

The Voice of the Void

By John W. Campbell, Jr.

Author of "The Metal Horde," "Piracy Preferred," etc.

THE science of astronomy concerns itself with the great and the small. The distances in the stellar world are inconceivable by man—so much so that the astronomer's unit of measurement is the light year. And within the suns of space, the ultimate smallest units of matter figure—the molecule is broken up and the smaller atom is formed, only to be disintegrated into electrons and protons. Energy and mass enter into the strange cycle. Our young author, who has already become a favorite with readers of scientific fiction, has woven a captivating romance out of the world of ultra-physics—captivating in its adventurousness as well as in its science.

Illustrated by WESSO

PERHAPS you or I would have hesitated to call him human, this strange small man. He seemed lost in the great dim-lighted observatory. On all sides of the room panels of some polished black material glistened in the ruddy light, and on all their great surfaces were instruments and faintly glowing screens. High above the smooth floor a great transparent roof was slung in a half-glimpsed arch, glasslike it was, but the lack of beams told of a strength and toughness no glass ever knew. Through it came every vibration that struck it, infra-light or ultra-light. Now in its center there glowed a great mass of lambent red flame, the dying sun. To Hal Jus, astronomer, the room was flooded with the light of the noon-day sun. The dull red glow that gave even his pale face a ruddy glow was to him pure white. But then Hal Jus could see heat, and to him blue light was a scientific term for a thing beyond human vision.

Ten billion years had wrought strange changes in the human race. For ten thousand thousand millenniums they had lived on the planets of the solar system, but now the mighty sun was dying. There had been no decadence in this race, through all their history had come a constant fight with a persistent enemy, Nature. But it was a kindly enemy, for the contest had constantly developed man to meet the new emergencies.

Ten thousand years ago the sun had grown too cool to supply heat enough for man; it was no longer possible to live on the frozen planets, and the two greatest of them had been hurled across the system to feed the

dying fires. Jupiter and Saturn had been sacrificed. Neptune and Uranus had long since escaped from the weakened clutches of the vanishing sun, and now of the family of original wheeling planets, only four were left: Mars, Earth, Venus and Mercury. And now again the fires of the system were dying too low. One and a half million tons of matter must be destroyed every second in that titanic furnace to supply a comfortable amount of heat. In our day three million tons of matter vanish every second, to be poured out as a mighty flood of heat and light that sweeps across the depths of space to us. The inner planets had been drawn far closer to the parent body, but even these heroic measures were failing.

Hal Jus worked at the controls of the electroscope for a moment and on one of the lambently glowing screens an image began to form, grayish at first, then quickly taking form and color. A great sphere swam on the screen; slowly as Hal Jus increased the power the body seemed to come nearer—it grew larger; it filled the screen, then rapidly there came a picture of low, age-old hills, worn low till they scarcely lifted their heads above the surrounding country. A mighty city of glistening metal buildings rising tier on tier a few miles north seemed to dwarf the hills into utter insignificance. Once a hill had lifted its proud head far into the blue of a two-hundred mile thick belt of atmosphere, but now the once mighty Mt. Everest alone remained as a relic of the high-flung mountains that old Earth had once known.

High in the jet black sky, a scant hundred miles from the ground below, a mighty space-freighter was taking off for Venus. The thin belt of atmosphere permitted it to reach a high speed quickly. Already it was in full stride and heading at 1,000 miles a second for Venus.

The scene on the screen blurred, grew gray, and faded out. Hal Jus was shifting the great electrocope tube. Again the screen glowed, and again an image appeared. It cleared quickly, then suddenly leaped into full life and color. The scene showed mighty machines working in a great pit of freshly tumbled soil. It was a land of intense shadow and where the dim red light of the distant sun did not touch, there was intense, utter blackness. There was no atmosphere here. And now, as a great freighter swung low, a machine on the ground below turned on a ray that stabbed out sharp and brilliant; a moment later the freighter tug lifted a half-million-ton piece of the planet on its attractor beams and rapidly gained headway as it shot off toward distant Venus.

The view became wider, the figure of the machines smaller. Then, as Hal Jus increased the observation distance, the entire planet came into view, as much of the planet Mars as was left. The great excavations were extended over all the surface. They were paring it down from all sides lest they disturb the balance of the planet.

Again the scene went blank. Now there formed on it a view of the starry heavens with glowing pinpoint stars. Suddenly this began to expand; star after star was forced from the field as the growing picture centered on one that burned bright in the center of the field. Mighty Betelgeuse glowed in the center of the field. It was a blurred image, like a tiny disc, but tremendous as was the power of the instrument, it could not have enlarged the image to that extent. The disc-like appearance was due to the tremendous brightness of the star spreading a bit on the sensitive vision receiver cell.

Slowly the mighty instrument swept over the field. Here and there a star would leap out of the darkness to form a burning disc, as one of the stars distant less than a dozen light years, swept across the field. Then at last came a star that blazed out as a burning disc an inch and a half across, emitting long tongues of shooting flame. Slowly it crept across the field. The instrument was adjusted for the motion of the Earth and this slow creeping was due to the motion of the star through space. Around it, far off across the field, circled a lone, small planet. Hal Jus watched it a while, then turned with a call of greeting, snapping off the current in the mighty instrument as several men walked in. They were seated now in several rows of chairs before the largest of the screens that were suspended on the walls of the room.

