these planes be equipped with simple rocket motors as well as an engine capable of three hundred miles per hour and use the earth's equatorial speed (one thousand miles per hour) to break loose? (From the thirty-thousand-foot altitude.)

Why can't a stratosphere balloon be built to support a passenger rocket? Then we could use its ten-mile height as a leg of our journey and its hydrogen gas to give the rocket an extra boost.

For that matter, I do not believe that anti-gravity is beyond our present science. All we need is a device to operate at an interfering frequency to the speed of falling objects. This device, I am sure, will presently be developed. Hoping this letter will cause much thought.—M. Erland, 1911 Albermarle Road, Brooklyn, N. Y.

Answer Following.

Dear Editor:

In the July issue appeared the fourteenth article of the series, *Interplanetary Dividends*, dealing with the study of the solar system.

Mr. J. W. Campbell, Jr., mentioned in this article (Page 46) that atomic energy can now be obtained from sand, limestone and iron, by influencing it with deuterons from "heavy" hydrogen.

Will you please inform me as to whether or not this is correct and, if so, where may I obtain a description of the procedure?—Cecil C. Conner, Watsonville, California.

See Next Letter.

Dear Editor:

In the article, *Interplanetary Dividends*, John W. Campbell, Jr., stated that atomic power has already been produced in laboratories.

This is of interest to me. I would appreciate any information you can give me on this subject or where I may obtain this information.—William Schwartz.

Atomic-Power Developments.

Dear Mr. Tremaine:

In answer to Mr. Schwartz and Mr. Conner, atomic power definitely has been released in the manner I indicated in the article *Interplanetary Dividends*. For exact references, I can only say that you would do best to look up the many articles on the subject, by using the "Chemical Abstracts," physics section, found in any large public library, and choose those which sound interesting.

Historically, the earliest method of transmutation (and consequent release of atomic power) was by using the immense striking power of the particles shot out by radium. It was a method of conversation basically similar to the method of the early Moslems: force, without persuasion.

All that makes for an atom's character, its stamp as a nitrogen, oxygen or aluminum atom, lies in the nucleus. In those early days of atomic structure, the nucleus was believed to consist wholly of protons, positively charged particles of mass equal to a hydrogen atom, and electrons, negative particles of very much

smaller mass (about 1/1800th that of the proton) but of equal and opposite electrical charge.

The atom nucleus appeared to have two physical characteristics: its mass and its electrical charge. The mass of the atom nucleus constituted, practically, the entire mass of the atom, and was simply the sum of the masses of the constituent "protons." (Modern knowledge takes exception to this, as explained below.)

The electrical charge of the nucleus, however, was not so simple and was the factor which determined the chemical behavior of the atom. The charge was influenced strongly by the number of electrons bound in the nucleus, since, while their mass was too slight to appreciably influence the mass of the atom, their charges were equal and opposite to the charges of the far more massive protons. Thus oxygen, for instance, was said to consist of a nucleus made up of 16 protons (giving an "atomic weight" of 16) and 8 electrons (which didn't influence the mass). The 8 negative charges of these nuclear electrons canceled 8 of the 16 positive charges of the protons, leaving a residual nuclear charge of plus 8.

That charge of plus 8 determined the structure of the rings of planetary electrons which, circling the nucleus in "planetary orbits," reacted in all chemical actions and were the only parts of the atom assailable by ordinary means. The immense energies involved in the structure of the nucleus itself brought about such fearfully concentrated energy effects that no ordinary force could apply a sufficient concentration of energy to perturb the immensely rigid structure noticeably.

It was simple enough to knock off a planetary electron, and equally simple for that electron to jump right back where it came from, with a net score of no results. If, somehow, an electron could be knocked off, and induced to stay off, the atom would no longer be oxygen; it would be nitrogen, since an atom having only 7 orbital electrons is, by definition, an atom of nitrogen. But the electrons were not going to stay away so long, as there were 8 unsatisfied positive charges on the nucleus.

