



Where I Wasn't Going
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*I studied and worked and learned my trade
I had the life of an earthman made;
But I met a spaceman and got way-laid—
I went where I wasn't going!*

The Spaceman's Lament

Making his way from square to square of the big rope hairnet that served as guidelines on the outer surface of the big wheel, Mike Blackhawk completed his inspection of the gold-plated plastic hull, with its alternate dark and shiny squares.

He had scanned every foot of the curved surface in this first inspection, familiarizing himself completely with that which other men had constructed from his drawings, and which he would now take over in the capacity of chief engineer.

Mike attached his safety line to a guideline leading to the south polar lock and kicked off, satisfied that the lab was ready for the job of turning on the spin with which he would begin his three months tour of duty aboard.

The laws of radiation exposure set the three-month deadline to service aboard the lab, and he had timed his own tour aboard to start as the ship reached completion, and the delicate job of turning her was ready to begin.

U.N. Space Lab One was man's largest project to date in space. It might not be tremendous in size by earth standards of construction, but the two hundred thirty-two foot wheel represented sixty-four million pounds of very careful engineering and assembly that had been raised from Earth's surface to this thirty-six-hour orbit.

Many crews had come and gone in the eighteen months since the first payload had arrived at this orbit—but now the first of the scientists for whom the lab was built were aboard; and the pick of the crews selected for the construction job had been shuttled up for the final testing and spin-out.

Far off to Mike's left and slightly below him a flicker of flame caught his eye, and he realized without even looking down that the retro-rockets of the shuttle on which he had arrived were slowly putting it out of orbit and tipping it over the edge of the long gravitic well back to Earth. It would be two weeks before it returned.

Nearing the lock he grasped the cable with one hand, slowing himself, turned with the skill of an acrobat, and landed catlike, feet first, on the stat-magnetic walk around the lock.

He had gone over, minutely, the inside of the satellite before coming to its surface. Now there was only one more inspection job before he turned on the spin.

Around this south polar hub-lock, which would rotate with the wheel, was the stationary anchor ring on which rode free both the stat-walk and

the anchor tubes for the smaller satellites that served as distant components of the mother ship.

Kept rigid by air pressure, any deviation corrected by pressure tanks in the stationary ring, the tubes served both to keep the smaller bodies from drifting too close to Space Lab One, and prevented their drifting off.

The anchor tubes were just over one foot in diameter, weighing less than five ounces to the yard—gray plastic and fiber, air-rigid fingers pointing away into space—but they could take over two thousand pounds of compression or tension, far more than needed for their job, which was to cancel out the light drift motion caused by crews kicking in or out, or activities aboard. Uncanceled, these motions might otherwise have caused the baby satellites to come nudging against the space lab; or to scatter to the stars.

There had been talk of making them larger, so that they might also provide passageway for personnel without the necessity for suiting up; but as yet this had not been done. Perhaps later they would become the forerunners of space corridors in the growing complex that would inevitably develop around such a center of man's activities as this laboratory in its thirty-six hour orbit.

At the far end of the longest anchor tube, ten miles away and barely visible from here, was located the unshielded, remote-controlled power pile that supplied the necessary energy for the operation of the wheel. Later, it was hoped, experimental research now in progress would make this massive device unnecessary. Solar energy would make an ideal replacement; but as yet the research was not complete, and solar energy had not yet been successfully harnessed for the high power requirements of the Lab.

Inside this anchor tube ran the thick coaxial cable that fed three-phase electric power from the atomic pile to the ship.

At the far end of the second anchor tube, five miles off in space, was Project Hot Rod, the latest in the long series of experiments by which man was attempting to convert the sun's radiant energy to useful power.

At the end of the third anchor tube, and comparatively near the ship, was the dump—a conglomeration of equipment, used and unused booster rocket cases, oddments of all sorts, some to be installed aboard the wheel, others to be used as building components of other projects; and some oddments of materials that no one could have given a logical reason for keeping at all except that they "might be useful"—all held loosely together by short guidelines to an anchor ring at the tube's end.

Carefully, Mike checked the servo-motor that would maintain the stationary position of the ring with clocklike precision against the drag of bearing friction and the spin of the hub on which it was mounted; then briefly looked over the network of tubes before entering the air lock.

Inside, he stripped off the heavy, complicated armor of an articulated spacesuit, with its springs designed to compensate for the Bourdon tube effect of internal air pressure against the vacuum of space, appearing in the comfortable shorts, T-shirt, and light, knit moccasins with their thin, plastic soles, that were standard wear for all personnel.

He was ready to roll the wheel.

Feeling as elated as a schoolboy, Mike dove down the central axial tube of the hub, past the passenger entrances from the rim, the entrances to the bridge and the gymnasium-shield area, to the engineering quarters just below the other passenger entrances from the rim, and the observatory that occupied the north polar section of the hub.

The engineering quarters, like all the quarters of the hub, were thirty-two feet in diameter. Ignoring the ladder up the flat wall, Mike pushed out of the port in the central axis tunnel and dropped to the circular floor beside the power console.

Strapping himself down in the console seat, he flipped the switch that would connect him with Systems Control Officer Bessandra Khamar at the console of the ship's big computer, acronymically known as Sad Cow.

"Aiee-yiee, Bessie! It's me, Chief Blackhawk!" he said irreverently into the mike. "Ready to swing this buffalo!"

Bessie's mike gave its preliminary hum of power, and he could almost feel her seeking out the words with which to reprimand him. Then, instead, she laughed.

"*Varyjat!* Mike, haven't you learned yet how to talk over an intercom? Blasting a girl's eardrums at this early hour. It's no way to maintain beautiful relationships and harmony. I'm still waiting for my second cup of coffee," she added.

"Wait an hour, and this cup of coffee you shall have in a cup instead of a baby bottle," Mike told her cheerfully. "Space One's checked out ready to roll. Want to tell our preoccupied slipstick and test-tube boys in the rim before we roll her, or just wait and see what happens? They shouldn't get too badly scrambled at one-half RPM—that's about .009 gee on the rim-deck—and I sort of like surprises!"

"No, you don't" Bessie said severely. "No, you don't. They need an alert, and I need to finish the programming on Sad Cow to be sure this thing doesn't wobble enough to shake us all apart. Even at a half RPM, your seams might not hold with a real wobble, and I don't like the idea of falling into a vacuum bottle as big as the one out there without a suit."

"How much time do you need?"

"On my mark, make it T minus thirty minutes. That ought to do it. O.K., here we go." There was a brief pause, then Bessie's voice came formally over the all-stations annunciator system.

"Now hear this. Now hear this. All personnel. On my mark it is T minus thirty minutes to spin-out check. According to program, acceleration will begin at zero, and the rim is expected to reach .009 gee at one-half revolutions per minute in the first sixty seconds of operation. We will hold that spin until balance is complete, when the spin will slowly be raised to two revolutions per minute, giving .15 gee on the rim deck.

"All loose components and materials should be secured. All personnel are advised to suit up, strap down and hang on. We hope we won't shake anybody too much. Mark and counting."

Almost immediately on the announcement came another voice over the com line. "Hold, hold, hold. We've got eighteen hundred pounds of milling equipment going down Number Two shaft to the machine shop, and we can't get it mounted in less than twenty minutes. Repeat, hold the countdown."

"The man who dreamed up the countdown was a Brain," Bessie could hear Mike muttering over his open intercom, "but the man who thought up the hold was a pure genius."

"Holding the countdown." It was Bessie's official voice. "It is T minus thirty and holding. Why are you goons moving that stuff ahead of schedule and without notifying balance control? What do you think this is, a rock-bound coast? Think we're settled in to bedrock like New York City? I should have known," she muttered, forgetting to flip the switch off, "my horoscope said this would be a shaky sort of day."

Chad Clark glanced up from his position at the communications console across the bridge from Bessie, to where her shiny black hair, cut short, framed the pert Eurasian features of the girl that seemed to be hanging from the ceiling above him.

"Is it really legal," he asked, "using such a tremendously complicated chunk of equipment as the Sacred Cow for casting horrible scopes? What's mine today, Bessie? Make it a good one, and I won't report you to U.N. Budget Control!"

"Offhand, I'd say today was your day to be cautious, quiet and respectful to your betters, namely me. However," she added in a conciliatory tone, "since you put it on a Budget Control basis, I'll ask the Cow to give you a real, mathematicked-out, planets and houses properly aligned, reading.

"Hey, Perk!" Her finger flipped the observatory com line switch. "Have you got the planets lined up in your scopes yet? Where are they? The Sacred Cow wants to know if they're all where they ought to be."

Out in the observatory, designed to swing free on the north polar axis of the big wheel, Dr. P. E. R. Kimball, PhD, FRAS, gave a startled glance at the intercom speaker.

"I did not realize that you would wish additional observational data before the swing began. I am just getting my equipment lined up, in preparation for the beginnings of the swing, and will be unable to give you figures of any accuracy for some hours yet. Any reading I could give you now would be accurate only to within two minutes of arc—relatively valueless." The voice was cheerful, but very precise.

"Anything within half an hour of arc right now would be O.K." Bessie's voice hid a grin.

"In that case, the astronomical almanac data in the computer's memory should be more than sufficiently precise for your needs." There was a dry chuckle. "Horoscopes again?"

As Bessie turned back to the control side of her console, she saw a hand reach past her to pick up a pad of paper and pencil from the console desk. She glanced around to find Mike leaning over her shoulder, and grinned at him as she began extracting figures from the computer's innards for a "plus or minus thirty seconds of arc" accuracy.

Mike sketched rapidly as she worked, and she turned as she heard him mutter a disgusted curse.

"These are angular readings from our present position," he said in an annoyed tone. "Get the Cow to rework them into a solar pattern."

"Yes, sir, Chief Blackhawk, sir. What did you think I was doing?"

"You're getting them into the proper houses for a horoscope. I want a solar pattern. Now tell that Sacred Cow that you ride herd on to give me a polar display pattern on one of the peepholes up there," he said, glancing at the thirty-six video screens above the console on which the computer could display practically any information that might be desired, including telescopic views, computational diagrams, or even the habitats of the fish swimming in the outer rim channels.

The display appeared in seconds on the main screen, and Mike growled as he saw it.

"Have the Cow advance that pattern two days," he said furiously. Then, as the new pattern emerged, "I should have known it. It looks like we're being set up for a solar flare. Right when we're getting rolling. It might be a while, though. Plenty of time to check out a few gee swings. But best you rehearse your slipstick jockeys in emergency procedures."

"A flare, Mike? Are you sure?"

"Of course I'm not sure. But those planets sure make the conditions ripe. Look." And he held his pencil across the screen as a straight line dividing the pattern neatly through the center.

"Look at the first six orbits, Jupiter's right on the line. And Mercury won't be leaving until Jupe crosses that line." The "line" that Mike had indicated with his pencil across the screen would have, in the first display shown all but one of the first six planets already on the same side of the sun and in the new display, two days later, it showed all six of the planets bunched in the 180° arc with Earth only a few degrees from the center of that arc.

"Hadn't thought to check before," he said, "but that's about as predictable as anything the planets can tell you. We can expect a flare, and probably a dilly."

"Why, Mike? If a solar flare were due, U.N. Labs wouldn't have scheduled us this way. What makes you so sure that means there's a solar flare coming? I thought they weren't predictable?"

"It's fairly new research—but fairly old superstition," Mike said. "You play with horoscopes—but my people have been watching the stars and predicting for many moons. I remember what they used to say around the old tribal fires."

"When the planets line up on one side of the sun, you get trouble from man and beast and nature. We weren't worried about radio propagation in those days, but we were worried about seasons, and how we felt, and when the buffalo would be restless."

"More recently some of the radio propagation analysts have been worrying about the magnetic storms that blank out communications on Earth occasionally when old Sol opens up with a broadside of protons. Surely plays hell with communications equipment."

"Yep, there's a flare coming. Whether it's caused by gravitational pull, when you get the planets to one side of Sol; or whether it's magnetism—I just don't know."

"Shucks," she said, "we had a five-planet line-up in 1961; and nothing happened; nothing at all. The seers—come to think of it, some of them were Indians, but from India," she added, "not Amerinds—the seers all predicted major catastrophes and the end of the world and all kinds of things, and nothing happened."

"Bessie," Mike's voice was serious. "I remember 1961 as well as you do. You had several factors that were different then—but you had solar flares then. Quite spectacular ones. You just weren't out here, where they make a difference of life or death.