For ages men had known that the sun was dying. In our day men can tell that within the next ten or eleven billion years it will become a closed star—not a cold star but a closed star. The energy of the sun comes from the destruction of the matter of which it is composed, which becomes floods of energy. This change is possible at a temperature of 40,000,000 degrees C., but below that it cannot take place. Thus, at the center of the sun, where this change is taking place, the matter is at that terrific temperature. As the sun grows older, more and more of the matter sinks into the center and reaches the region of awful heat. The atoms are so violently colliding with each other at that temperature, that the atoms themselves are knocked to pieces by the violence of their collision. If the molecules of a substance collide sufficiently violently, they are broken up. Thus, at 5000 degrees, the molecules of water collide so violently that they cannot maintain

themselves, and the shocks break them down into hydrogen and oxygen atoms. But at 40,000,000 degrees the atoms collide so violently they are decomposed into protons and electrons. At this temperature, a further, subtle change takes place, and the electrons and the protons suddenly are gone, and in their place is an equal mass of energy. For energy in any form has mass, and mass in any form is a measure of the energy content. Thus to say "one gram" is an easier way of saying "nine hundred million million million ergs," but the two mean the same to Nature. Now an atom is something like a porcupine with his quills up; it is much bigger in looks than in fact, only an atom has much longer "quills." An atom has much more empty space than anything else. Suppose our porcupines have quills a mile long. If all those quills are on end we won't be able to pack the animals very closely, but if we can induce them to become more friendly and lay the quills down, then the density of our imaginary population of porcupines will be greatly increased. Similarly the atoms, with the electrons revolving in wide orbits, occupy a much greater space than they really need. In the tremendous heat of the Sun, the atoms are so battered, the electrons are knocked off the nuclear protons, and we can imagine the quills now lying down. The density will be far greater. This is demonstrated by the density of some stars which are now known to have a density of over 1000. This is the result of packing the electrons and protons in the center, which is gradually going on in all stars.

Gravity increases four times if the distance is halved. As the matter inside becomes denser and denser, the star contracts, till finally its density reaches a tremendous figure.

The Sun in Hal Jus's day was becoming a closed star. Long since the X-rays had ceased. Gradually the ultraviolet and the blue light had diminished; the red and infra reds had been accentuated; for the light was changed by the passage through that intense gravitational field. Hal Jus had, less than two thousand years ago, predicted the exact time of the Sun's final decay. After ten more years the Sun would be unable to support its family. The planets they now inhabited—Earth, Venus and Mercury—were supported artificially. The atmospheres of all the planets had long since slowly dissipated into space, and with them had gone the water. These vital things were being replaced constantly by transmutation of the elements of the rocks of the planets. Long ages ago Earth had had a large satellite, which had been used through the ages to supply energy for the factories of man, and to supply the necessary atmosphere. The satellites of Mars had gone as had Saturn with its rings, Jupiter with its satellites, along with the asteroids; but before it escaped, much of Neptune had been freighted to the habitable planets. And now, since Mars had grown too cold, it too, was being sacrificed. Already it was honeycombed with great caverns that had been used as sources of materials and energy. Now it was being split up into small parts, and freighted to the other planets. Already the work was well under way. Mars was furthest from the sun, and smaller than either Venus or Earth.

But when men were assured that there was no hope of life in the solar system for more than half a lifetime, they began an even more frantic search for still another way to overcome this last crushing blow of Nature.

But at last a thing was announced that switched the endeavor of the scientists to a new line. The impossible was done. Einstein had said that it was impossible to signal faster than light. But it had at last been done. A scientist had signaled the seventy-five million miles from Earth to Venus in so short a time that the care-

fully prepared cathode ray oscillograph could not detect it. The signal was sent by radio and by the new method exactly simultaneously, and when they reached the station on Venus, the difference in time was just long enough for the radio to make the trip. It was a modification of something that we know in our day, a modification possible only to these descendants of ten billion years of science. Phase velocity we know. When X-Rays pass through certain materials, the index of refraction is less than one, and this can only be true if the velocity in those materials is greater than the velocity of light. The true velocity of the rays is not, but there is a second velocity, the phase velocity, that under those circumstances is greater than the velocity of light.

Phase velocity is due to a wave traveling along the wave chain. A man can go faster than the train he is riding on by walking toward the engine, but practically speaking he cannot reach the station before the train. Similarly, the phase velocity cannot reach the station before the light or X-Rays do. But for countless ages the light has poured forth from the sun, and a message sent down that long train would be able to go many, many trillions of miles at a speed far greater than that of light. That was the new hope of life. For man must escape from the dying sun or perish with it. And now the experiments were pushed forward with new hope.

Then a brilliant young physicist, scarcely through the seventy-year course in one of the great technical institutes, devised a new machine that brought the idea considerably closer to complete success. Television had been invented many years ago and constantly improved. Long since had they gotten away from the scanning apparatus, and the principle was well nigh forgotten, but in some dusty, neglected volume Morus Tol discovered the diagrams. And, with a simple arrangement of known machines, he made a wonderful mechanism that had been worked on for many, many ages. He made a scanning machine that worked in the fourth dimension, thereby being enabled to scan all the other three simultaneously. His first experiments led to amazing images, which, thrown on a fourth dimensional screen, could be seen to pick up solid bodies. The work of lifting them was done by the motor-driving the fourth dimensional projector. The drag of the body's weight tended to throw the image out of adjustment, but by making a very powerful motor, they could show the image of a man lifting thousands of pounds! The images were absolutely solid. The man did no work.

And then came new developments. The experiments were safer now. Wherever danger was incurred, the scientist merely made his image do the actual experiment! But Morus Tol still led the field. It was he who finally developed the apparatus that could project the images and have them come into three dimensions, being without the aid of a projector at the receiving end. Already the machines had been used in connection with the phase-velocity signaling system.

It was while he was working on the development of his apparatus that the fatal accident occurred and killed him. Luckily he had kept a careful record of all his experiments, and men were able to duplicate them with the aid of the remnants of his apparatus. He had been working on the actual making of the images; he wanted to be able to keep them real without the machine; in other words, he wanted to give them actual existence; he wanted to reconstruct, atom for atom, the object under his fourth dimensional scanner.

He had been trying to find some ray that would respond to the individual characteristics of the atoms under consideration. He had found it, but finding it he had met his death. The ray had attacked him somehow.

It does not seem likely that he experimented on himself without trying it on some inanimate body first. But perhaps he did. At any rate, it did what he hoped, it scanned him, and recognized each individual atom, and each separate molecule, and as far as it went, it was successful. But in scanning him the ray released all the energy in the atoms of his body. He was killed instantly and most of his apparatus was utterly ruined. However, enough was saved to make a beginning possible for the others. And on this basis they built.