Two things, they thought, could change that: add an electron to the nucleus, or subtract a proton. (Actually, neither works, because the product in each case is unstable. But that theory was immensely difficult to put into action. To knock out those nuclear particles, you must hit an infinitesimal target with a terrific energy concentration. There are few things on earth that can produce such a concentration of energy as was required, but the most readily available one was radium, which, by its natural and spontaneous disruption of atomic figures, produces, quite naturally, energy concentrations of the magnitude involved in transmutation.)

That was the day of conversion by force, and it ran into one huge difficulty right at the start. Radium produced the needed energy concentration, but the bearer of that energy was an alpha particle, an atom nucleus in itself, the nucleus, in fact, of the helium atom, and the most stable configuration of all. That consisted, the theory held, of 4 protons and 2 electrons, giving a net charge of plus 2. Like charges repel, and the charges follow the inverse square law, so that when the distance is halved, the repulsion is quadrupled.

And, sadly, the distances involved were super-ultra-microscopic, so that those repulsions became stupendously great. First, even an atom-packed mass such as a solid is almost entirely empty space, so that random bombardment naturally missed almost everything. Further, if there were any great angle to the "collision," it wasn't a collision; the alpha particle sheered away from the repulsion engendered by 2 like charges.

Because there were a lot of atoms, and a lot of alpha particles, something was bound to happen once in a while. They did get some transmutation, but as far as releasing atomic energy appreciably, the theory wouldn't work. Then they discovered they'd been missing something. It seems, in fact, they'd been missing slightly

more than half the total universe: neutrons—a particle of mass equal to the proton, and no charge whatever. It immediately became evident that oxygen had a nucleus consisting not of 8 electrons and 16 protons, but of 8 uncharged, massive neutrons and 8 massive, positively charged protons. Half its mass, in other words, was made up of the hitherto undiscovered neutron. (They hadn't noticed it before because, being uncharged, it didn't have any handle to take hold of, and didn't attract attention.)

A new principle appeared as a corollary: excepting hydrogen alone, every atom's mass consisted of neutrons to the extent of at least one half. Further, since the addition of neutrons didn't affect an atom's charge, and hence its properties chemically, a number of them could be added to a nucleus without changing it chemically, but yet change its atomic weight. Thus, evidently, in missing the neutron they had overlooked the particle which, alone, made up more than half the matter of the universe.

The next important light on atomic structure was the discovery that even hydrogen could follow that rule of one half or more; this resulted in the discovery first of deuterium and then of tritium.

To atomic structure, deuterium was immensely important because it consisted of a neutron that could be handled, which they hadn't succeeded in doing before.

Starting with deuterium ("heavy" hydrogen), they ionized it. This removed the single planetary electron, leaving a pair, a proton and a neutron bound together. An electric field accelerates the proton, and the neutron drags along, too. A large speed is built up, and the combination is smashed abruptly against a mass of atoms. The positive charges of the atomic nuclei repel the proton, decelerating it terrifically. But they don't affect the neutron in the slightest; it's perfectly willing to go ahead, and, in fact, its inertia urges it on forcefully.

In atomic terms, the proton and neutron part company. The physicist has now succeeded in getting what he wanted in the first place: a rapidly moving neutron.

They tried bombarding atoms with that new particle, and at once, as might be expected, the whole picture of their results changed immensely. The neutron was not repelled; it did not shy away from atomic nuclei. They began to get a far more important percentage of transmutations, but still a percentage far too small to be of importance.

One step remained. Shortly, it was discovered that slow neutrons produced far better results than did fast ones. A new effect was being used. Calcium has an atomic weight, according to the chemist, of 40.08. By physical analysis, it has been shown that calcium, like lead, has a number of isotopes, atom types with varying numbers of neutrons. It always has 20 protons, but there are atoms of weight 40, 42, 43, and 44, containing 20, 22, 23, and 24 neutrons. But no atoms of weight 41 containing 21 neutrons. That isotope is unstable; it cannot endure but explodes spontaneously and violently if formed. So, suppose we bombard calcium with slow neutrons. There is no repulsion, the slow-moving neutrons drift near an atom, and the mass attraction slips the neutron into the unresisting nucleus.