"Don't let anybody hold us too long getting this station lined up and counted down and tested out. Because we've got things building up out there, and we may get that flare, and it may not be two days coming," he finished.

With that the Amerind sprang catlike to a hand-hold on the edge of the central tunnel and vanished back towards the engineering station, from which he would control the test-spin of the big wheel.

Bessandra Khamar, educated in Moscow, traced her ancestry back to one of the Buryat tribes of southern Siberia, a location that had become eventually, through the vast vagaries of history, known as the Buryat Autonomous Soviet Socialist Republic.

She was of a proud, clannish people, with Mongolian ancestry and a Buddhist background which had not been too deeply scarred by the political pressures from Western Russia. Rebellious of nature, and of a race of people where women fought beside their men in case of necessity, she had first left her tribal area to seek education in the more advanced western provinces with a vague idea of returning to spread—not western ideologies amongst her people—but perhaps some of their know-how. This she had found to be a long and involved process; and more and more, with an increase of education, she had grown away from her people, the idea of return moving ever backwards and floundering under the impact of education.

She had been an able student, though independent and quite argumentative, with a mind and will of her own that caused a shaking of heads amongst her fellow students.

Having sought knowledge in what, to her, were the western provinces of her own country, she had delved not only into the knowledge of things scientific, but into the wheres and whyfores of the political situations that made a delineation between the peoples of Russia and the other peoples of the world.

Somehow she had been accepted as part of a trade mission to South America, and with that first trip out of her own country her horizons had broadened. Carefully she had nurtured that which pleased others in such a way that she had been recommended to other, similar tasks. And eventually she had gone to the U.N. on an extended tour of duty. It was here for the first time that she had heard of the recruitment of a staff for the new U.N. Space Lab project, and here she had made a basic decision: To seek a career, not in her own country or back among the peoples of her own clan, but in the U.N. itself, where she could better satisfy the urge to know more of all people.

She had, of course, been educated in a time of change. As a child she had attended compulsory civilian survival classes, as had nearly every person in the vast complex of the Soviet Union. She had learned about atomic weapons; and that other peoples for unknown reasons as far as she could determine, might declare her very safety and life forfeit to causes she did not understand.

Later, as she had made her way westward seeking reasons and causes for these possible disasters, and more knowledge in general, her country had undergone what amounted to a revolutionary change. Not only her country, but the entire world had moved during her lifetime from an armed camp or set of camps with divided interests and the ability for total annihilation, towards a seeking of common goals—towards a seeking of common understandings.

The catastrophe that had threatened to engulf the entire world and claim the final conquest had occurred while she was a very junior student in Moscow, when the two major nations that were leaders—or had thought themselves to be leaders, so far as atomic weaponry and such were concerned—had stood almost side by side in horror, and attempted to halt the conflagration that had been sparked by a single bomb landed on the mainland of China by Formosa.

While Russia and the United States had stood forth in the U.N. and renounced any use of atomic weapons, the short and bitter struggle which reached its termination in a mere five days had brought the world staggering to the ultimate brink of atomic war, as the Formosan Chinese made their final bid for control of mainland China.

The flare of atomic conflict had been brief and horrible. Where the bombs had come from had been the subject of acrimonious accusations on the floor of the U.N. The United States had forsworn knowledge, and for a time no one had been able to say from whence they had come. Later, shipping records had proven their source in the Belgian Congo as

raw material, secretly prepared and assembled on Formosa itself, and it became obvious to the entire world that an atomic weapon was not something that could be hidden in secrecy from the desires of desperate men.

The Chinese mainland had responded with nuclear weapons of its own; weapons they, too, had not been known to possess, but had possessed.

That the rest of the world had not been sucked into the holocaust was a credit to the statesmen of both sides. That disarmament was agreed to by all nations was a matter of days only from the parallel but unilateral decisions of both Russia and the United States, that disarmament must be accomplished while there was yet time.

Under the political pressures backed by the human horror of all nations, the nuclear disarmament act of the U.N. had given to the U.N. the power of inspection of any country or any manufacturing complex anywhere in the world; inspection privileges that overrode national boundaries and considerations of national integrity, and a police force to back this up—a police force comprised of men from every nation, the U.N. Security Corps.

The United Nations, from a weak but hopeful beginning, had now stepped forth in its own right as an effective world government. There was no political unity at a lower echelon amongst the states or sub-governments of the world. To each its own problems. To each its own ideologies. To each, help according to its needs from the various bureaus of the U.N. And from each the necessary taxes for the support of the world organization.

In Russia the ideology of Marx-Lenin was still present. And in other countries other ideologies were freely supported. But the world could no longer afford an outright conflict of ideologies, and U.N. Security was charged not only with the seeking out and destruction of possible hoards of atomic weapons, but also with the seeking out and muzzling of those who expressed an ideology at all costs, even the cost of the final suicide of war, to their neighbors.

No hard and fast rules could be drawn to distinguish between a casual remark made in another country as to one's preference for one's own country, and an active subversion design to subvert another country to one's own ideology. But nevertheless, the activity of subversion had become an illegal act under the meaning of "security." And individual governments had recalled agents from their neighboring countries—not only

agents, but simple tourists as well. For the stigma of having an agent arrested in another country and brought to trial at the U.N. was a stigma that no government felt it could afford.

Over the world settled a pall. The one place outside of one's own country, where one's ideology could be spoken of with impunity, was within the halls of the U.N. Assembly itself, under the aegis of diplomatic immunity. Here the ideologies could rant and rave against each other, seeking a rendering of a final decision in men's age-old arguments; but elsewhere such discussions were *verboden*, and subject to swift, stiff penalties.

There were some who thought quietly to themselves that perhaps in the reaction to horror they had voted too much power to a small group of men known as Security, but there were others, weary of the insecurity of world power-politics, who felt that Security was a blessing, and would for all time protect all men in the freedom of their own beliefs. The pressures had been great, and the pendulum of political weight had swung far in an opposite direction. In fact, man had achieved that which he would deny—in a reach for freedom, he had made the first turn in the coil that would bind him—in the coil that would bind the mass of the many to the will of the very few.

In school in Moscow, these things touched Bessandra's life only remotely. The concepts, the talk, the propaganda from Radio Moscow, these she heard, but they were not her main interests.

Her main interests were two—one, the fascination which the giant computer at Moscow University held for her; and two, the students around her. People, she had noted, had behavior patterns very similar to the complex computer; not as individual units, though as individual units they could also be as surprisingly obtuse as the literal-minded reaction of the computer; but in statistical numbers they had an even greater tendency to act as the computer did.

The information fed them and their reactions to it had a logic all its own; not a logic of logic, but a logic of reaction. And the reaction could be controlled, she noted, in the same self-corrective manner that was applied to logic in the interior of the computer—the feedback system.

It was obvious that with a statistical group of people, the net result of action could be effectively channeled by one person in an obscure position acting as a feedback mechanism to the group, and with selective properties applied to the feedback.

At one point she had quietly, and for no other reason than to test this point to her own satisfaction, sat back and created a riot of the women

students at the University, without once appearing either as the cause or the head or leader in the revolt. The revolt in itself had been absolutely senseless, but the result had been achieved with surprisingly little effort on the part of one individual.

Computers and people had from that day become her tools, whenever she decided to bend them to her will.

Even earlier in her career, she had managed to put her rebellious nature under strict control, never appearing to be a cause in herself; never appearing as a leader among the students; merely a quiet student intent upon the gain of knowledge and oblivious to her surroundings.

Later as she realized her abilities, she had sought council with herself and her Buddhist ancestry, to determine what use her knowledge should serve. And to her there was but one answer: Men were easily enslaved by their own shortcomings; but men who were free produced more desirable results; and if she were to use their shortcomings at all, it must be to bend them in the path of freedom that she might be surrounded by higher achievements rather than sheeplike activities which she found to be repugnant.

Gradually she had achieved skill in the manipulation of people; always towards the single self-interest of creating a better and more pleasant world in which she herself could live.

In rim sector A-9, Dr. Claude Lavalle was having his troubles. Free fall conditions that were merely inconvenient to him were proving near-disastrous to the animals in the cages around him.

Many and various were the difficulties that he had had with animals during his career, but never before such trifles that built *peu à peu*—into mountains.

Claude Lavalle had originally planned to leave his stock of animals, which contained sets of a great many of the species of the small animals of Earth, on their own gravity-bound planet until well after the spin supplied pseudo-gravity to the ship; but the schedule of the shuttles' loads had proved such as to make possible the trip either far in the future, or to put him aboard on this trip, with spin only a few hours away.

The cages, with their loads of guinea pigs, rabbits, hamsters and other live animals to be used in the sacrificial rites of biochemical research were, to put it mildly, a mess. Provision had been made for feeding and watering the animals under free-fall conditions, but keeping them sanitary was proving a near-impossible task; and though the cages were sealed to confine the inevitable upset away from the remainder of the

lab, it was good to hear that the problem was nearly over as the news of the imminent countdown came over the loud-speaker.

Meantime, Dr. Claude Lavalle was having his difficulties, and he wished fervently that his assistants could have been sent up on the shuttle with him.

In rim-sector A-10, the FARM (Fluid Agricultural Recirculating Method control lab, according to the U.N. acronym), Dr. Millie Williams, her satiny brown skin contrasting to her white T-shirt and shorts, was also having her troubles.

The trays of plants, in their beds of sponge plastic and hydroponic materials, were all sealed against free-fall conditions, but should be oriented properly for the pseudo-gravity as the great wheel was given its rotational spin.

The vats of plankton and algae concentrates were not so important as to orientation, but should be fed into their rim-river homes as soon as possible, although this could not be done until the rim spin was well under control.

The trays, the plants, the plankton, the algae—even a large proportion of the equipment in the lab, were all new, experimental projects, designed to check various features of the food and air cycles that would later be necessary if men were to send their ships soaring out through the system.

The primary purpose of Lab One was a check of the various survival systems and space ecology programs necessary to equip the future explorations under actual space conditions. Her job on the FARM would be very important to the future feeding and air restoration of spacemen; but more important, the efficient utilization of the wheel itself, since success in shipboard purification of air and production of food would free the shuttle to bring up other types of mass.

At present, the ship's personnel were existing almost entirely on tanked air, but within two weeks one of the three air-restoration projects on the satellite—either hers, in which hydroponic plants and algae were the basic purifiers; or projects in the chem and physics labs—would have to be already functioning in the job, or extra shuttles would have to be devoted to air transportation until they were ready.

The provision of good fresh vegetables and fresh, springlike air would almost certainly be up to her department. The other two labs, Dr. Carmencita Schorlemmer in chemistry, and Dr. Chi Tung in physics, were both working on the air-restoration problem by different

means—electro-chemistry in the one case; gas dialysis membranes in the other.

The work of the physics labs was operating on the differential ability of various gas molecules to "leak" through plastic membranes under pressure, causing separation of the various molecular constituents of the atmosphere; shunting carbon dioxide off in one direction, and returning oxygen and the inert nitrogen and other gases back to the surrounding atmosphere.

This latter method had proved highly satisfactory back on Earth, where it was separating out fissionable materials in large quantities and high purities from closely similar isotopes; and would now be tested for efficiency versus weight in some of the new problems being encountered in space.

A fourth method, direct chemical absorption by soda lime, had been discarded early in the program, although it was still used in spacesuit air cleaners, and for the duration of the canned air program under which they were now operating.

The lab was like that—no problem has a single solution. And it was the lab's job to evaluate as many solutions as possible so that the best, under different conditions, might be proved and ready for use in later programs.

Paul Chernov, ordinary spaceman—which meant that he had only a little more specialized training than the average college graduate—was working in the dump, surrounded by much of the equipment that remained to be placed aboard Space Lab One, and trying to identify the particular object he sought.

Looking down almost directly over the eastern bulge of the African coast, he sighted what was probably the ECM lathe he was after, and kicked towards it, simultaneously pulling his pistol-gripped Rate of Approach Indicator from the socket in his suit.

The RAI gun, he sometimes felt, was the real reason he'd become a spaceman in these tame days. Even if he couldn't be a space pirate, it gave him the feel.

Humming to himself, he aimed the search beam from the tiny gallium-arsenide laser crystal that was the heart of the gun at the bulky object, and read off the dial at the back of the "barrel" the two meter/second approach velocity and the twenty-eight meter distance.

He could as easily have set the RAI gun to read his velocity and distance in centimeters or kilometers, and it would have read as well his rate of retreat, if that had been the factor.