As the ray scanned and recognized an atom it drew out its energy, to leave it free. This had fused the apparatus, stopped the ray, and killed the scientist. Knowing the danger, others experimented. By draining the energy away safely they scanned a small object, and sent the signals to another station where, by feeding the necessary energy into the machine, they were able to reconstruct it. The first step had been taken.

But it required many years to develop this apparatus. Now came the greatest problem of all. They must find some means to send the material image to a predestined terminal without having a station there to receive it. This could be done with a three dimensional shadow image. Could they do it with the solid bodies?

The ten thousand years had dwindled steadily—five thousand had passed before the development of the fourth dimensional scanning. Morus Tol was still a young man when he was killed, but with four thousand two hundred years yet to go, they met their hardest problem, and they were without a genius to solve it.

The long years had dwindled to less than two centuries before there came a man who solved the problem of a refinement of the vibration control. It is impossible for me to describe the machines of that day as it would be for a blind man to describe red to another. It is a thing inconceivable to each. But it was done—only to find that the shock of the journey killed all living creatures. And then, ten short years before the sun at last faded forever, the last bridge was crossed. A man in a space ship was projected from a laboratory on Earth to a point near Venus. All the System watched that demonstration through the news machines.

Long since they had decided where they would go. Now that they could travel with almost infinite speed, they chose a goal that would be safe to life for aeons to come. BETELGUESE! It was their goal now.

And now out in space the great sending station was constructed. The ship to be sent was put in position before it; the scanner viewed it; and the signal for each atom and each molecule followed each other in swift flight on the train of light waves that was their wire. One billion miles from Betelguese the ship would be reintegrated from the energy sent along the beam of the phase-velocity sender.

And now, in the observatory of Hal Jus, the greatest men of the system had gathered to watch those men far out in space. With them had been sent another machine to be operated by one man, a miniature phase-velocity sender that could, if necessary, send the ship back. This was to be stationed in space, going in an orbit about the mighty star.

Now, above the soft whirr of the news-casters focussed on the great screen, there came an audible sigh of excitement, as there flickered on the great screen a dim gray image, blurred and indistinct. Well it might be. Sent on the phase-velocity projector across the universe, it was bringing them the scene within the recreated ship—suddenly the great screen was filled with a brightly lighted scene, and through the sound pick-up came a subdued hum of the mighty engines in the power room. Through the windows of the ship they could see a brilliant shaft of bluish light pouring over the floor. Out through the main pilot's window they saw the

blazing field of stars—and there they saw one dim red one, barely discernible. Probably if they had been there they could not have seen it. Only the super-sensitiveness of the machine made it visible—their sun as it looked millenniums ago! For the light had been traveling slowly for thousands of years to reach the distance their machine had reached in less than an hour.

The men had been anesthetized before the process began, and now they lay in deep sleep. The automatic controls were running the ship, taking complete charge of it.

Strange those men would seem to us. They were under four feet in height, with great barrel chests, long arms and short legs. The dying planets had scant atmosphere, and economy advised a low pressure of the precious gases, lest too much diffusion take place; and Mercury, the smallest planet, put a distinct limit to the pressure. They journeyed from one planet to the other so frequently that an equal pressure on each was almost a requisite. The long arms ended in slender, delicate fingers that were the most perfect tools ever developed. And the toes, too, had become highly prehensile. The many machines that man had built had required all his directing powers. The feet had at first been used only to push pedals, but gradually there came other purposes. Those members could be so useful!

The head was not much larger than ours, but the high, straight forehead seemed much larger on the small man. The brain was deeply creased, the convolutions so complex that, without increasing the size greatly, the surface had been multiplied many times. And it is the surface area that counts. Their large eyes seemed to hold a gentle benignity that would so transcend us as to leave us contented to watch only; still, there was in them a fire of ambition, of hope and of adventure. But we can no more hope to understand their personality than a child of a few days can understand us.

But now the men in the car out in space were stirring; consciousness was returning. The Commander approached the view plate now.

"Sir, I wish to report a successful trip. Betelgeuse is within one billion miles. One man has died, but the ship's doctor will have him around shortly, as his body temperature is still above 95. We will head for the nearest planet, connecting you now with the outside view plate."

The screen went dark a moment later; the gray surface showed thousands of gleaming points, distant stars, and here and there were a few tiny discs. These, then, must be planets of this mighty sun. Rapidly one of them was growing, expanding. Soon it was an inch across; then it grew rapidly till the shining disc covered all the glowing screen. They had been approaching at 2000 miles a second, but they slowed down to the more moderate pace of 100 miles per second.

Now they saw a strangely glowing light coming up from the planet below. It seemed to approach quickly—then the screen went blank, to be lighted a moment later by the scene within the ship. There was a rapid but efficient scene of action. The commander stepped up to the view plate. Just as he began to speak, the screen went gray, the image blurred, then cleared for a moment; there was an expression of sudden astonishment and surprise on the face of the young commander—then again the screen was dark.

Three hours they waited, but there was no sign from the far-off ship. Silently the men filed out. But day and night that screen was watched. It was late in the evening of the second day that they were at last rewarded for their vigilance. The screen was suddenly shot over with a streak of brilliant red; it glowed green, then went dully gray. A few minutes later it was

again illumined, but now the gray field resolved itself into distorted images; men seemed working frantically over the instrument, then the queer chirping sounds of the voices suddenly underwent a change. The screen cleared; then sharp and distinct came the words across the void and the picture of that far-off scene. They were looking from the top of a great rugged cliff of sharp rock such as no living man had ever seen, and the scene beyond was even more strange to their eyes! Great wooded hills rolled off into the distance, and over the carpet of bright green was flung a marvelous canopy of blue, in which there was set a wondrous jewel that flamed blue in majestic splendor. As large as the sun from Mercury it was, but so bright one could not look at it. And in the far distance there rolled a mighty ocean of sparkling water. Such a scene no living eye had ever seen, save in the ancient records, where there were shown the great space flyers hanging over mighty stretches of such water. But in the center of the field was that which riveted the attention of all. There they could see the twisted wreck of the mighty flyer. The great beams were bent and torn apart, the instruments and machinery were wrecked, and to one side there was a great pit that the machinery had blasted in the soil before it was shut off.