Then all hell breaks loose in that atom. Abruptly, it has become a forbidden isotope—it cannot be—and it doesn't stay that way. The atom blows up with a violence that puts radium to shame. Lithium atomic weight 7 may accept a neutron, and become lithium-isotope 8—which doesn't exist. It is, instead, 2 helium atoms of atomic weight 4. Beryllium accepts a neutron, and explodes with an immense violence that has been known to yield neutrons of 15,000,000,000 volt energies—in place of neutrons that slipped in with energies of only 5 or 10 volts! (Radium particles have about one thousandth as much energy.)

Half the atomic table blows up in the presence of slow neutrons. Iron forms an unstable isotope, almost any atom of common materials. Hydrogen and carbon do not; they are perfectly stable. This is used in slowing the neutrons

released in the deuterium process described above. The fast neutrons are shot into blocks of paraffin, where, by collision with hydrogen and carbon atoms, their 50 to 100 kilovolt energies are reduced to no more than a gentle drift. (Actually, about equal only to normal heat motion.)

Sadly, nothing is impervious to neutrons. Uncharged, they slip easily through any matter, unless caught in an atomic explosion, or in that unique atom, cadmium. Most atoms that absorb neutrons discharge them again with catastrophic results. Cadmium absorbs them—finis. That's all. It soaks up neutrons as water is absorbed in a sponge, except that they can't be squeezed out again.

There is the answer. Atomic power at call, if you can supply 2 things: a tank that will hold neutrons; a tube that will carry the first of the "noble gases," and a slightly more efficient method of securing the free neutrons would help. Supplies? Innumerable millions of tons of heavy hydrogen in sea water.

Atomic power, impossible dream in the days of charged particle bombardment, does not seem distant with neutron explosions.—John W. Campbell, Jr., 418 Central Ave., Orange, New Jersey.

Gravity vs. Inertia.

Dear Editor:

Richard Wilson asks two questions which I will attempt to answer.

In the first one he asks about the effects of acceleration upon a person in an elevator, saying something about gravity having a greater hold upon the person. The effect of acceleration has nothing to do with gravity at all. It is all caused by inertia, which forces a body to tend to remain in the same place unless some force acts upon it. Now, when the elevator moves upward, a person tends to remain where he was before, and therefore presses with greater force upon the floor of the elevator. However, as soon as the elevator is moving at a constant speed, this effect stops, because his inertia keeps him moving with the elevator. Force is exerted only when the speed is increasing. When the elevator stops, the person tends to keep moving upward, and he presses upon the floor with less force until his momentum is extended.

Now for the calculations. The effect of gravity is to make a falling body accelerate with an acceleration of 32 feet per second per second. This, upon a mass of 1 pound, is equal to a force of 1 pound. In other words, a force which will give a pound mass an acceleration of 32 feet per second per second is a force of one pound. If an elevator moves upward with an acceleration of 3.2 feet per second per second, it exerts an additional force of 0.1 pound upon every pound mass in the elevator, so a 200-pound person appears to weigh 220 pounds.

To get the effect of a downward-accelerating elevator reverse reasoning is required. A freely falling body has no weight. As soon as a force is put upon it to arrest its fall slightly, its weight increases in proportion with the force put upon it, until at the moment when the force is equal to the mass of the body, causing the body to be at rest, the body has a weight equal to its mass.

In a downward-accelerating elevator the body is not freely falling and it is not at rest, but in a condition between the 2. If the elevator is accelerating at a rate of 3.2 feet per second per second, 1/10th of the force upon the body has been removed, resulting in the body appearing to weigh 1/10th of its original weight. This, however, is only as long as the acceleration is applied. As long as there is no acceleration, the weight of the body is the same as the original.

In the second question the questioner seems to have the idea that time is irrevocably bound up with the rotation of the earth. That is as far from the truth as anything can be. A year is merely a convenient way to measure time and has nothing to do with the actual time rate itself. If the year comes to be 1/10th what it is now, then people will live 10 years and only

grow old as they formerly did in 1 year. There is no way to measure time apart from any material object. 2 methods which come as close to it as possible are the speed of light and the disintegration of radioactive substances. But one depends upon units of length, and the other upon units of mass. The speed of light might be the closest method at that, because it is definitely constant and is not affected by motion. But that applies only to relative time rates, and not to absolute. I doubt if the latter can be found at all.