Paul's RAI gun might be, to others, a highly refined, vastly superior great-grandson of the older radar that had required much more in the way of equipment than the tiny bulk of this device, but to him, alone in his spacesuit, the galaxy spread around him, it was the weapon with which he had conquered the stars.

In the distance, off beyond the wheel in a trailing orbit, the huge spherical shape of Project Hot Rod glowed its characteristic green—another application of the laser principle, but this one macroscopic in comparison to the tiny laser rate-of-approach gun.

Happily, Paul burst into song.

*"There's a sky-trail leading from here to there
And another yonder showing;
But I've a yen for gravity—
This is where I wasn't going!"*

From the other side of the dump, Tombu's voice bellowed into his ears over the intercom. "If you're going to audition for the stars, cut down the volume!"

Paul grinned and reached for the volume control.

"O.K., M'Numba, 's m'numba!—I'm a space-yodler from way out. Heave a line over this way and let's get this ECM lathe aboard."

Tombu's "last name" M'Numba had delighted Paul from the moment he'd heard the story of its origin. By the customs of his own country, Tombu had only a single name. However, when he had first enrolled as a student in England there had been a lack of comprehension between him and the rather flustered registrar and, when he had muttered something about "my number," the registrar had misunderstood and put him down as M'Numba. Tombu had let it stand.

Paul Chernov, fine-boned, blond, with an ancestral background of the Polish aristocracy, and his side-kick, Tombu, black, muscular giant from the Congo, were one of the strangest combinations of this international space lab crew. Yet it was perhaps even stranger that the delicate-looking blond youth was a top machinist, a trade that he had plied throughout his student days in order to economically support an insatiable thirst for knowledge. A trade that had led him to this newest center of man's search for knowledge.

But perhaps the combination was not so strange, for Tombu, also, was of the aristocracy—an aristocracy that could perhaps be measured in terms of years extending far behind the comparable times for any European aristocracy.

Tombu was Swahili, a minor king of a minor country which had never been recognized by the white man when he invaded Africa and set up his vast protectorates that took no account of the peoples and their tribal traditions; protectorates that lumped together many hundreds of individual nations and tribes into something the white man looking at maps could label "Congo."

Tombu himself, educated in the white man's schools to the white man's ways, and probing ever deeper into the white man's knowledge, was only vaguely aware of his ancestral origin. He counted his kingdom in negative terms, terms that were no longer applicable in a modern world. Where national boundaries everywhere were melting further and further into disuse, it would seem to his mind foolish to lay claim to a kingship that had been nonexistent for more than one hundred years over a people that had been scattered to the four winds and ground together with other peoples in the Belgian Congo protectorate.

Odd the combination might be; but together the two machinists worked well, with a mutual respect for each other's abilities and a mutual understanding that is rare to find among members of different races.

Quickly they lashed and anchored the crate containing the lathe and hauled it in towards the main south lock of the big wheel.

These were not the only activities in and around the wheel, or other places in space. Man already had a toehold in space, and that toehold was gradually growing into a real beachhead. Swarms of satellites in their short, fast orbits down close to Earth had been performing their tasks for many years. Astronauts had come and gone, testing, checking, probing however briefly; bravely clawing their way up the sides of the long gravitic well that separated Earth from space.

The moon project that had originally been forecast for immediate accomplishment had met with delay. As yet there was no base on the moon, though men had been there, and this was bound to occur.

But the lab was not here so much as a stepping stone to the moon as it was to provide information for the future manned trips out towards Mars and the asteroids; and in towards Venus and the sun.

Besides research, the big wheel would provide living quarters for men building other projects; would provide a permanent central for the

network of communications beams that was gradually encompassing man's world and would eventually spread to the other planets as well. Cooperating with this master communications central, other satellites, automatic so far, occupied the same orbit, leading and lagging by one hundred twenty degrees.

A twenty-four hour orbit would have been more advantageous from the point of view of communications, except for the interference that would have been occasioned by the vast flood of electrons encircling Earth in the outer Van Allen belt. These electrons, trapped by Earth's magnetic field from the solar wind of charged particles escaping the sun, unfortunately occupied the twenty-four hour orbit, and, as their orbit expanded and contracted under the influence of the shifting magnetic field and solar flares, could produce tremendous havoc even in automatic equipment, so that it had been deemed economically impractical to set up the originally-postulated three satellites in stationary twenty-four orbits as communications terminals.

As the next best choice, the thirty-six-hour orbit had been selected. It gave a slow rate of angular displacement, since the satellite itself moved ten degrees an hour, while Earth moved 15° , for a differential rate of only five degrees an hour, making fairly easy tracking for the various Earth terminals of the communications net; and making possible a leisurely view of more than ninety per cent of Earth's surface every seventy-two hours.

The other two power and communications stations which led and lagged Space Lab One by 120° each, would combine to command a complete view of Earth, lacking only a circle within the arctic regions, so that they could provide power and communications for the entire world—a fact which had been the political carrot which had united Earth in the effort to create the labs with their combined technologies.

The danger of such powerful instruments as Hot Rod, concentrating megawatt beams of solar energy for relay to earth, and which could also be one of man's greatest weapons if it fell into unscrupulous hands, had been carefully played down, and also carefully countered in the screening by the Security Forces of U.N. of the personnel board.

T minus three and counting.

On the zero signal Mike in the engineer's quarters would change the now idly-bubbling air jets in the rim-rivers over to the fully-directional drive jets necessary to spin the fluid in counter-rotation through the rim tanks.

The suiting-up and strapping down were probably unnecessary, Mike thought, but in space you don't take chances.

"T minus two and counting." Bessie's voice rang over the com circuit in officially clipped clarity.

From the physics lab came a rather oddly pitched echo. "Allee allee in free fallee! Hold it, please, as Confusion would say! Paul forgot to secure the electrolite for the ECM equipment. Can't have these five-gallon bottles bouncing around!"

"And we can't have you bouncing around either, Dr. Chi Tung. Get that soup under wraps quick. How much time do you need?" came the captain's voice from his console angled over Bessie's head.

Clark's voice could be heard murmuring into his Earth-contact phone. "T minus two. Holding."

Less than two minutes later, Dr. Chi released the hold by announcing briefly, "Machine shop and physics department secure."

"T minus two and counting... ."

"T minus one and counting... ." Bessie continued officially. "Fifty, forty, thirty, twenty... ."

The faint whine of high-speed centrifugal compressors could be heard through the ship.

"Ten... ." The jets that had previously bubbled almost inaudibly took on the sound of a percolating coffee pot.

"... Four, three, two, one, mark."

The bubbling became a hiss that settled into a soft susurrus of background noise, as the jets forced air through the river of water in the circular tanks of the rim.

The water began to move. By reaction, the wheel took up a slow, circular motion in the opposite direction.

Then, gently, the wheel shook itself and settled into a complacently off-center motion that placed Bessie somewhere near the actual center of rotation.

"We're out of balance, Mr. Blackhawk," said the captain, one hand on the intercom switch.

"Bessie, ask the Cow what's off balance." It was Mike's voice from engineering control. "Thought we had this thing trued up like a watch."

But the computer had already taken over, and was controlling the flow of water to the hydrostatic balance tank system, rapidly orienting the axis of spin against the true axis of the wheel.

The wobble became a wiggle; the wiggle became the slightest of sways; and under the computer's gentle ministrations, the sways disappeared and Space Lab One rolled true.

Slowly Mike inched the jet power up, and the speed and "gravity" of the rim rose—from 0.009 to 0.039 to the pre-scheduled 0.15 of a gravity—two RPM—at which she would remain until a thorough test schedule over several days had been accomplished. Later tests would put the rim through check-out tests to as high as 1.59 gee, but "normal" operation had been fixed at two RPM.

In the background, the susurrus of the air jets rose slightly to the soft lullaby-sound that the wheel would always sing as she rolled.

New, experimental, her full complement of six hundred scientists and service personnel so far represented by only one hundred sixty-three aboard, the big wheel that was Space Lab One rotated majestically at her hydrodynamically controlled two revolutions per minute.

She gave nearly half her mass to the water that spun her—huge rivers of water, pumped through the walls of the wheel's rim, forming a six-foot barrier between the laboratories within the rim and the cosmic and solar radiations of outer space.

Arguments on Earth had raged for months over the necessities—or lack of them—for the huge mass of water aboard, but the fluid mass served many purposes better than anything else could serve those purposes.

As a radiation shield, it provided sufficient safety against cosmic radiations of space and from solar radiations, except for solar flare conditions, to provide a margin of safety for the crew over the three months in which they would do their jobs before being rotated back to Earth for the fifteen-month recovery period.

The margin was nearly enough for permanent duty—and there were those who claimed it was sufficient—but the claim had not been substantiated, and the three months maximum for tour was mandatory.

Originally, shielding had not been considered of vital importance, but experience had proven the necessity. The first construction personnel had been driven back to Earth after two weeks, dosimeters in the red. The third crew didn't make it. All five died of radiation exposure from a solar flare. An original two weeks' limit was raised as more shielding arrived—three weeks, four, five—now the shadowy edge of the theoretic ninety-day recovery rate from radiation damage and the ninety days required to get the maximum safe dosage overlapped—but safety

procedures still dictated that a red dosimeter meant a quick return to Earth whether the rate of recovery overlapped or not.

The question was still open whether more shielding would be brought up to make the overlap certain, or whether it would be best to maintain a personnel rotation policy indefinitely. Some factions on Earth seemed determined that rotation must remain not only a procedural but an actual requirement—their voices spoke plainly through the directives and edicts of U.N. Budget Control—but from what source behind this bureaucratic smokescreen it would have been difficult to say.

As a heat sink, the water provided stability of temperature that would have been difficult to achieve without it. Bathed in the tenuous solar atmosphere that extends well beyond the orbit of Earth, and with a temperature over 100,000 C, maintenance of a livable temperature on board the big wheel was not the straight-forward balancing of radiation intercepted/radiation outgoing that had been originally anticipated by early writers on the subject.

True, the percentage of energy received by convection was small compared to that received by radiation; but it was also wildly variable.

As a biological cultural medium, the hydraulic system provided a basis for both air restoration and food supplies. When the proper balance of plankton and algae was achieved, the air jets that gave the ship its spin would also purify the ship's air, giving it back in a natural manner the oxygen it was now fed from tanks.

As a method of controlling and changing the rate of rotation of the wheel, the rivers of water had already proven themselves; and as a method of static balancing to compensate for off-center weights, masses of it could be stopped and held in counterbalance tanks around the rim, thus assuring that the observatory, in its stationary position on the hub, would not suddenly take up an oscillatory pattern of motion as the balance within the wheel was shifted either by moving equipment or personnel.

In effect, the entire ship operated against a zero-M-I calculation which could be handled effectively only by the computer. The moment of inertia of the ship must be constantly calculated against the moment of inertia of the hydraulic mass flowing in the rim. And the individual counterbalance tanks must constantly shift their load according to the motions of the crew and their masses of equipment that were constantly being shifted during installation. For already the observatory was hard at work, and its time must not be stolen by inappropriate wobbles of the hub.

A continuously operating feedback monitor system was capable of maintaining accuracy to better than .01% both in the mass inertial field of centrifugal force affecting the rim; and in overall balance that might otherwise cause wobbles in the hub.

While such fine control would not be necessary to the individual comfort of the personnel aboard, it was very necessary to the accuracy of scientific observation, one major purpose of the lab; and even so, many of the experimenters would require continuous monitor observation from the computer to correct their observations against her instantaneous error curve.

The mass of water in the rim formed a shell six feet through, surrounding the laboratories and living quarters—walls, floor and ceiling—since its first function was that of radiation shielding.

But the bulk of this water was not a single unit. It was divided into separate streams, twenty in number, in each of which various biological reactions could be set up.

While a few of the rivers were in a nearly chemically pure state, most of them were already filling with the plankton and algae that would form the base of the major ecological experiments, some with fresh water as their medium, others using sea water, complete with its normal microorganisms supplemented from the tanks of concentrate that Dr. Millie Williams had brought aboard. One or two of the rivers were operating on different cycles to convert human waste to usable forms so that it might reenter the cycles of food and air.

Several of the rivers were operating to provide fish and other marine delicacies as part of the experiment to determine the best way of converting algae to food in a palatable form.

Within, the rivers were lighted fluorescently—an apparent anomaly that was due to the fact that the problems of shielding marine life from direct sunlight in such a shallow medium had not yet been worked out; while the opaque plastic that walled the laboratories within the rivers was a concession to their strength, since the clear plastic that would have provided aquarium walls for the lab and complete inspection for a constant and overall check of the ecological experiments had been overruled by U.N. Budget Control. Portholes at various spots made the seaquariums visible from any part of the rim, but in Dr. Millie's laboratory alone were the large panels of clear plastic that gave a real view into the rivers.