The projector now showed the members of the crew of the ship working busily at the makeshift apparatus. They were using hand disintegrators for power supplies. The apparatus was that which they could salvage from the wreck, and faulty. Frequently as they watched they would see the connections arc across, the scene would fade, then come back as quick work repaired the connection. The disintegrator power units were much overloaded and heated so badly that they had to run them in relays. They could not attach more; there was insufficient cable.

"Sir, we were attacked by hundreds of strange beings. They seemed pools of force, living, sentient beings, but the electronic-activity indicators indicated a frequency that denotes atomic forces. I believe they are beings living on atomic energy. They have no material body. Heat rays do not affect them in the least. They shed disintegration rays as a repulsor screen does meteorites. They are unaffected by our most powerful explosives. They have tremendous power. One of them took our space ship and threw it violently away with so terrific an acceleration that the neutralizer was damaged overcoming it. We tried to flee from them, but they seem to be able to go with a speed approaching that of light, and easily overtook us. Finally they forced us near this, the sixth of the ten planets, and threw us down. The machine was wrecked, but the neutralizer, crippled as it was, saved us. The matter disintegrator was broken open, and the power ray tore up the ground a bit. The atomic creatures are hunting us, I believe—they are—there they come—they can blanket our power somehow—"

The screen went gray-black. Never again did they hear from that expedition. But that voice across the void had served as a warning to those that followed.

IT was scarcely a month later that a second expedition of ten ships was projected, one after the other, across the infinite void. These ships were fully armed, but they had come to investigate, not to fight. The enemy seemed to have some strange weapon that they could control from a distance; it was a weapon not conceivable to these people, merely one unknown. That the Things were in truth living beings was incredible; it was the terrible shock of the sudden attack that must have made the men engender any such strange belief. But the expedition now on its way would solve the problem, no doubt. Again came that silent meeting

Hal Jus's great domed laboratory. The greatest men of the System had assembled; they were being called in in consultation to examine the weapon of the enemy. Hales Tonn, the System's greatest Moleculist, as they called chemists, was there. Tai Nos, the genius of Physics, and Tornok Lor, the great Atomist, and the greatest specialists in every line were present at that conference.

And now before them the great screens glowed mistily. Then slowly they cleared to show in gray outline the interior of the far-off ships. Each ship was represented by a great screen. And now, as the ship gained solidity, the screens cleared, the images became sharp and strong, color filled them out with greater detail. Then slowly the men stirred. They moved with returning consciousness, and took over the control of the ships from the automatic controls. One by one they reported back to headquarters. There was only forty-seven seconds' delay in the time of transmission of signals now, so they maintained two-way communication.

The outside projectors were switched on and the fleet fell into a small cone formation. With the flagship in the lead, they set out to investigate the planets from a distance. The electroscope on the flagship should permit them to make fairly close surface examinations from a safe distance.

Ten planets they found circling the mighty star.

Three of the planets would be directly habitable for man. But on none did they find the great cities they had expected to see. They only saw strange globes of lambent fire darting about. From planet to planet they went, the red glow lighting a great sphere twenty feet in diameter, but for a hundred feet about it the air glowed purple under the ionizing force of some strange radiance. When they moved, they were shooting comets, with brilliantly glowing heads of red and long tails of blue. But they seemed to live on all the planets. Even in the blazing minor star they lived, darting in and coming out of its flames as unconcernedly as a Solarian ship would dart in or out of an atmosphere. Could it be that those men had spoken the truth? It seemed incredible—impossible—but these men had learned millions of years ago that nothing is impossible, and were ready to credit anything if they had reason to believe it so.

For two days those great ships wheeled above the planets, deep in space, undetected. Then one of the glowing Force beings passed close—a scant ten thousand miles away, and through the electroscope, and by means of the electronic activity meters, by spectroscopy and pyrometer, by all the complex instruments of their age, they studied him. And the result was conclusive. They were living, sentient beings—Force creatures, conscious pools of titanic energies, forces so great they lived by, that no material body could serve them, and their limbs were the forces that nature had given them. Those forces, which man had spent thousands of years in discovering, a kind nature had given these beings. But in return she seemed to have decided that they needed no brains, for they possess no intelligence. Had man waited another billion years, there might have been intelligence developed in these strange creatures. What an intelligence it would have been—an intelligence based on forces of atomic nature!

But they too had been discovered. In some strange way the creature had sensed them, and sent a call to his friends, for across all the system they could see the strange creatures racing at a velocity that could not be much short of that of light, for while the men were material, and as such could not travel at that speed, the force beings, by their very natures akin to light, could very probably attain to that motion.

THE battle was on. At first the force beings hung in a sphere, a three-dimensional cordon, about the ships, then suddenly their lambent red glowed more strongly, and the screens in the far-off laboratory went dark. They had in some way prevented the transmission of further messages. The men at once formed the ships in a great tube, with the one scanner ship in the center, and then one by one they dropped out and were sent across the void—back to the Sun.

Then one of the watching creatures darted forward, toward one of the great ships hanging there in space. As he came within range a disintegration ray flashed out, touched him, and was shed from him in great leaping sparks as the energy was met and opposed. A heat ray leaped forth—the creature paid no attention to that, did not even bother to oppose it—only circled closer. A stream of explosive bullets were launched at it, but they affected it no more than the heat ray. It seemed hopeless. And now the creature hung there, and suddenly he underwent a strange change. In the glowing center of his strange force-pool there suddenly appeared a strange nucleus of glowing violet light, a nucleus that spread throughout the twenty-foot sphere of lambent red force. But it was shot through by strange streamers of waving angry red. Then these strange streamers of fiery red seemed to condense to two main streamers that reached out and out—and touched the great ship. There was a blinding flash of red light—and in place of the great ship there floated a slow cloud of fine, fine dust that glowed softly in the light of the blazing sun. Then the strange streamers seemed to contract, to lessen, and with them the strange purple light from the creature. Slowly, gently he floated away. Of the fleet of ten great ships, and the accompanying matter-sender, six ships returned. The rest floated out there in the interplanetary space around Betelgeuse.