But I have strayed from the point. Aside from the above, there are practical objections to the problem. A planet cannot possibly move about the sun in the time of a minute, because the centrifugal force of the velocity would cause the planet to move farther away from the sun. Even if the planet were to approach close to the surface of the sun, it would take an appreciable time to go around. Just consider that in order to go around the sun in one second, a velocity of about 2,500,000 miles per second is required. Far above the speed of light! So the latter part of the question is absurd, unless you want to consider the effect of high velocities upon time rates, about which I do not know much.

Just figured out that according to Kepler's third law, a planet at the surface of the sun would take about 5 hours to go around, at a speed of about 700 miles per second.

On October 31st, there will be held in Philadelphia the Third Eastern Science-Fiction Convention. All science-fiction fans are invited. We will try to make this convention as much better than the second convention as the second was better than the first.

All interested in attending will please write to me at the address below.—Milton A. Rothman, Philadelphia Convention Committee, 2113 N. Franklin Street, Philadelphia, Pa.

A Fourth State of Matter.

Dear Mr. Tremaine:

In the September *Astounding*, Mr. Robert Barclay states that I err in my article *Stress-Fluid* in stating that the earth's interior is in a condition of semifluidity. Mr. Barclay suggests that such a constitution would lead to breakup under the action of gravitational cross pulls, and that there would be no visible tides at the surface, since the solid body of the earth would yield to tidal forces and so mask the tidal effects not visible in the liquid waters of the surface.

In the article, *Stress-Fluid*, it was pointed out that granite could be made to flow under conditions of extreme pressure, but only *very slowly*. As a matter of fact, although for the purposes of the article I deduced the condition of the deep interior almost entirely from laboratory data and earthquake phenomena, the conclusions may be independently checked by astronomical data. I did not include this material in my article, as it had already been covered, in some degree, by John W. Campbell, Jr., in his article *The Double World*, wherein the interior constitution of the earth was deduced from astronomical data. Planets appear to be highly elastic bodies, forces of a magnitude that produce minor distortions, and display a very great rigidity to such action. So does the piece of granite in the compression block mentioned in the article.

But if long-time stresses are applied, both planets and compressed granite flow *slowly* into new forms. I called stress-fluid a fourth state of matter, neither liquid nor solid, yet partaking of the properties of both. It does in this respect: it acts as liquid to long-term stresses, flowing out of the way; yet to short-term stresses it displays both rigidity and elasticity.

The earth acts as a rigid, elastic solid to such things as gravitational cross pulls. Remember that, although stress-fluid, the matter so forced out of natural form retains its normal solid strength, which normal fluid does not. Stress-fluid is a *very* peculiar state—a fourth state not any more related to liquid state than

to solid, and not to be interpreted entirely on the basis of liquid behavior. For instance, the granite rock in the compression cylinder mentioned in the article might have a steel ball imbedded in it. Although flowing under the great pressure, as though a liquid in that respect, that steel ball in its center would be as rigidly immobile as though the rock were still normal. It would not sink through it. In that, stress-fluid state differs from the liquid state. Had the granite been fused and cast into the new shape, the true liquid state would have been attained, and the steel ball would have sunk through it.

"When great pressure is brought to bear on a liquid, it returns to solid form," Mr. Barclay points out. I would first modify that to "some liquids," and then add that we are not dealing with a liquid, or the molten state, but purely with the cold solid in stress-fluid condition.

That the isostatic balance of the earth is more incredible than some of the science-fiction material in the magazine does not detract from its truth. That we do not begin to know all the truth might be taken as philosophic indication of the extremely limited powers of man's imagination, but surely not as indication that facts are impossible. I would, for instance, hesitate to propose in fiction an animal with functions quite as preposterous as the normal biological reactions of the octopus, which succeeds in digesting its food before swallowing it, and has developed a completely incredible reproductive system.—Arthur McCann, 761 Scotland Rd., Orange, N. J.

Frequency of Light Waves.