This ecological maze of rivers and eddies and balance tanks; of air jets and current and micro-life; of spin-rate-control and shielding, were all keyed to servo-regulated interdependence that for this self-contained

world replaced the stability achieved in larger ecologies through survival mechanisms.

Within the maze, existing by it and contributing to it, were the laboratories concerned with other things, but surrounded by the waters that had made life's beginnings possible on Earth, and the continuance of life possible in space. Man might some day live in space almost totally without water, but for now they had brought a bit of the mother waters with them.

Sitting in complacent control of these overall complexities that must be met with automatic accuracy was the Starrett Analogue/Digital Computer, Optical Wave type 44-63, irreverently referred to by the acronymically-minded as Sad Cow, though more frequently as the Sacred Cow, or simply Cow.

Most of the computer's intricate circuits were hidden behind the bulkhead in a large compartment between the control center and the south polar lock; but it was from this console in the control center that her operation was keyed.

From this position, every function of the wheel was ordered.

This was the bridge.

Spaced equally around its thirty-two-foot ring-shaped floor were the computer's console where Bessie presided; the com center in charge of Communications Officer Clark; and the command console where Captain Naylor Andersen, commanding officer of Space Lab One had his formal, though seldom-occupied post.

At the moment, Nails Andersen was present, black cigar clamped firmly between his teeth; hamlike Norwegian hands maneuvering a pencil, he was making illegible notes on a scrap of paper—illegible to others because they were in his own form of shorthand that he had worked out over the years as he tried to make penciled notes as fast as his racing mind worked out their details.

Whether Nails were politician or scientist would be hard to say. Certainly his rise through the ranks of U.N. Bureaus had been rapid; certainly in this rise he had been political, with the new brand of politics that men were learning—world, rather than national politics. Certainly, also, he was a scientist; and certainly he had used his political abilities on the behalf of science, pushing and slashing at red-tape barriers.

Nails was more than most responsible for the very existence of U.N. Space Lab One, and Project Hot Rod besides. He was also a sponsor of

many other projects, both those that had been done and those that were yet to be done.

The justification of a space project in these times was difficult indeed; for no longer could nations claim military superiority as a main reason for pushing forward across the barriers of the inner marches of space; for spending billions in taxes in experimental research. For a project to achieve reality now, it must have benefits, visible benefit, for the majority of mankind. It must have a *raison d'être* that had nothing of a military flavor. And occasionally Nails had been hard put to explain why, to people who did not understand; to explain his feeling that men must expand or die; that from a crowded planet there could be only one frontier, and that an expansion outward into space.

Of course there were, Nails admitted to himself, other frontiers. The huge basin of the Amazon had been by-passed and ignored by man, and quite possibly would be in the future as well. The oceans, covering seventy-five per cent of Earth's surfaces also presented a challenge to man, and the possibility of a new frontier of conquest.

But these did not present the limitless frontier for expansion offered by space. Men must look upon them as only temporary challenges, and cherish them as remaining problems, never to be solved for fear of a loss of the problem itself.

Yet space was different. Here man's explorations could touch upon infinities that were beyond comprehension, into that limitless void man could plunge ever outward for thousands of generations without ever reaching a final goal or solving a last problem. Here was a frontier worthy of any man, against which the excess energies of a warrior spirit might be expended without harm to their fellows.

To open a crack in this frontier was Nails' supreme goal, because, once opened, men need never fight again amongst themselves for lack of a place to go or a thing to do.

Space Lab One had been in spin for two days.

On Earth, TV viewers no longer demanded twenty-four hours of Lab newscasts, and were returning to their normal cycles of Meet the Press, the Doctor's Dilemma, and the Lives of Lucy, and other juicier items of the imagination that, now that their lab was a functioning reality, seemed far more exciting than the pictures of the interminably spinning wheel and the interviews with scientists aboard that had filled their screens during the spin-out trial period.

On the wheel itself, life was settling into a pattern, with comments about being able to stand upright becoming old hat.

In rim sector A-9, Dr. Claude Lavalle's birds and beasts had adapted themselves to the light gravity; and their biological mentor had evolved feeding, watering, and cleaning methods that were rapidly becoming efficient.

Next door, Dr. Millie Williams' FARM had survived the "take-off" and the plants, grateful for their new, although partial gravity, were now stretching themselves towards the overhead fluorescents in a rather fantastic attempt to imitate the early growing stages of Jack's famous beanstalk.

In the machine shop, Paul Chernov carefully inspected the alignment of the numeric controlled laser microbeam milling and boring machine, brought it to a focus on a work piece, and pressed an activation switch that started the last pattern of tiny capillary holes in the quartz on which he was working. In moments the pattern was completed.

Gently removing the work piece from its mounting, he turned to the open double bulkhead that served as an air lock in emergencies and that separated his shop from the physics lab beyond, where Dr. Y. Chi Tung, popularly known as Ishie, was busy over a haywire rig, Chief Engineer Mike Blackhawk and Tombu beside him.

Reverently, Dr. Chi took the part from Paul's hands. "A thousand ancestral blessings," he said. "Confusion say the last piece is the most honored for its ability to complete the gadget, and this is it.

"Of course," he added, "Confusion didn't say whether it would work or not."

"What does the gadget do?" asked Paul.

"Um-m-m. As the European counterpart of Confusion, Dr. Heisenberg might have explained it, this is a device to confuse confusion by aligning certainties and creating uncertainties in the protons of this innocent block of plastic." The round, saffron-hued Chinese face looked at Paul solemnly.

"As the good Dr. Heisenberg stated, there is a principle of confusion or uncertainty as to the exact whereabouts of things on the atomic level, which cannot be rendered more exact due to disturbance caused by the investigation of its whereabouts. My humble attempt is to secure a sufficiently statistical sample of aligned protons to obtain data on the distortion of the electron orbits caused by an external electrostatic field, thus rendering my own uncertainties more susceptible of analysis in a statistical manner."

Suddenly he grinned. "It's a take-off," he said, "from the original experiments in magnetic resonance back in '46.

"The fields generated in these coils are strong enough to process all the protons so that their axis of spin is brought into alignment. At this point, the plastic could be thought of as representing a few billion tiny gyroscopes all lined up together.

"Matter of fact," he said in an aside, "if you want a better explanation of that effect, you might look up the maintenance manual on the proton gyroscopes that Sad Cow uses. Or the manuals for the M.R. analyzer in the chem lab. Or the magnetometer we use to keep a check on Earth's magnetic field.

"So far, about the same thing.

"What I'm trying to do is place radio frequency fields and electrostatic fields in conjunction with the D.C. magnetic field, so as to check out the effect of stretching the electron orbits of the hydrogen atoms in predictable patterns.

"I picked this place for it, because it was as far away from Earth's field as I could get. And Mike, when I get ready to test this thing, I'm going to pray to my ancestors and also ask you to turn off as many magnetic gadgets as you safely can."

Mike was squatting on his heels by the haywire rig, built into what looked suspiciously like a chassis extracted from one of the standard control consoles of the communication department.

Reaching gingerly in through the haywire mass of cables surrounding the central components, he pointed to one of the coils and exclaimed in the tones of a Sherlock Holmes, "Ah-ha, my dear Watson! I have just located the final clue to my missing magnaswedge. I suppose you know the duty cycle on those coils is only about 0.01?"

"Not after I finished with them!" Ishie grinned unrepentant. "Besides, I don't want to squash anything in the field. I just want a nice, steady field of a reasonable magnitude. As Confusion would say, he who squashes small object may unbalance great powers."

While he talked, Ishie had been busy inserting the carefully machined piece of quartz plate that Chernov had brought, into a conglomeration of glassware that looked like a refugee from the chem lab, and flipped a switch that caused a glowing coil inside a pyrex boiler to heat a small quantity of water, which must escape through the carefully machined capillary holes in the plate he had just installed. Each jet would pass through two grids, and on towards a condenser arrangement from which

the water would be recirculated into the boiler by a small pump which was already beginning to churkle to itself.

"O.K.," Mike said. "I dig the magnetic resonance part. And how you're using the stolen coils. But what's this gadget?" and he pointed to the maze of glass and glass tubing.

"Oh. Permit me to introduce Dr. Ishie's adaptation of a French invention of some years previous, which permits the development of high voltages by the application of heat to the evaporation of a fluid medium such as water—of which we have plenty aboard and you won't miss the little that I requisitioned—causing these molecules to separate and pass at high speed through these various grids, providing electrostatic potentials in their passage which can be added quite fantastically to produce the necessary D.C. field which... ."

As he spoke, Mike's finger moved nearer a knob-headed bolt that seemed to be one of the two holding the glass device to its mounting board, and an inch and a half spark spat forth and interrupted the dissertation with a loud "Yipe!"

"Confusion say," Ishie continued as Mike stuck his finger in his mouth, "he who point finger of suspicion should be careful of lurking dragons!"

"Anyhow, that's what it does. There are two thousand separate little grids, each fed by its capillary jet, and each grid provides about ninety volts."

Tombu took the opportunity to inquire, "Have you got that RF field-phase generator under control yet?" He pointed to still another section of the chassis.

"Oh, yes." The physicist nodded. "See, I have provided a feedback circuit to co-ordinate the pick-up signal with the three-phase RF output. The control must be precise. Can't have it skipping around or we don't get a good alignment."

There was a gurgling churkle from the innocent-looking maze as the "borrowed" aerator pump from the FARM supplies began returning the condensate back to the boiler.

Major Steve Elbertson stood on the magnetic stat-walk of the south polar loading lock, gazing along the anchor tube to Project Hot Rod five miles away.

"There are no experts in the ability to maneuver properly in free fall," he told himself, quieting his dissatisfaction with his own self-conscious efforts at maintaining the military dignity of the United Nations Security

Forces in a medium in which a man inevitably lost the stances that to him connotated that dignity.

Awkwardly, he attached the ten-pound electric device affectionately known to spacemen as the scuttlebug, to the flat ribbon-cable that would both power and guide him to Hot Rod.

As the wheels of the scuttlebug clipped over the ribbon-cable, one above and two below, and made contact with the two electrically conductive surfaces, he saw the warning light change from green to red, indicating that the ribbon was now in use, and that no one else should use it until he had arrived at the far end.

Seeing that the safety light was now in his favor, he swung his legs over the seat—a T-bar at the bottom of the rod which swung down from the drive mechanism—grasped the rod, and pulled the starting trigger.

The accelerative force of one gee, the maximum of which the scuttlebug was capable, provided quite a jolt, but settled down very quickly to almost zero as he picked up speed and reached the maximum of one hundred twenty miles per hour.

A very undignified method of travel, he thought. Yet for all that, the scuttlebugs were light and efficient, and reduced transit time between outlying projects and the big wheel to a very reasonable time, compared to that which it would take for a man to jump the distance under his own power—and, he thought, without wasting the precious mass that rockets would have required.

The low voltage power supplied by the two flat sides of the ribbon was insufficient to have provided lethal contact, even if the person were there without the insulation of a spacesuit around him, a very unlikely occurrence. Furthermore, the structure of the cable, with the flat, flexible insulation between its two conductive surfaces, made it practically impossible to short it out; and the flanged wheels of the scuttlebug clipped over it in such a fashion that, once locked, it was thought to be impossible that they could lose their grip without being unlocked.

As Steve gained speed along the ribbon, "his" Project Hot Rod was in view before him—appearing to be a half moon which looked larger than the real moon in the background behind it; and seeming to stand in the vastness of space at a distance from the far end of the long anchor tube, a narrow band of bright green glowing near its terminator line.

From the rounded half of the moon, extending sunward, four bright, narrow trceries seemed to outline a nose that ended in a pale, globular tracery at its tip, pointing to the sun.

The narrow tracteries were in actuality four anchor tubes, similar to the one beside which he rode; and mounted in their tip was the directing mirror that would aim Hot Rod's beam of energy.

Project Hot Rod was actually a giant balloon eight thousand feet in diameter, one-half "silvered" with a greenish reflective surface inside that reflected only that light that could be utilized by the ruby rods at its long focal center; and that absorbed the remainder of the incident solar radiation, dumping it through to its black outside surface, and on into the vastness of space. This half of the big balloon was the spherical collector mirror, facing, through the clear plastic of its other half, the solar disk.