The men of the system had data to work on, but a great deal of work was yet to be done. They must find some way to destroy these pools of force. Only forces could affect them, and they must find one that was fatal to them. Only ten short years remained to them, so, although no weapon had been developed, a great battle fleet was started, that the ships might be ready when at last the weapon was developed.

And on all the worlds great works were to be done. The records of a civilization ten thousand thousand thousand years old must be collected and prepared for their journey across the void. The exhibits from museums, ages old, must be packed with tenderest care. They had strange exhibits there of the first beginnings of civilization, tools and weapons of savage man, strange things that killed or injured by throwing small bits of metallic matter at the enemy. Strange clumsy vehicles they had, made of metals that corroded so rapidly as to fall to pieces in a brief 1,000 years or so, unless they were preserved in an atmosphere of argon and driven by great clumsy engines tapping the slight energy of molecules with an efficiency of hardly 10 per cent. Other machines that had been intended to drag man through the air, not supported by forces, but held up by air! Then came the first ancient antigravitators; then the swifter machines propelled by the energy of matter.

Exhibits unutterably ancient they had, and these must be sent across all that void. Invaluable archives they were.

But with them must go their own great machines, mighty mechanisms for producing their foods, for making their ships; the thousand and one things that went to make up the great structure of their age-old civilization. And huge sending stations of inconceivable power had to be erected to transmit them. Titanic projectors capable of sending a machine weighing a quarter of a million tons in one scanning. Other machines were so

huge that they must be cut into sections and sent in pieces.

A GREATER work—a quieter, invisible work—was being done by tireless workers in the laboratories. Fifty-three hours a day they worked in the great government laboratories on Earth. On Venus the shorter day made shorter hours desirable. But steadily the scientists were working on their problem. At last the Minus Energy was developed. They were to try it out before equipping the entire fleet with it. At last ten ships were equipped and sent with a scanner machine to Betelgeuse.

Now they courted an encounter with the Force Giants. They were soon satisfied, for thousands of them came at terrific speed the moment they attacked one. That first one had floated into range as they threw a searchlight on it; then, as it began to color with the deadly violet and red destruction, a tiny projectile was launched at it. Not more than six inches long by two in diameter it raced at its target at nearly a thousand miles a second. It was carefully followed by the anxious watchers at the ship's electroscopes—it reached the floating Thing, and exploded.

But perhaps you or I would not have termed that action explosive. That little projectile contained several pounds of half-destroyed matter. It had been used as a fuel in an industrial plant, till it had been about half annihilated, and now it was in that curious, borderline condition, when it had a tremendous tendency to absorb energy and become matter again, and an equally tremendous tendency to release its energy and become free energy as light or heat. The conditions determined one or the other, and the new Minus Force shells were used under conditions of space that made them exert a tremendous tendency to become matter. Billions of billions of ergs of energy they could absorb, and would absorb. They drew it from all the surrounding ether so rapidly that it had the effect on all surrounding substance or sources of energy of being in contact with something at a temperature far below absolute zero. The result was obvious. When it was set off, all light, heat, or any other energy within a region of ten miles or so, was instantly drawn to it, until it had been satisfied. It was an energy vacuum shell.

That first Atomic Giant did not last long enough to warn the others. It was an entirely unexpected form of attack, and when the light of the mighty sun could once more be seen through the spot where the Minus Force had been sent, the Atomic Creature was not there, all its great forces had been drained from it. And, being only a pool of force, it vanished.

But now there came from all directions great streams of the Atomic Giants. They seemed to suddenly appear close at hand, apparently coming from nowhere. They traveled as fast as light, therefore they reached them as soon as the light, so that their approach was invisible. Only when they slowed down could they be seen. And now, from each ship came steady streams of these Minus Force shells. Thousands of the energy-absorbing projectiles flew in amongst the massed attackers—and many of them took effect, drawing the energy from the great creatures, destroying them utterly. The weapon was a success! They fired a second volley when others of the creatures came within sighting range—but they did not affect the Atomic Giants this time. Great dark patches appeared, but the creatures that had been there before, were there now, as powerful as ever, quite uninjured! What did it mean?

They did not know. They only knew that the enraged creatures were closing in on them, closer and closer—and now the ships were being sent back to the system

as rapidly as possible—~~one—two—three—four—but~~ more could not get through—the others were cornered, marooned in infinity by the destruction of the sender. The Force Creatures, utterly immune to the Minus Force shells attacked unchecked, gripped it with strange forces, limbs, hands or gripping force, that tore through the foot-thick alloy like so much tissue paper, metal, which was fifty times as strong as our frail steel, a metal whose molecules had been designed by the scientists of the race millions of years ago, and in all those ages no stronger, more inert metal had ever been found: But now that tough envelope was torn open, for the forces of atoms were greater than the forces of molecules, and the creatures used those forces.

But those marooned ships were lost—destroyed soon by the vengeful giants. And the forces of man on the far-off planets of a far-off sun were worried anew. Their weapon was a failure after all. Some new thing must be developed. But how did it happen that the first attempts were successful? The scientists believed it was due to the fact that the first attempts were utter surprises to the creatures—they were taken before they could prevent the loss of their energy. In some way they were able to build a barrier about themselves that prevented the loss of energy, even as it prevented the penetration of the energy of the disintegration ray.

But man must develop some new, some stronger weapon. The time was getting too short for more failures. For Hal Jus had announced a discovery that made men even more anxious to abandon their age-old home. The Sun was to become a nova. These flaming stars had been known and studied for ages. Dim, old stars they were that suddenly flared up for a brief period of intense activity, then quickly faded back even lower than before. It behooved man to move quickly. A mighty people that for ten billion years had slowly built up the mighty structure of their science had to move.

Many weapons were tried, many expeditions of two or three ships made the trip, and attempted to destroy the creatures. Some succeeded moderately well, others met with ghastly failure.