Dear Editor:

In *Space Blister*, by John D. Clark, Ph.D., the author states, in relation to his story, "and the autumn leaves, which should be red and yellow, were blue and violet," and also, "light travels slower inside of the blister than outside, and the frequency of light waves is, of course, the same since that depends on the source of the light and not on the transmitting medium. So, as a result, the wave length is shorter. Light that would be bright-red outside is green or blue inside, and anything that would be green or blue

or violet normally, shows up just as plain ultraviolet."

I do not offer the following as necessarily being the absolute truth. However, it is a thought which should be given to this phenomenon. The facts given by the author are taken as true. However, any light that we see must pass through the vitreous humor of the eye before it strikes the retina. This being the case, regardless of the speed of light before entering the eye, the speed must remain uniform, depending upon this medium (vitreous humor). There should, therefore, not be any displacement of the wave length of the light toward the violet.

Light traveling through water has a slower speed than through air, and yet a person viewing light through this medium, when submerged, does not experience any change of wave length. If this analogy be a true one, there should neither be a change in wave length, as described by the author, for light traveling slower inside the blister.

Also the dual nature of light—waves or particles—should be considered. With each color of light there is associated energy equal to "hv," where "h" is Plank's constant and "v" is the frequency of light. Therefore, since the speed of light does not affect this energy, it should not affect the wave lengths either, because if the wave length is increased, there is less energy associated with it.—Gordon M. Dunning, 37½ E. Court Street, Cortland, New York.

Attention, Amateur Experimenter.

Dear Mr. Tremaine:

I am a constant reader of *Astounding Stories* and among other things, enjoy the Science Discussions department very much.

I realize that many of your readers pursue scientific hobbies, but, due to many factors, cannot contact others in that field.

I propose to set up a nonprofit organization to act as a clearing house of scientific information for the amateur experimenter.

So, come on all you chemists, biologists or what have you, write me for further details.—George Jordon, Jr., 151 E. 8th Avenue, Roselle, N. J.

BRASS TACKS

Do you want this department restored? If so—write now!

Unfair?

Dear Mr. Tremaine:

I read everything in every issue—good or bad. I like stories to be stories, and not crushed by the weight of science in them. Thus, it was with regret that I saw many so-called stories, which were little more than theoretic ramblings, creeping into *Astounding*. Lately, however, there has been a vast improvement in the stories, for which an ardent thanks. Following up the *Smith* serial with one by Taine or Campbell would be excellent. Of course, if you could talk McClary into writing another like *Rebirth* we wouldn't mind.

Speaking bluntly, I think the change from Brass Tacks to Science Discussions was unfair. Unfair because it was done without consulting the readers before the change was made. And since the change we have no way of getting our protests into print. I suggest that a vote be taken to see which department the readers prefer—for, after all, it is supposed to be their corner.

As to the value of Science Discussions—where is it? When an article is accepted by you and

paid for with good American money, and then proves to be a hodge-podge of inaccurate facts such as *The Talking Hill* turned out to be, what can be expected from an ordinary reader in the way of accurate information?

In your editorial you cite Science Discussions as being valuable because it enables us to see both viewpoints. How about our viewpoint in the elimination of Brass Tacks? In fact, from an editorial viewpoint, probably the best thing about its discontinuance is that letters like this can now be quietly consigned to the wastebasket, while the magazine is free to do as it pleases.—Richard H. Jamison, Rural Route No. 1, Valley Park, Missouri.

Stories Most Important.

Dear Mr. Tremaine:

In the heat and furor of scientific discussion, the readers are forgetting all about the stories, which, after all, are the most important part of the magazine. So, if you don't mind, I'm going to go Brass Tack for a minute.

1. *Galactic Patrol* promises to be, as you

have said, the best of the efforts of E. E. Smith, if that's possible. I only read parts of the *Sky-lark of Valeron*, unfortunately, and it seemed to be the ultimate in science-fiction.

2. Please publish a sequel to *Frontier of the Unknown*, for I think it left every one in a state of suspense. *Crystallized Thought* also calls for a sequel.

3. The one and only kick I have is this: no more hackneyed stories like *Gravity*, *Unaffected*. Otherwise, I think you have the greatest publication of any kind in America.