Well inside the balloon, at the tip of the ruby barrel that was its heart, were located the boiler tubes that activated the self-centering inertial orientation servos which must remain operational at all times. If the big mirror were ever to present its blackened rear surface to the sun for more than a few minutes, the rise in temperature would totally destroy the entire project. Therefore, these servos had been designed as the ultimate in fail-safe, fool-proof control to maintain the orientation of the mirror always within one tenth of one degree of the center of Sol.

Their action was simplicity itself. The black boiler tubes were shielded in such a way that so long as the aim was dead center on the sun they received no energy; but let the orientation shift by a fraction of a degree, and one of these blackened surfaces would begin to receive reflected energy from the mirror behind it; the liquid nitrogen within would boil, and escape under pressure through a jet in such manner as to re-orient the position to the center of the tracking alignment.

Since the nitrogen gas escaped into the balloon, the automatic pressure regulator designed to maintain pressure within the balloon would extract an equal quantity of gas, put it back through the cooling system on the back side of the mirror, and return it as liquid to the boiler.

These jets were so carefully and precisely balanced that there was virtually no "hunting" in the system.

The balloon itself was attached to its anchor tube by a one hundred meter cable that gave free play to these orientation servos. The anchor point was the exact center of the black outside surface of the mirror-half of the balloon; and beside that anchor point was the air lock to the control center, to which Steve was now going.

From the control room, a column extended up through the axis of the balloon for thirty-five hundred feet—and most of the surface of this column was covered with the new type, high power ruby rods, thirty

feet long and one-half inch in diameter, mounted in tubular trays of reflective material which took up sufficient space to make each rod occupy two inches of the circumference of the tube on which it was mounted.

These ruby rods were the heart of the power system, converting the random wave fronts of noncoherent light received from the mirror into a tremendous beam of coherent infrared energy which could be bundled in such a pattern as to reach Earth's surface in a focal point adjustable from here to be something between twenty-two feet in diameter to approximately one mile in diameter.

The banks of rods were so arranged that each of the one hundred sections comprising the three thousand feet of receptive surface at the focus of the mirror formed a concentric circle of energy beams; each circle becoming progressively smaller in diameter, so that the energy combined into one hundred concentric circles, one within the other, as it left the rods; but these circles were capable of the necessary focusing that could bring them all together into a single small point near Earth's surface.

The beam leaving the rods represented three hundred seventy-five million watts of energy, tightly packaged for delivery to Earth. But this was only a small fraction of the solar energy arriving at the big mirror.

The remainder, the loss, must be dumped by the black surface at the back; and to account for the loss in the rods themselves, to prevent their instantaneous slagging into useless globules of aluminum oxide, their excess loss energy must also be dumped.

A cooling bath of liquid nitrogen therefore circulated over each rod and brought the excess heat to the rear of the big lens, where it, too, could be dumped into the blackness of space beyond.

For all its size and complexity, Hot Rod was only a trifle over six per cent efficient; but that six per cent of efficiency arriving on Earth would be highly welcome to supplement the power sources that statistics said were being rapidly depleted.

The spherical shape of the mirror itself, one of the easiest possible structures to erect in space, had dictated the placement of the rods through its center since there was no single focal point for the entire mirror surface.

But it had also added a complication. From this position, the rods could have been designed to fire either straight forward or straight back.

However, due to the hollow nature of the thirty-five hundred foot laser barrel; the necessity for access to the rods from inside that barrel; and the placement of the control booth at its outside end, the firing could

only be forward, straight towards the sun on which the mirror was focused.

But to be useful, the beam must be able to track an ever-moving target.

This problem had been solved by one of the largest mirror surfaces that man had ever created—flat to a quarter of a wave-length of light, and two hundred fifty feet in diameter, the beam director, from this distance looking as though it were a carelessly tossed looking-glass from milady's handbag, anchored one diameter forward of the big power balloon.

For all its size, this director mirror had very little mass. Originally it had been planned to be made of glass in much the same manner as Palomar's 200-inch eye. But this plan had been rejected on the basis of the weight involved.

Instead, its structure was a rigid honeycomb of plastic; surfaced by a layer of fluorocarbon plastic which had been brought to its final polish in space, and then carefully aluminized to provide a highly reflective, extremely flat surface.

This mirror was also cooled by the liquid nitrogen supplied from the back side of the big mirror. Necessarily so, since even its best reflectivity still absorbed a sufficient portion of the energy from the beam it deflected to have rapidly ruined it if it were not properly cooled.

The several tons of ruby rods in the barrel, with their clear sapphire coatings, were far more valuable than any gems of any monarch that had ever lived on Earth. Synthetic though they were, Steve Elbertson, the project's military commander, knew they had been shipped here at fantastic cost and were expected to pay for themselves many thousands of times over in energy delivered.

As yet, the project had had no specific target; nor had it been fully operational as of midnight yesterday.

But this "morning" for the first time the terrific energy of the laser beam would be brought to bear on the Greenland ice cap—three hundred seventy-five million watts of infrared energy adjusted to a needle-point expected to be twenty-two feet in diameter at Earth's surface, delivering one million watts per square foot, that should put a hole a good way through the several thousand feet of glacier there in its fifteen minutes of operation, possibly even exposing the bare rock beneath, and certainly releasing a mighty cloud of steam.

Focused to this needle sharpness, the rate of energy delivery was many orders of magnitude higher than that delivered by man's largest nuclear weapons only a few yards from ground zero.

Today's test was primarily scheduled as a test of control in aiming and energy concentration. Careful co-ordination of the project by ground control was vital, so that no misalignment of the beam could possibly bring it to bear on any civilized portion of Earth's surface. For, fantastic as this Project Hot Rod might be as a source of power for Earth, Major Elbertson knew that it was also the most dangerous weapon that man had ever devised.

Therefore, the scientists were never alone in the control booth, despite the mile-long security records of each. Therefore, he and his men were in absolute control of the men who controlled the laser.

Therefore, too, Steve told himself, as the time came when there would be a question of command between himself and Captain Nails Andersen, science advisor to the U.N. and commander of Space Lab One, his own secret orders were that he was to take command—and the rank that would give him that command was already bestowed, ready for activation.

Nails Andersen, Steve reminded himself with amusement, had originated the laser project; had fought it through against the advice of more cautious souls; and had, through that project, attained command of the space lab, and the rank that made that command possible, all in the name of civilian science.

But not command of the laser project, Steve told himself.

Not of the most dangerous military weapon ever devised—dangerous and military for all that it was a civilian project, developed on the excuse that it would power Earth, which was rapidly eating itself out of its power sources.

Not in command of that, Steve told himself. Nobody but a military man could properly protect—and if necessary, properly use—such power.

Those were his secret orders; and he had the papers—and the authority from Earth—to back him up. And orders to shoot to kill without hesitation if those orders were questioned.

Meantime, today's peacetime experiment would bring forcibly to the attention of Earth both the power for good and the power for destruction of the laser which he commanded.

Project Hot Rod was manned twenty-four hours a "day." The new shift of scientists—the ones who would turn on the powerful—or

deadly—beam, would come aboard in about half an hour. The men who had put the finishing touches on the project during the past shift would remain for another hour. His own crew of Security men shifted with the scientists—but he, himself, shifted at will.

The immensity around him went unheeded as Steve Elbertson, eyes on Project Hot Rod, savored the power of the beam that could control Earth.

In the observatory, Perk Kimball and his assistant Jerry Wallace were having coffee as the various electronic adjuncts to the instruments of the observatory warmed up. Transistors and other solid state components that made up the majority of the electronic equipment in the observatory required no "warm up" in the sense that the older electron tubes had—but when used in critical equipment, they were temperature sensitive, and he allowed for time to reach a stable operating temperature. Then, too, the older electron tubes had not been entirely replaced. Many of them were still in faithful service.

The day would not be spent in the observation which was their main job there, because calibration of many of the instruments remained to be done, and the observatory was behind schedule, having had a good deal of its time taken up in the sightings required by the communications lab and Project Hot Rod.

Both of the astronomers were heartily sick of spending so much of their observational time with recalcitrant equipment; and in making observations of the globe from which they had come. After all, why should an astronomer be interested in Earth? Though admittedly this was the first observatory in man's entire history that had had the opportunity for such a careful scrutiny.

"This flare business, that our captive Indian was predicting," Jerry asked. "Think there's anything to it? Or am I just learning rumors about my profession from lay sources?"

"A rather presumptuous prediction, though he may be right." Perk's clipped tone was partly English, partly the hauteur of the professional. To him, solar phenomena were strictly sourced on the sun, and if they were to be understood at all, it would be in reference to the internal dynamics of the sun itself.

"The torroidal magnetic fields dividing the slowly rotating polar regions from the more rapid rotation near the solar equator," he said slowly, rather pedantically, but as though talking to himself, "should have far more effective control over solar phenomena than the periodic

unbalance created by the off-center gravitic fields when the inner planets bunch on the same side of their solar orbits.

"To imply otherwise would be rather like saying that the grain of sand is responsible for the tides.

"Yet," he added honestly, "the records compiled by some of the communications interests that used to be greatly disturbed by the solar flares' influence on radio communications, seem to indicate that there is a connection. So there is the possibility, however remote, that our captive red-skin might be right; or rather, that there is a force involved that makes the two coincidental."

But even as he talked, an unnoticed needle on the board began an unusual, wiggling dance, far different from its ordinary, slow averaging reactions. Twice, without being noticed, it swung rapidly towards the red line on its meter face; and then on its third approach the radiation counter swung over the red line and triggered an alarm.

From only one source in their environment could they expect that level of X-ray intensity. Without so much as a pause for thought, as the alarm screamed, barely glancing at the counter, Perk reached for the intercom switch and intoned the chant that man had learned was the great emergency of space: "Flare, flare, flare—take cover."

Simultaneously, he flipped three switches putting the observatory, the only completely unshielded area within the satellite, on automatic, to record as much as it could of the progress of the solar flare with its incomplete equipment, while he and Jerry dove through the open air lock down the central well to the emergency shield room in the center of the hub.

It was a poor system, Perk thought, that hadn't devised sufficient shielding for the observatory so that they could watch this phenomenon more directly. "We'll have to work on that problem," he told himself and since his recommendations would carry much weight after this tour of duty, he could be sure that any such system that he could devise would be instrumented.

Major Steve Elbertson, caught in mid-run between the lab and Project Hot Rod, resisted the temptation to reverse the scuttlebug on the line and pull himself to a fast stop, as the flare warning from the observatory came to him over the emergency circuit of his suit, followed by Bessie's clipped official voice saying:

"A flare is in progress. Any personnel outside the ship should get in as rapidly as possible. Personnel in the rim have seven minutes in which to

secure their posts and report to the flare-shield area in the hub. Spin deceleration will take effect in three minutes; and we are counting on my mark towards deceleration. Mark, three minutes."

The Security officer squeezed the trigger of the "bug" tighter in a vain effort to force it and himself forward at a higher speed.

The lesser shielding of the Hot Rod control room would not provide a sufficient safety factor even for the X rays that he knew were already around him; but he must supervise the security of the shutdown; and he could only be very thankful that he was already nearly there and would not have to make the entire round trip under emergency conditions.

The scuttlebug automatically reversed and began slowing for the end of its run—tripped by a block signal set in the ribbon cable. As it came to a stop at the end of the long anchor tube, Steve dismounted and kicked over the short remaining distance, which was spanned only by a slack cable to permit the inertial orientation servos of Hot Rod unhindered freedom to maintain their constant tracking of the solar disk.

Passing through the air lock of the control room, he reflected that his exposure would probably be sufficient to give a touch of nausea in the first half hour.

Inside Hot Rod control there was little excitement. The equipment was being turned off in the standard approved safety procedures necessary to turn control over to the laser communication beam which would put the project under Earth control at Thule Base, Greenland, until the emergency was over.

This separate, low-power control beam, focused on Thule Base nearly eighty miles away from the main focus of Hot Rod on its initial target, carried all of the communications and telemetry necessary for the close co-ordination between Thule and the project.

As Elbertson entered, the Hot Rod communications officer was switching each of the control panels in turn to Earth control, while Dr. Benjamin Koblensky, project chief, stood directly behind him, supervising the process. Elbertson took up his post beside Dr. Koblensky, replacing the Security aide who had had the past shift. "Suit up," he said to the man briefly.

As the communications officer completed the turnover, and the other five scientists in the lab left their posts to suit up, the com officer glanced up, received a nod from Dr. Koblensky, and said into his microphone "All circuits have now been placed in telemetry security operation. On my mark it will be five seconds to control abandonment. Mark," he said after another nod from Dr. Koblensky. "Four, three, two, one, release."