Two brief years now remained to them. Expeditions to many of the younger stars within range of their great projectors were made, but always they brought back bad news. Here they found no habitable planets; there the sun had not yet developed planets, and there was no time to stop to make and cool off a planet. That would require a century, even for one as small as Mercury. They must migrate to Betelgeuse. But Toralk, the mighty sun without planets, was kept in mind. If necessary, they could make the planet, and while it cooled, float in space, living in their mighty ships, making air and food and all their needs from matter torn from the sun. The great battle fleet of thirty thousand ships was ready. Each ship, two thousand one hundred feet long and three hundred feet beam, was ready to start. They merely awaited the hoped-for weapon.

At last it was discovered. Another of the test trips was made. Three small ships went, and one sender that they might return.

In the depths of space they were re-integrated, and now they slowly proceeded to the blazing star before them, then hovered near one of the circling planets. In a moment they were discovered, and literally thousands of the glowing creatures darted up from the green, brightly lighted world below. These creatures had learned that these ships were hostile and as they drew near, they were already changing to that fatal violet, streaked with red. Great flaming streamers of force reached out to the ships, but in that instant the ships suddenly seemed to shimmer, as an object



The entire wall area of the great room was covered with projectors, and before each one sat a man, but the mighty cylinder in the center was carefully railed off.

through heated air, and around them there was a strange, pale radiance, a radiance that seemed to have substance. It seemed to flow, to move, yet always remained as a strange, half-visible, milky shroud, that surrounded the ships. And then the streamers of glowing death reached out—touched it—and disappeared! The creature leaped back, as though in pain, writhing away. The usual color of the creature was suffused by a pale, but growing green—then as the red was more and more overcome by the rising green, the glowing shape grew misty—then like a puff of vapor before a breeze it was gone—the great Atomic Giant

had been mortally wounded and before their eyes, had died. Instantaneous dissolution had taken place.

The others held back in fear. There was something new to combat and they went cautiously. Now there leapt out from the nose of the ship a long beam of the milky, glowing ray—it touched one of the great creatures—there was a slight flash of light—and it was gone. Then the glowing ray swept around and erased those forms there in space, erased them as one might wipe the image from the screen with the flick of the switch. And then, precipitately they fled. They were beaten; they could not attack this new ship.

ACROSS the void it was sent, while the few men left in the ray machine awaited the coming of the mighty battle fleet that would soon be ready. Around them glowed a pale, scarcely visible field of light. Defenseless they seemed as they lived and slept in the car swinging in its orbit about the blazing sun, but many of the Atomic Giants found the mighty strength that lay hidden in that thin wall of scarcely visible vibration. And constantly the men were observing the planets and communicating the data to the leaders on Earth and Venus.

And in the System wild activity was going on. The entire force of the machines of all the planets was concentrated on the production of the great generators of this new force. It was simple in principle. The Atomic Giants lived by using as their "fuel" the energy of the atoms. We live by burning the carbon and hydrogen of our foods with the oxygen of the air. If the supply of either oxygen or food were cut off, the incombustibility results and we die. If oxygen is cut off, we die because the carbon compounds will no longer burn. If food is cut off, we die because there is nothing to consume the oxygen with.

The Atomic Giants needed no oxygen or carbon—any element would do. But they needed elements that they could decompose for their energy. Any atom under normal conditions would do, but if that atom was made incombustible they too died. This new force that was so deadly to them, was a force created by the energy of matter. The electrons of matter were altered by the application of terrific spatial strains, and they would no longer react in the same way and would not decompose as did the normal electron. They merely prevented the use of atomic energy wherever they were. Thus the "fuel" of the Atomic Giants was made incombustible and they died.

But there was a tremendous amount of work to be done before they could be ready for the great offensive to be carried across space. The great ships were rapidly being equipped with the electron projectors and assembled in long rows outside the great transmitting stations, awaiting the final start.

It was nearly two weeks before the great fleet was ready. Then they were all assembled, ready to start. The control ship went first. Since the cessation of the release of atomic energy did not affect the release of material energy, they did not have to worry for the safety of the men when projected out into space. They would regain consciousness soon enough, and the wonderful automatic devices that ran the complex mechanism would hold it in place, maintain its temperature and the distance of the one ship from the other. The protective shield of the strained electrons would protect them.

In the darkened observatory on Venus, many men were watching in silence. The room was absolutely silent; only the smooth, gentle hum of the smoothly operating news-casters marred the utter quiet. They had come to observe, not to comment, and they waited quietly.

There was a flash of light on the screen and the image became clear and sharp. They seemed to be in a huge room, the walls were lined with small electrovision boards, tier above tier of balconies ran around the sides of the great room, and in the center rose a mighty cylinder. The entire wall area of the great room was covered with the projectors, and before each one sat a man. But the mighty cylinder in the center was carefully walled off. Now, as they watched it, it suddenly glowed faintly bluish—the air about it was being ionized—there arose a faint, deep hum; then there appeared about it an intense corona of air, ionized under the titanic forces within it—tiny shooting sparks crackled blue over all its polished surface—

The view faded; another replaced it. Now they seemed to be in a smaller room, a room whose front wall was lined with a series of large view boards. Twenty of these boards there were, and on each was the image of a room whose metal walls glistened in the light of the dull red sun. They were looking into the operating room of the greatest of the ships—the flagship. This ship, unlike the others, was a cube, surmounted by a smaller cube control-top. The mighty cylinder inside generated a field that surrounded all the ship with the protecting force, but triply intense. The fighting machines were two thousand one hundred feet long, and three hundred beam. These carried powerful protective force generators, but also they carried fourteen sets of the projectors, three along each side, the top and the bottom, and one at each end. Inside, the terrific energy needed to operate these was being generated in smoothly humming machines. Titanic they loomed above the tiny men tending them. These same giant machines would, later, with a few simple adjustments, furnish the power for the receiver machines to receive the things from the Solar System. But now they were engines of war. Over each thousand of these great ships was a division leader. The twenty division leaders were represented by the twenty view boards in the flagship. The individual ships were each represented by one of the boards in the central control room, so that in any case they knew the fate of every ship, and aid could be sent them.

Now the scene on Hal Jus's screen became misty—the ship was being sent into space. It would be close to an hour before the scene reappeared. Now they shifted the adjustment to watch the sending of the armada of space.