4. Let's hear more of Ron Goncen (*Released Entropy*), Sam Kleon and Beltan (*Past, Present and Future*), Deverel and Colbie (*Jupiter Trap*), and Glyn Weston (*Seeker of Tomorrow*).—Henry Boernstein, 1071 Mount Royal Boulevard, Montreal, Canada.

Can't Stop!

Dear Editor:

Now for the August issue. You can expect a commentary every month. Now I've started, I can't stop!

Released Entropy, by Williamson: Jack turns out extra-good stories, and this one promises to be typical. Glad to see Wesso getting more work.

Frontier of the Unknown, by Knight: The story did not hold my interest, so that makes it poor, because I read for entertainment. Doid gets better, but his men look underfed.

Crystallized Thought, by Schachner. Dear Nat, have you been reading "Hawk Carse"? There was in that highly interesting series a story called "The Affair of the Brains." Your story was too much like it for me. Astounding is searching for new ideas. I take back my former statement. Doid is getting worse.

Jupiter Trap, by Rocklyne: Not so bad. Doid is getting worse, and will soon be down to the level of Morey!

Specialization, by Winterbotham: Your short stories aren't as good as formerly, and the illustration did not make me jump for joy.

Temporary Warp, by Long: Too many "warp" stories; too many poor illustrations. If Schnee-man did one illustration per year, it would be one too many for me.

The Time Bender, by Saari: Oliver E. is an up-and-coming author. Illustration not so hot.

Space Blister, by Clark: Hardly worthy of the brain of a Ph.D. The illustration was an example of what not to put in Astounding.

Smelpos of Space, by Campbell: This series is extra good. The illustrations are extra lousy.

What Are Positrons? by Swisher: I still don't know what they are, but I do know they took up too much story space in the book. One article per month is enough.

Editor's Page: One of the most interesting features of the magazine.

Science Discussions: There is too much shouting about nothing, and the whole thing has the atmosphere of arguing for the sake of arguing. Also, every one wants to suggest a new subject and no one wants to debate on the other fellow's suggestion. Brass Tacks please!

The cover was excellent. I am glad to see that Wesso has done the cover and illustrations for *The Galactic Patrol* and am also glad to see you recognize real talent.

Trimmed edges are back. Thanks. I almost feared you could not stand the (financial) strain, and the July issue will stand out like a sore thumb, in my collection.

I am glad to see you putting 1937 beside the month on the back of the magazine.—Ronald Armitage, 30 Nicholson Road, Sheffield 8, England.

Plato.

Dear Mr. Tremaine:

Cheers, growing louder as increasing distance intercepts them, for L. Sprague de Camp's characterization of Plato: "Professional wind-bags, like Plato."

More and more on the topic of Atlan, please.—C. B. Loomis, Manhattan Beach, California.

Statement of the Ownership, Management, etc., required by the Acts of Congress of August 24, 1912, and March 3, 1933, of Astounding Stories, published monthly, at New York, N. Y., for October 1, 1937.

State of New York, County of New York (ss.)

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared H. W. Ralston, who, having been duly sworn according to law, deposes and says that he is Vice President of Street & Smith Publications, Inc., publishers of Astounding Stories, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: *Publishers*, Street & Smith Publications, Inc., 79-89 Seventh Avenue, New York, N. Y.; *editor*, F. Orin Tremaine, 79 Seventh Avenue, New York, N. Y.; *managing editors*, Street & Smith Publications, Inc., 79-89 Seventh Avenue, New York, N. Y.; *business managers*, Street & Smith Publications, Inc., 79-89 Seventh Avenue, New York, N. Y.

2. That the owners are: Street & Smith Publications, Inc., 79-89 Seventh Avenue, New York, N. Y., a corporation owned through stock

holdings by the Estate of Ormond G. Smith, 89 Seventh Avenue, New York, N. Y.; the Estate of George C. Smith, 89 Seventh Avenue, New York, N. Y.; Ormond V. Gould, 89 Seventh Avenue, New York, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are: None.

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H. W. RALSTON, Vice President,
Of Street & Smith Publications, Inc., publishers.

Sworn to and subscribed before me this 30th day of September, 1937. De Witt C. Van Valkenburg, Notary Public No. 16, New York County. (My commission expires March 30, 1938.)



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