His hand on the master switch, he waited for the green light above it to assure him that the communications lag had been overcome, and as the green light came on, pushed the switch and rose from the console.

Major Elbertson stepped behind him, scanned the switches, inserted his key into the Security lock, and turned it with a final snap, forcing a bar home through the handles of all of the switches to prevent their unauthorized operation by anyone until the official Security key should again release them. In the meantime, no function could be initiated within the laser system by anyone other than the Security control officer at Thule Base on Earth.

Hot Rod was secured, and its crew were taking turns at the lock to make the life-saving run back to the flare-shield area in the hub of Lab One.

Last man out, three minutes after the original alarm, Steve glanced carefully around his beloved control booth, entered the now-empty air lock, and reaching the outside vacuum dove fast and hard toward the anchor terminal and the scuttlebug that would take him swiftly to the big wheel and its comparative safety.

In the gymnasium that served under emergency conditions as the flare-shield area of the hub, long since dubbed the "morgue," the circular nets of hammocks that made it possible to pack six hundred personnel into an area with a thirty-two foot diameter and a forty-five foot length, were lowered. They would hardly be packed this time, since less than one-third of the complement were yet aboard.

Even so, each person aboard had his assigned hammock space, two and a half feet wide; two and a half feet below the hammock above; and seven feet long; and each made his way toward his assigned slot.

At one end of the morgue was the area where the cages of animals from Dr. Lavalley's labs were being stored on their assigned flare-shield shelves; and where Dr. Millie Williams was supervising the arrangements of the trays and vats of plants that must be protected as thoroughly as the humans.

At the other end of the morgue, the medics were setting up their emergency treatment area, while nearby the culinary crew pulled out and put in operating condition the emergency feeding equipment.

The big wheel's soft, susurrus lullaby had already changed to a muted background roar as her huge pumps drew the shielding waters of the rim into the great tanks that gave the hub twenty-four feet of shielding

from the expected storm of protons that would soon be raging in the vacuum outside.

The ship was withdrawing the hydraulic mass from its rim much as a person in shock draws body fluids in from the outer limbs to the central body cavities. The analogy was apt, for until danger passed, the lab was knocked out, only its automatic functions proceeding as normal, while its consciousness hovered in interiorized, self-protective withdrawal.

On the panel before Bessie the computer's projection of expected events showed the wave-front of protons approaching the orbit of Venus, and on the numerical panel directly below this display the negative count of minutes continued to march before her as the wave-front approached at half the speed of light.

The expected diminishment of X rays had not yet occurred. Normally, there would be a space of time between their diminishment and the arrival of the first wave of protons; but so far it had not happened.

Six minutes had passed, and the arriving personnel of Project Hot Rod came in through the locks from the loading platform, diving through the central tunnel over Bessie's head and on to the shielded tank beyond.

Seven minutes; and from Biology lab came an excited voice. "I need some help! I've lost a rabbit. I came back for the one I'd been inoculating but he got away from me, and I can't corner him in this no-gravity!"

Bessie wasn't sure what to say, but Captain Andersen spoke into his intercom. "Dr. Lavalley," he said in a low voice, but with the force of command, "ninety per cent of your shielding has already been withdrawn. Abandon the rabbit and report immediately to the hub!"

The pumps were still laboring to bring in the last nine per cent of the water that would be brought. The remaining one per cent of the normal hydraulic mass of the rim had been diverted to a very small-diameter tube at the extreme inner portion of the rim, and was now being driven through this tube at frantically higher velocities to compensate for the removal of the major mass, and to maintain a small percentage of the original spin, so that the hub would not be totally in free fall, though the pseudo-gravity of centrifugal force had already fallen to a mere shadow of a shadow of itself, and some of the personnel were feeling the combined squeamishness of the Coriolis effect near the center of the ship, and the lessening of the gravity, pseudo though it had been, that they had had with them in the rim.

As the last tardy technician arrived, the medics were already selecting out the nearly ten per cent of the personnel who had been exposed to abnormally dangerous quantities of radiation during the withdrawal

procedure, which included, of course, all the personnel that had been aboard Project Hot Rod at the time of the flare.

Even as the medics went about injecting carefully controlled dosages of sulph-hydral anti-radiation drugs, the beginnings of nausea were evident among those who had been overexposed. However, only the dosimeters could be relied on to determine whether the nausea was more from the effects of radiation; the effects of the near-free-fall and Coriolis experienced in the hub; or perhaps some of it was psychosomatic, and had no real basis other than the fear engendered by emergency conditions.

Major Steve Elbertson was already in such violent throes of nausea that his attending medic was having difficulty reading his dosimeter as he made use of the plastic bag attached to his hammock; and he was obviously, for the moment at least, one of the least dignified of the persons on board.

Displays of the various labs in the rim moved restlessly across most of the thirty-six channels of the computer's video displays, as Bessie scanned about, searching for dangerously loose equipment or personnel that might somehow have been left behind.

In the Biology lab, the white rabbit that had escaped was frantically struggling in the near-zero centrifugal field with literally huge bounds, seeking some haven wherein his disturbed senses might feel more at home, and eventually finding a place in an overturned wastebasket wedged between a chair and a desk, both suction-cupped to the floor. Frightened and alone, with only his nose poking out of the burrow beneath the trash of the wastebasket, he blinked back at the silent camera through which Bessie observed him, and elicited from her a murmur of pity.

Seven minutes and forty-five seconds. The digital readout at the bottom of Bessie's console showed the computer's prediction of fifteen seconds remaining until the expected flood of protons began to arrive from the sun.

As radiation monitors began to pick up the actual arrival of the wave front, the picture on her console changed to display a new wave front, only fractionally in advance of the one that the computer had been displaying as a prediction.

The storm of space had broken.

Captain Andersen's voice came across the small area of the bridge that separated them. "Check the rosters, please. Are all personnel secured?"

Bessie glanced at the thirty-two minor display panels, checking visually, even as her fingers fed the question to the computer.

The display of the labs, now that the rabbit was settled into place, showed no dangerously loose equipment other than a few minor items of insufficient mass to present a hazard, and no personnel, she noted, as the Cow displayed a final check-set of figures, indicating that all personnel were at their assigned, protected stations in the morgue, in the engineering quarters, and on the bridge.

"All secure," she told the captain. "Evacuation is complete."

"Well handled," he said to her, then over the intercom: "This is your captain. Our evacuation to the flare-shield area is complete. The ship and personnel are secured for emergency conditions, and were secured well within the time available. May I congratulate you."

"The proton storm is now raging outside. You will be confined to your posts in the shield area for somewhere between sixteen and forty-eight hours."

"As soon as it is possible to predict the time limit more accurately, the information will be given to you."

As he switched out of the ship's annunciator system, Captain Nails Andersen leaned back in his chair and stretched in relief, closing his eyes and running briefly over the details of the evacuation.

When he opened them again, he found a pinch bottle of coffee at his elbow, and tasting it, found it sugared and creamed to his preference. His eyes went across the bridge to the computer console, and lingered a moment on the slender, dark figure there.

Amazing, he thought. The dossier, the personal history, her own and all the others aboard, he had studied carefully before making a selection of the people who would be in his command for this time. Not that the decision had been totally his, but his influence had counted heavily.

This one he had almost missed. Only by asking for an extra survey of information had he caught that bit about the riot at Moscow University that had raged around her ears, apparently without touching or being influenced by or influencing her own quiet program.

That they didn't think alike was evident. That this was a competent sociologist, and not just a computer technician had not at first been evident. But Nails was well pleased with his decision in the selection of this particular unit of his command.

Things would go well in her presence, he felt. Details he might have struggled with would iron out or disappear, and scarcely come to his attention at all.

Very competent, he thought. And attractive, too.

In the engineering compartment, Mike was adjusting the power output from the pile ten miles away, down from the full emergency power that had been required to pump the more than five hundred thousand cubic feet of water from the rim to the hub in seven minutes, to a level more in keeping with the moderate requirements of the lab as it waited out the storm.

As he threw the last switch, he became aware of a soft scuffling sound behind him, and turned to see tiny Dr. Y Chi Tung, single-handedly manhandling through the double bulkhead the bulky magnetic resonance device on which he had been working when the flare alarm sounded, and having the utmost difficulty even though the near free-fall conditions made his problem package next to weightless.

The monkeylike form of the erudite physicist, dwarfed by the big chassis, gave the appearance of a small boy trying to hide an outsize treasure; but the nonchalant humor that normally poked constant fun at both his profession as a physicist and the traditions of his Chinese ancestors, was lacking.

Dr. Ishie was both breathless and worried.

"Mike," he gasped. "I was afraid to leave it, unshielded. It might pick up some residual activity. Radiation, that is. From those hydrogen hordes outside." He let the object rest for a moment, mopping his head while he talked. "Can you hide it in here? I'm not really anxious to have Budget Control know where some of this stuff went—even though I have honorable intentions of returning the components later—and the good captain down there on the bridge might not consider its shielding important, either, if he knew I'd sabotaged his beautiful evacuation plan to bring my pet along!" The tone of Ishie's voice indicated his uncertainty as to Mike's reception.

The idea of Dr. Y Chi Tung worrying about any components he might have "requisitioned" seemed almost irreverent to Mike. Budget Control would gladly have given that eminent physicist a good half of the entire space station, if he had expressed his needs through the proper channels—as a matter of fact, anything on board that wasn't actually essential to the lives of those on the satellite.

But Ishie seemed genuinely unaware of his true status, and the high regard in which he was held. Besides, Mike suspected in him a constitutional inability to deal through channels.

Recognizing the true sensitivity that underlay Ishie's constant humor and ridicule of himself, Mike kept himself from laughing aloud at the stealth of the man who could have commanded the assistance of the captain himself in shielding whatever he thought it necessary to shield.

Instead, he carefully kept his face solemn while he commented: "It ought to fit in that rack over there." He pointed to a group of half-filled racks. "We can slip a fake panel on it. Nobody will be able to tell it from any of the other control circuits."

Ishie heaved a deep sigh of relief and grinned his normal grin. "Confusion say," he declared, "that ninety-six pound weakling who struggle down shaft with six hundred pound object, even in free fall, should have stood in bed."

It took the two of them the better part of half an hour to get the unit into place; to disguise its presence; and to make proper power connections. Ishie had objected at first to connecting it up, and Mike explained his insistence by saying that "If it looks like something that works, nobody will look at it twice. But if it looks like something dead, one of my boys is apt to take it apart to see what it's supposed to be doing." He didn't mention his real reason—a heady desire to run a few tests on the instrument himself.

The job done, the two sat back on their heels, admiring their handiwork like bad boys.

"Coffee?" asked Mike.

"Snarl. Honorable ancestor Confusion doesn't even need to tell me what to do now. My toy is safe. I am going to bed. I have worked without stopping for two days and now the flare has stopped me.

"Confusion decide to relent. He tell me now: 'He who drive self like slave for forty-eight hours is nuts and should be sent to bed.' I hope," he added, "that the hammocks are soft; but I don't think I shall notice. I know just where to go for I checked in once to fool the Sacred Cow before I went to get my beautiful. Now I go back again."

And without so much as a thank-you, he staggered out, grasping for hand-holds to guide himself in a most unspacemanlike manner.

Mike craftily sat back, still on his heels beside the object, and watched until Ishie had disappeared, and then turned his full interest to the playtoy that fortune had placed in his shop.

Without hesitation he removed the false front they had so carefully put in place. He still had a long tour of duty ahead, and it was very unlikely that he would be interrupted, or, if interrupted, that anyone would

question the object on which he worked. It would be assumed that this was just another piece of equipment normally under his care.

Carefully he looked over the circuits, checking in his mind the function of each. Then he went to his racks and began selecting test equipment designed to fit in the empty racks around it. Oscilloscope, signal generator, volt meters and such soon formed a bank around the original piece of equipment, in positions of maximum access.

Gingerly he began applying power to the individual circuits, checking carefully his understanding of each component.

The magnetic field effect, Ishie had explained; but this three-phase RF generator—that puzzled him for a while.

Then he remembered some theory. Brute strength alone would not cause the protons to tip. Much as a top, spinning off-center on its point, will swing slowly around that point instead of tipping over, the spinning protons in the magnetic field would precess, but would not tip and line up without the application of a rotating secondary magnetic field at radio frequencies which would make the feat of lining them up easy.