With the many stations in operation, the work went along smoothly and within two hours all were there. The twenty thousand ships had automatically assumed the formation of a mighty cone; the three dimensional equivalent of the flying wedge of their remote ancestors.

Gradually now the men within were awakening. The scene in the control room shifted to the flagship's engine room, as clicking relays shifted the connection to another viewplate on the distant ship. The mighty engines loomed huge above the tiny cots of the sleeping engineers. Here too was the mighty cylinder, but now it was seen as the core of a gigantic coil, into which ran great cables from huge, soft-purring generators. Even the forces of material energy required straining to operate that great electron distorter.

Hal Jus pushed another button. Again the tiny relays out in space reconnected him. The commander was awake. The control room was soon a scene of the greatest activity. As soon as the necessary weapon had been discovered, the plans for the great action had been sketched. The formations were rapidly being worked out.

The great fleet was divided into ten parts of two thousand each, and to each of the nine smaller, cool planets one of the ten divisions went. The tenth stayed as a guard to the flagship. Now they went in ten great cones of glistening ships, a mighty armada of space, coming across the void to conquer the new universe for Mankind. And now they separated as they drew closer to the System, for the ships had been re-formed nearly four billion miles from the central sun, Betelgeuse.

THE expeditions swept along over and close to the surface of the planets they had been sent to investigate. Heat, cold, size, made no difference to the Atomic Creatures and all the small planets would be taken first. The smaller planets would be attacked first. The creatures would probably flee to the outer planet, but it was necessary to plan to attack them there.

Low over the sunlit surface of a great planet they were swinging; below them there rapidly unrolled a terrain of mighty forests of green trees, vast green meadows of gently rolling land, and all bathed in the blinding glory of a blazing white sun. What a scene for eyes that had been starved of light for countless years! What a land of hope and promise and pleasure it seemed to these small gentle men. For generations the only plants they had seen were the poor small things raised artificially in the museums. Here they saw magnificent trees that towered two hundred feet into the air, in wondrous profusion of leafy green.

Now they were swinging over mighty oceans, gigantic patches of water that were large enough to cover all the surface of their smaller globes, for this planet was large as the long gone Neptune, or Uranus. How wonderful those vast areas of magnificent blue water, sparkling brilliantly in the light of the gigantic sun, seemed to them. Each man, before he started on this expedition, had his eyes treated that the new light would not be too bright and that it might appear white to him, so that now they could fully appreciate the wondrous beauty of the scene beneath.

And wondrous it was to men who had never seen water except as it had been manufactured in their great plants for community use. No oceans, no rivers, no lakes had there been in their system for over five billion years.

Now they were following a mighty river, a river larger than any that Earth had ever seen, for it drained a vast area of a humid planet. Yet it was a new planet, with mighty mountain ranges, mountains that towered in mighty snowcapped peaks in the blue distance, over wide ranges of green forest! What a sight it was for the eyes of these men! What a wondrous country! And now, as they rounded the bend in the great river, they cried out in excited wonder, for before them the great river, vaster than three Amazons, was pouring over a mighty ledge of rock, nearly four hundred feet in height; and from it rose a tremendous wave of sound that made the great ships tremble with the force of it, as they slowed to a few hundred miles an hour to watch the gigantic cascade. Then on again—There was much to do ere they could claim this beautiful country.

And on a low ridge among the mighty mountains they came upon a grim reminder—that it was not theirs yet. A great hole lay carved out in bare soil—a sharp contrast with the rich green of the country. Here and there they saw scattered brightly shining bits of metal and a section of heavy metal armor plate, torn and twisted by some enormous strain. To one side lay a heavy girder, torn and bent into a U. They recognized the spot whence the voice of the lost expedition had come across the void to them. Careful electroscopic and photographic studies of the spot were made ere they moved on.

The Atomic Creatures feared them now, it seemed, for though they had come even to one of the planets, they had seen none of the enemy. Surely there must be many hiding!

On the other side of the great mountain range they found their answer. Here, too, was a vast area of green, rolling meadow, but far out across it they could see a great bare spot, where only the dark, raw soil was visible. They swung the armada toward it, and shot forward to investigate, but before they had come within a thousand miles of the spot there suddenly appeared as from nowhere an army of the Atomic Giants. No doubt this bare spot was their home, and from the great area it seemed that they must inhabit it in great numbers. The powerful radioactive effects of their force-fields no doubt killed every plant.

These creatures were not entirely defenseless, for if their numbers were great enough they could exert a

powerful interfering force and break down the protective field. But they knew that many would be required. And now all in an instant the battle for this world was on, the great creatures striving to destroy the ships, while burning rays of milk radiance stabbed and slashed at their strange glowing force-pools. Soon they found the vulnerable point of the ships and began to attack single ships in numbers. Slowly, slowly, the milky radiance would contract, while the smooth purring of the mighty generators rose to a throaty hum, then became a vicious snarling roar. The great electron distorter cylinder would become a mass of shooting sparks, crackling, snapping till the atmosphere about it was alive with twisting streamers of flame twelve to twenty-four inches long. Then slowly it would heat—and if the attack was still unbroken, there would be a queer sighing hum from the generator, and a slight explosion—and the ship was gone. The generators, however, would withstand the attacks of ten or eleven of the creatures safely, and the other ships would come to the rescue—but many times there were no free ships in the neighborhood, and all available power must be turned into the ray generators, the slashing beams cutting at the many opponents. Even the propulsion apparatus was robbed of energy that every last meg-erg might be fed into the ray generators. Thousands of the Atomic Giants were destroyed, their color turning that strange green, then they suddenly were snuffed out. But sixty-two ships were lost. Still many remained when at last the Atomic enemy fled suddenly into space. There was no way of following their motion, they merely disappeared, going off with the speed of light. Then the visitors explored all that world, and nowhere did they find any more creatures.