There, then, were two of the components that Ishie had built into his device. A strong magnetic field supplied by the magnaswedge coils—stolen magnaswedge coils if you please—and a rotating RF field supplied by the generator below the chassis.

But this third effect? The DC electric field? That one was new to him.

In his mind he pictured the tiny gyroscopes all brought into alignment by the interplay of magnetic forces; and around each proton the tiny, planetary electrons.

Yet it was very well to think of the proton nucleus of the hydrogen atom as a simple top, he reminded himself; but they were more complex than that. Each orbiting electron must also contribute something to the effect.

At that point, Mike remembered, the electron itself would be spinning, a lighter-weight gyroscope, much as Earth has a lighter weight than the Sun. The electron, too, had a magnetic field; more powerful than the proton's field because of its higher rate of spin, despite its lighter mass. The electron could also be lined up.

Somewhere in the back of his mind, Mike remembered having read of another effect. The electron's resonance. Electron para-magnetic resonance.

It, too, could be controlled by radio frequencies in a magnetic field—but the frequencies were different, far up in the microwave region; about three centimeters as Mike recalled—and he went back to his

supply cabinet to get another piece of equipment, a spare klystron that actually belonged to the radar department but that was "stored" in his shop.

At these frequencies, the three centimeter band of the electromagnetic spectrum, energy does not flow on wires as it does in the lower frequency regions. Here plumbing is required. But Mike, amongst other things, was an expert RF plumber.

Even experts take time to set up klystrons, and it was three hours later before Mike was ready with the additional piece of haywire equipment which carefully piped RF energy into the plastic block.

This refinement by itself had been done before; but some of the others that Mike applied during his investigation probably hadn't—at least not to any such tortured piece of plastic as now existed between the pole faces of the device.

To have produced the complete alignment of both the protons and the electrons within a mass might have been attempted before. To have applied an electrostatic field in addition to this had perhaps been attempted before. To have done all three, at the same time to the same piece of plastic, and then to have added the additional tortures that Mike thought up as he went along, was perhaps a chance combination, repeatable once in a million tries, one of those experimental accidents that sometimes provide more insight into the nature of matter than all of the careful research devised by multi-million-dollar-powered teams of classical researchers.

When the contraption was in full operation, he simply sat on his heels and watched, studying out in his mind the circuits and their effects.

The interruption of the magnetic resonance by the electrostatic field—by the DC—with the RF plumbing—twisted by—each time the concept came towards the surface, it sank back as he tried to pull it into consciousness.

Churkling to itself, the device continued applying its alternate fields and warps and strains.

"It's a Confusor out of Confusion by Ishie, who is probably as great a creator of Confusion as you could ask," Mike told himself, forgetting his own part in the matter, watching intently, waiting for the concept to come clear in his mind.

Presently he went over to his console, to his pads of paper and pencils, and began sketching rapidly, drawing the interlocking and repulsing fields, the alignments, mathing out the stresses—in an attempt to visualize just what it was that the Confusor would now be doing... .

In the Confusor itself, a tiny chunk of plastic, four by four inches square and one-half inch thick, resting in the middle of the machine between the carefully aligned pole-faces of the magnet, was subjected to the cumulatively devised stresses, a weird distortion of its own stresses and of the inertia that was its existence.

Each proton and electron within the plastic felt an urge to be where it wasn't—felt a pseudo-memory, imposed by the outside stresses, of having been traveling at a high velocity towards the north star, on which the machine chanced to be oriented; felt the new inertia of that velocity... .

Each proton and electron fitted itself more snugly against the north pole face and pushed with the entire force of its newly-imposed inertial pattern.

Forty pounds to the square inch six hundred forty pounds over the surface of the block, the plastic did its best to assume the motion that the warped laws of its existence said that it already had.

It was only one times ten to the minus five of a gravity that the four by four by half inch piece of carefully machined plastic presented to the sixty-four million pound mass of Space Lab One.

But the force was presented almost exactly along the north-south axis of the hub of the ship, and in space a thrust is cumulative and momentum derives per second per second.

The Confusor churkled quietly as the piece of plastic exerted its tiny mass in a six hundred forty pound attempt to take off towards the north star. And, since the piece itself was rigidly mounted to its frame, and the frame to the ship, the giant bulk of five million cubic feet of water, thirty-two million pounds of mass; and the matching mass-bulk of the ship itself, responded to the full mosquito-sized strength of the six hundred forty pound thrust, and was moved—a fraction of a fraction of a fraction of a centimeter in the first second; a fraction of a fraction in the second; a fraction... .

On the bridge, the com officer had completed transmitting the captain's detailed report of the evacuation to the hub-shield area caused by the solar flare.

On another line, under Bessie's ministrations, the computer was feeding the data obtained by the incomplete equipment in the observatory in its automatic operation.

The captain himself was finishing a plastic-bottle of coffee, while he wrote up his log.

It was exactly nine minutes since the Confusor had come into full operation.

The fractions of fractions of centimeters had added on the square of the number of seconds; and the sixty-four million pounds of mass of Space Lab One has moved over thirteen meters.

Trailing the wheel ten miles off, was the atomic pile, directly attached to its anchor tube.

Tightening, each with a whanging snap too tiny to be remarked within the mass of the ship, were the cables that attached the various items of the dump to their anchor finger.

But still free on the loose one hundred meter cable that attached it to its anchor, and which had had fifteen meters of slack when the ship first began its infinitesimal movement, was Project Hot Rod.

Nine minutes and twenty-three seconds. The velocity of the wheel with its increasing mass of trailing items, was five point four six centimeters per second. The nearly four million pound mass of Hot Rod was slowly being left behind.

The cable tautened the final fraction of a centimeter. Its tug was not fast, but was unfortunately applied very close to the center of gravity of the entire device, since most of Hot Rod's weight was concentrated in and around the control room.

Five point four six centimeters per second. Four million pounds of mass.

If the shock had been direct, it would have equaled two point eight million ergs of energy, created by the fractional movement of the mighty mass of the ship against Hot Rod.

But the shock was transmitted through the short end of a long lever. The motion at the beam director mirror, a full diameter out from the eight thousand foot diameter balloon that was Hot Rod, was multiplied nearly sixteen thousand times. Hot Rod rolled on its center of gravity, and its beam-director mirror swung in a huge arc. Sixteen thousand centimeters per centimeter of original motion. Eight hundred and seventy-three meters in the first second, before the tracking servos took over and began to fight back.

Hot Rod fought at the end of its tether like a mighty jellyfish hooked on the end of a line.

Gradually the swings decreased. Four hundred meters; two hundred meters; one hundred meters; fifty meters; twenty-five meters—and it had come back to a nearly stable focus on the sun.

But the beam director had also been displaced, and vibrated. Internally, the communications beam to Thule Base had been interrupted; and the fail-safe had not failed-safely.

The mighty beam had lashed out. The vibrations of the directing mirror began placing gigantic spots and sweeps of unresistible energy across the ice cap of Greenland, in an ever-diminishing Lissajous pattern.

By the time the servos refocused the communications beam on Thule, there was no Thule; only a burnt-out crater where it had been.

Slowly, but surely, the giant balloon settled itself to the task of burning a hole through the Greenland ice cap at a spot eighty miles north of that now-burnt-out Thule Base that had originally been planned as a test of its accuracy; and to the simple task of holding that focus in spite of the now steady, though infinitesimal acceleration under which it joined the procession headed by Lab One.

Now that the waves of action and reaction from the shock energy of its sudden start had subsided, Hot Rod's accuracy was proving great indeed; and its beam focus was proving as small as had been predicted.

But the instruments that would have measured those facts no longer existed.

In the engineering control center of Space Lab One, the Confusor churkled quietly and continued to pit its mosquito might against its now nearly seventy-eight million pound antagonist, as the protons and electrons of the plastic that was center to its forces did their inertial best to occupy that position in space towards the north star in which the warped fields around them forced them to belong—the mosquito strained its six hundred forty pound thrust against its giant in the per second per second acceleration that was effective only in the fraction of a fraction of a fraction of a centimeter in the first second, but that compounded its fractions per second.

On the quiet bridge, the captain looked up as the Com Officer said, "Thule Base, sir," and switched on his mike.

"Hot Rod has been sabotaged," a frantic voice on the other end of the beam shouted in his ear without formalities. "She's running wild. Kill her! Repeat, Hot Rod is wild! Kill Hot Rod! Kill—" the mike went dead as Captain Andersen switched to the morgue intercom.

"Hot Rod crew," he said briefly. "Report to the bridge on the double. Repeat. Hot Rod crew. The bridge. On the double."

As he switched off the intercom, the communications officer spoke urgently. "Captain. I've lost contact with Thule base."

"Keep trying to raise them," Captain Andersen said. He turned to Bessie. "Give me a display of the Hellmaker," he said; then, almost to himself, "There's still a flare in progress out there. We've got to kill it without sending men into that—"

He cut himself off in midsentence, as the computer displayed both Hot Rod, swaying gently as she fought out the battle of the focus through its final moments, and a telescopic view of Greenland, a tiny, glowing coal of red showing at the center of her focus.

Through the door nearly catapulted the first of the Project Hot Rodders, followed almost on his heels by twelve more.

"Where is Major Elbertson?"

"In sick bay, sir. He got a big radiation dose—"

The captain flipped the intercom key.

"Calling Major Elbertson in sick bay. Report to the bridge on the double, no matter what your condition. This is the captain speaking."

The intercom came alive at far end.

"This is Dr. Green, Captain Andersen. Major Elbertson is unconscious. He cannot report for duty. He was extremely ill from exposure to radiation and we have administered sulph-hydral, antispasmodic, and sedative."

Nails Andersen turned to the project crew.

"Which of you are Security officers?"

Three men stepped forward.

"Are all the project members here?"

"No, sir," said one. "Eight of our men are in sick bay."

"Very well," said the captain. "Now hear this, all of you. There is a saboteur—maybe more than one, we do not know—among you. There is no time to find out which of you it is. However, he has managed to leave Project Hot Rod operational while unattended. You are to turn it off, and to prevent the saboteur from stopping you. Do you understand?"

A voice in back—a rather high voice—spoke up. "Of course it's operational," it said. "We left it operational."

"You ... WHAT?"

"We left it operational. It's under Earth control. The control center at Thule is in charge, sir."

"Who are you?" the captain asked.

"Hot Rod communications officer, sir. I turned it over last thing before we shut down. Under the instructions of Dr. Koblensky. That's the shut-down procedure."

"Where's Dr. Koblensky?"

"Out. Out like a light," said another voice. "He got a good dose. Of radiation. The medics put him out."

"Who's senior officer here?"

"I'm Dr. Johnston." It was a man in front. Rather small, pedantic-looking. "I'm Dr. Koblensky's ... well, assistant." The word came hard as though the fact of an assistantship were at the least distasteful.

"Who's senior in Security?"

"I, sir. Chauvenseer."

"Very well. Dr. Johnston and Chauvens ... sor? ... are in charge. Now shut down that ruby hellmaker as fast as it can be done."

"But, captain," Dr. Johnston spoke, "we can't turn it off. We haven't the authority. We haven't the Security key. And the radiation won't let up for hours."

"I have just given you the authority. As for the radiation, that's a hazard you'll have to take. What's this about a Security key?" The captain's voice was not gentle.

"Major Elbertson has the key. He has the only key. Without it, the station cannot be removed from Earth control. Earth *is* in control. They can turn it off, captain." Dr. Johnston's voice took on as firm a tone of authority as that of the captain.

"Chau ... Chau ... You!" barked the captain. "Get that key!" He waited until the Security officer had disappeared through the door, then turned to the scientist.

"Dr. Johnston, Earth is not in control. I do not know why, and there is no way of finding out. Hot Rod is wild, and *that*," he pointed at the enlarging red spot that centered the computer display, "is what your ruby is doing to Earth.

"You will turn off the project, at gunpoint if necessary," he continued in a grim voice. "If you turn it off volitionally, you will be treated for radiation. If you refuse, you will not live to be treated for anything. Do you understand? How many men do you need to help you ... and I do mean *you* ... with the job?" he asked.

Dr. Johnston hesitated only fractionally, and Nails Andersen mentally put him down on the plus side of the personnel for the shortness of his com lag. Then he said, "The job will require only two men for the fastest accomplishment. You realize, captain that you are probably signing our death warrants—the two of us. But," he added, glancing only casually at the display on the console, "I can understand the need to sign that warrant, and I shall not quibble."

The intercom spoke. "This is Dr. Green, captain. There is no key on the person of Major Elbertson. We have searched thoroughly, sir. I understand the need is of an emergency nature. The key is not on his person. We have taken every possible measure to arouse him, as well, and have been unsuccessful."