But now the reports from all the other planets were coming in, and in every case eventual victory was secured. On two planets the issue was for a time in doubt, for there seemed to be great centers of the creatures here. However, there was no difficulty in discovering where the remnant had fled to! The electronic activity readings of the outermost planet, the minor sun, had risen 12.5 per cent. Since a star does not depend on atomic energy, it was easy to see that the creatures had sought refuge here. The range of the present ray was too short to permit attack on that planet. The blazing furnace drove them back to a distance of a million miles as the least distance of safe approach. They could not attack the creatures here. What could they do? They must exterminate them before the people moved to their new planets, for the creatures could make a raid, destroy a city, and be gone before the battleships could leave their docks.

The control ship proceeded directly to the most pleasant of the planets, with its guard, and the other ships were sent to watch the planets lest the Atomic Creatures return. Then on the planet the men began to set up one of the great receiving stations. From the sides of the ships ran mighty power cables to the powerful station. Then across space there came expert engineers, workmen, instruments and tools, working machines, constructor robots, and then great pieces of machinery so huge they could send only one section at a time. With these a new station was built to replace the temporary one.

ALREADY a small city was developing it seemed. But back on the old planets, mighty works were being undertaken. They were building two thousand ships, the biggest that had ever been built. Millions of tons they weighed, and each ship was one vast power plant. Down through the heart of it ran a mighty cylinder of glistening metal. A tiny control room, invisible among the titanic machines, governed all its vast

energies. It was a gargantuan projector of the nullifying field, a mighty ship that could hurl its energies into space to form a field of the force that could reach out across a million and a half miles. Two thousand of these vast machines were being built. Gigantic power plants they were. But these peacefully minded men designed them so that, their work done, they could be easily converted into merchant cargo ships, and the mighty generators could be used to light and heat their cities.

In less than two weeks the great ships were ready, and were resting on the surface of the great world out there across space, ready for the attack. The last mighty form had but just floated, light as a feather, from the huge receiving station, and now they lay in a row. So vast they were that they seemed unreal, fragments of some strange dream. Mighty cigar-shaped hulls of four-foot armor plate, half sunken in slight depressions they lay now, their terrific weight making the soil flow like some semi-liquid mass. Nestled between two of the gargantuan ships there rested the control ship. Now, one by one the fleet of the mighty hulks rose gently, gracefully into the air, formed in a perfect cone, with the control ship, scarcely visible in this congregation of giants, following behind the leading ship.

Out to that minor sun they flashed, and around it they formed a great sphere of ships. Then each of the mighty projectors, nose pointing to the blazing sun below, turned loose its powers. Through special filters they could watch the field forming. First it was a thin shell that surrounded the entire planet as the projectors threw it into position. Ten thousand small ships were occupied in maintaining the field of electrons in place with their projectors. Already the shell of force was thick and strong. Unless the Force Creatures made a concerted effort at some one point, they would soon be doomed.

They did this. There must have been many, many thousands of them. The field was almost broken, it was bulging out, scattering under the drive of their energies. Soon they would have broken through, but one of the great projector ships reached the spot before the field had quite yielded, and condensing his field projector till it was a ray, they could see the field suddenly fall in, driven in by the awful power of that titanic driving.

It took them sixty-three hours to completely establish that mighty energy field. Naturally the star, which made no use of Atomic energy, was quite unaffected. But when, at the end of three weeks, the energy field had slowly dissipated itself into space, there were no more of the Atomic Giants.

Now the four habitable planets were at once settled upon. Already they had been carefully mapped, and the Supreme Council had drawn up a plan for the use of the vast planets. More area there was than they needed now, by far, so the cities were scattered widely over the globes. Mere planetary distances meant nothing to them. And all the areas between were carefully preserved as vast, natural parks. Through them wound roads for the little ground cars, so that the people might better see the beauties of the place. And some of the harmless animals would be permitted to live that the future population might know them. It was to be the

fulfilment of a millennium-old dream—a warm, sunlight world, a kindly, young world where nature supplied the air, and the water, and the warmth in great abundance.

It was a kindly nature they seemed to have met here. And the work began.

Dozens, hundreds of the great receiver stations were set up. And at each station there would grow a great city. Now there poured across the infinite void a mighty influx of machines and workers and tools. These were the first, for they must build the cities for the billions to come. Rapidly the work went on as the skilled artisans directed the mighty machines in their labors, and on the surface of this new globe there rose from the ground mighty walls of lustrous, gleaming metal, reflecting the sun in a million different colors, a wondrous city of flashing, changing light, for the metal walls were automatically ruled with thousands of lines to the inch, a titanic diffraction grating that sent up a rainbow of changing, flashing color. A mile and a half into the air towered the buildings of the cities, and already the commerce was building up as the great receiver stations discharged their steady stream of immigrants.

One and a half years it took them to move all their treasures and priceless records, all their goods, all their machines and themselves across the void into their new cities. One and a half years of swift, efficient labor that transformed these new worlds into civilized planets.

But now they had twenty billion years to live ere these planets, too, would be dark, cold and sunless. And then they could easily move to some other distant system. But why wait till the Sun grew cold? They were already making investigations. Out across space there still glowed countless millions of unexplored stars! Now there would be no population limit to their peoples; there would be expansion, and since each man lived from two to three thousand years, the expansion could be rapid.

Four of the planets were naturally habitable, but five there were which should be so in the future. There was one yet a glowing planet, still hot from its formation. Two were so far from the major sun that they were cold to absolute zero, save when they were in conjunction with the minor sun. These the engineers and astro-physicists had investigated. They would be drawn nearer the sun when the population warranted, and one more that turned on its axis but once a year could easily be started rotating. Air and water it lacked, but that would be easy to supply. And a last planet was so close to the mighty blazing Betelgeuse that it was kept dull red by the titanic furnace so near it, a scant thirty million miles away. That would be drawn to a more comfortable distance. There was indeed room for much expansion in this system.

But still there was the urge of exploration, of adventure. There might be other battles to fight, other worlds to conquer! Already mighty exploration ships were being prepared to dispatch to half a dozen systems. Perhaps they would bring commerce; perhaps it would be wider domain. But it was that same lure of adventure that had driven the first caveman from his rocky cliff to explore the wilder lands. It was the love of adventure, another name for ambition. It would take more than ten thousand thousand thousand years to kill that!