Andersen flipped his switch. "Let me speak to the Hot Rod Security officer," he said briefly.

"Chauvenseer speaking, sir," the man's voice came on.

"Do you know what the key looks like?"

"Yes, sir. It looks somewhat like a common Yale key, sir. But I've never seen another just like it."

"There is only the one?"

"Yes, sir."

"Where would he keep it, if not on his person?"

"I don't know, sir. We came straight to the morgue—the shield area, from the air lock. I don't believe he stopped off anywhere he could have put it."

The captain turned to the second Security officer. "Search Elbertson's spacesuit," he said. Then to the intercom, "Search his hammock. Search every spot he went near. That key must be found in minutes. Commandeer as many men as can help in the search without getting in the way."

He paused a moment, then flipped another intercom key.

"Mr. Blackhawk," he said.

The intercom warmed at the far end. "Yes sir?" Mike's voice was relaxed.

"Is there any way to turn off Hot Rod without the Security key?"

"Why sure, captain." Mike's voice held a grin. "I could pull the power switch."

"Pull it. Fast. Hot Rod's out of control."

Mike's hand flashed to a master switch controlling the power that fed Hot Rod, and blessing as he did it the fallacy of engineering that had required external power to power the mighty energy collector.

In the big balloon now happily following the wheel at the end of its tether, the still-undamaged power-off fail-safe went into operation. The mirror surface behind each ruby rod rotated into its shielding position, dispersing the energy that the huge mirror directed towards the rods, back into space.

Hot Rod was secure.

Mike received only one further communication from the captain.

"Mr. Blackhawk," he was asked over the intercom, "is there any way that you secure the Hot Rod power switch so that it cannot be turned on without my personal authorization?"

"Sure, captain, I can—"

The captain interrupted. "Mr. Blackhawk, I should prefer that you not tell me or anyone else aboard the method you will use; and that you make your method as difficult as possible to discover. This I shall leave," he added dryly, "to your rather ... fertile ... imagination.

"There is reason to believe that Project Hot Rod was turned on by a saboteur. Your method must be proof against him, and if he exists, he will not be stupid." The captain switched off.

Mike turned to the control panel, and after a few minutes thought busied himself for some time.

Then he headed for the bridge where Dr. Johnston, Chauvenseer, and the captain had dismissed the others and were utilizing every check that Dr. Johnston could dream up to assure themselves that Hot Rod was actually turned off and would remain secure at least for the duration of the flare; and trying as well to find out just what form the sabotage had taken.

Without interrupting the others, Mike seated himself at the subsidiary post at the computer's console on Bessie's right, and got her to brief him while he examined the close-up display of Hot Rod.

After a few minutes he reached over and increased the magnification to its maximum, showing only a small portion of the balloon, then moved the focus to display the control room entrance as well as part of the anchor tube and the cable between the two.

"I think I've found your saboteur, sir," he said.

The captain was at his side almost instantly. "Where is he?" he asked briefly.

"Not he, sir. It. And I'm not sure just where—but look. Hot Rod's cable is taut. There's thrust on the balloon. That probably means a puncture and escaping nitrogen.

"I think," he said, "that the saboteur may have been a meteor that punctured the balloon, and the nitrogen escaping through the hole it made is now producing enough thrust to keep that cable taut. Though," he added thoughtfully, "I don't see why the servos couldn't maintain the beam to Thule—though obviously, they couldn't."

"How dangerous is such a puncture?" asked the captain. "How seriously would Hot Rod be damaged? How soon must it be repaired?"

"The puncture itself shouldn't be too dangerous. Even if all the nitrogen's gone, the balloon's in a vacuum and won't collapse—and that's about the only serious effect a puncture would have. Just a moment. We'll estimate its size by the thrust it's giving the ship," he added, and turned to Bessie.

"Ask the Cow whether we're getting thrust on the ship; and if so, how much. Wait a minute," he added, "if you ask for thrust on the ship, she'll say there isn't any because Hot Rod would be pulling us, not pushing. And if you ask her for the thrust on Hot Rod, she hasn't got any sensors out there.

"Hm-m-m. Ask her if we have added any off-orbit velocity; and if so how much."

The computer displayed the answer almost as soon as she received the question.

"Well," said Mike, "that's not too large a hole. Ask her how ... let's see ... how many pounds of thrust that velocity represents. That way we don't confuse her with whether it's push or pull."

The Cow displayed the answer, six hundred forty pounds of thrust.

"O.K.," said Mike. "Thanks." Then to the captain and the scientist and Security officer who were waiting beside him: "The puncture is obviously small enough to serve as a jet, rather than to have let the nitrogen out in one *whoosh*, since that would have given you far more than six hundred forty pounds of thrust. Therefore, it will probably be quite simple to patch the hole.

"Nitrogen is obviously escaping, but it wouldn't be worth a man's life to send him out into that flare-storm to patch it. We may even have enough nitrogen aboard to replace what we lose.

"The best I can figure," he said, "is that the meteor must have hit the orientation servos and thrown them off for a bit. We'll have to wait till after the flare to make more than an educated guess, though.

"We shouldn't be too far off-orbit by the time the flare's over, either, even with that jet constant. It'll take quite a bit of work, but we should be able to get her back into position with not too many hours of lost worktime.

"Except for Thule, I'd say we got off fairly light.

"Yes," he added grimly, "it looks like that's what your saboteur was. Rather an effective saboteur, but you'll have a hard time putting him up against a firing wall."

Having satisfied himself as to existing conditions, Mike excused himself shortly and went back to the engineering quarters, but his mind was no longer on Ishie's strange device. He glanced rapidly at the instruments regulating the power flow to the wheel, then stretched out comfortably on the acceleration couch and in minutes was asleep.

The captain, Dr. Johnston and Chauvenseer remained on the bridge another hour, convincing themselves that Mike's analysis was correct, and dictating a report to Earth, before the captain called in an aide to take over the bridge, and the three retired.

In the morgue, Dr. Y Chi Tung, who still slept peacefully as he had since the moment he reached his hammock, muttered quietly in his sleep, "Confusion—"

Mike snapped awake and glanced guiltily at the clock. Six hours had passed.

A situation report from the Cow was the first thing on his agenda any time that he had been out of contact for any length of time, flare or not.

It was not his job to be in constant contact with the complete situation of the ship and its vast complexities; he was not the captain. Nor was it in the manuals that he should have access to the computer's huge memory banks and abilities other than through "channels"—i.e., Bessie. But the book definition of the information he needed for his job, and his own criteria, were somewhat different, and he had built on Earth and installed shortly after he came aboard, a subcontrol link which put him in direct contact with the placid-Cow.

His original intention in rigging the link had been to use the calculator for that occasional math problem which might be more quickly resolved with her help; but then the criteria of needed information, curiosity, or both, had got the better of him, and the secret panel hidden in the legitimate control panels of an engineer's console was actually quite a complete link, covering all of the Cow's multiple functions without interfering in any way with Bessie's control links, or revealing its existence. This linkage gave Mike the only direct access to the computer's store of information and abilities other than that of the operator at the control console.

And Mike's secret pride was the vocoder circuit with which he had terminated his link, originated because a teletype system similar to that used at the control console would have been too obvious; and his nimble fingers got all tangled up on a keyboard anyhow.

Bessie might speak to the Cow through the teletype link and switches of her control console, but only Mike had the distinction of being able to speak directly to the big computer, and get the complacent, somewhat mooring answers; and only Mike knew of the existence of the vocoder aboard.

It had taken some care to get used to the literal-minded conversation that resulted; but eventually Mike felt he had worked out a satisfactory communications ability with the overly obvious "cow."

What he wanted now was a situation report. If he simply asked for that, however, he'd have received such miles of data that he'd have been listening for hours. So instead he broke his question down into the facets that he needed.

In a few minutes he had elicited the information that the solar flare was now predicted to be terminated and the major part of the flare protons past their solar orbital position within another ten hours; that Earth co-ordinates had shifted, indicating their own orbital shift to be a trifle over thirty-seven kilometers north in the past eight hours.

North? he thought. Hot Rod's pull on a taut cable would be to the south.

No. Lab One could be re-oriented to trail the thrusting balloon. But the lab's servos should have prevented that re-orientation unless the thrust were really heavy.

"What is our velocity?" he asked. Temporarily he was baffled by the placid Cow's literal translation of his request as one for any actual velocity, since she had replied with a figure very close to their original orbital speed. "What is our velocity at right angles to original course?" he inquired.

And the Cow's reply came: "Two-o-o hundred and fifty-seven point seven six ce-entimeters per se-econd."

That should be about right for six hundred forty pounds of thrust for, say, six and a half hours; and the distance of the orbit shift was about right.

But the direction?

"Is Hot Rod pulling us north?" he asked.

"No-o-o," came the placid reply.

"If it's pulling us south, then why—" He stopped himself. Any "why" required inductive reasoning, and of that the Cow was not capable. Instead of asking why they were moving north with a south thrust, Mike broke his question into parts. He'd have to answer the "why" himself, he knew.

"Is Hot Rod pulling us south?" he asked.

"No-o-oo," came the answer.

This time he was more careful. "In which direction is the thrust on Hot Rod oriented?" he asked.

"No-oorth."

"Then Hot Rod is—" Quickly he stopped and rephrased the statement which would have had a question in its tone but not its semantics, into a question that would read semantically. "Is Hot Rod pulling us north?"

"No-o-oo," came the reply.

Carefully. "Is Hot Rod pulling us?"

"No-o-oo."

Mike was stumped. Then he figured a literalness in his phrasing.

"Is Hot Rod pushing or in any other way giving motion to Space Lab One?" he asked.

"No-o-oo," came the answer.

Now Mike *was* stumped.

"Is Space Lab One under acceleration?" he asked.

"Ye-es," said the Cow.

"Then where in hell is that acceleration coming from?" Mike was exasperated.

"We a-are uunder no-o-o acceleration fro-om he-ell," the literal mind told him.

Mike laughed ruefully. No acceleration from hell—well, that was debatable. But no thrust from the hellmaker was not a debatable point. The Cow wasn't likely to be wrong, though her appalling literalness was such that an improperly phrased question might make her seem to be.

Computers, he thought, would eventually be the salvation of the human race, whetting their inventors' brains to higher and higher efforts towards the understanding of communications.

Very carefully now he rephrased his question. "From what, and from what point is the acceleration of Space Lab One originating?"

"From the co-ontinu-ous thrust o-originating at a po-oint thirteen fe-et from the a-axial center of the whe-el, in hu-ub section five no-orth, one hundred twelve degrees fro-om reference ze-ero of the engine-eering longitude references sta-ation assigned in the con-struction ma-anual dealing with relative po-ositions o-of ma-asses lo-ocated o-on Spa-ace La-ab O-one."

Mike glanced up at the tube overhead, which represented the axial passageway down the hub of the wheel. Thirteen feet from the imaginary center of that tube, and in his own engineering compartment.

Then his gaze traveled on around the oddly built, circular room with its thirty-two-foot diameter. The reference to hub section five north meant this compartment. The degrees reference referred to the balancing co-ordinates by which the Cow kept the big wheel statically balanced during rotation. There was a bright stripe of red paint across the floor which indicated zero degrees; and degrees were counted counterclockwise from the north pole of the wheel.

His eyes strayed across the various panels and racks and came to rest in the one hundred twelve degree area. A number of vacant racks, some holding the testing equipment he had moved there not too many hours before—and churkling quietly in its rack near the floor, Ishie's Confusor of Confusion.

Mike contemplated the device with awed respect, then phrased another question for the Cow.

"Exactly how much thrust is being exerted on that point?" he asked.

The computer reeled off a string of numbers so fast that he missed them, and was still going into the far decimal places when Mike said:

"Whoa! Approximate number of pounds, please."

"A-approximately six hundred forty. You-u didn't specify the limits o-of a-accuracy tha-at you-u wanted." The burred tone was still complacent.

"Just what acceleration has that given us?" asked Mike, still looking at the Confusor. "Approximately," he added quickly.

"Present a-acceleration is a-approximately eight point nine five ti-imes te-en to the mi-inus third ce-entimeters per se-econd per se-econd. I ca-an ca-arry that to-o-o several mo-ore de-ecimal pla-aces if you-u wi-ish."

"No, thanks, I think you've told me enough."

Mike stood up.

This, he thought, needs Ishie. And coffee, he told himself as a second thought.

And then as a third thought, he turned back to his secret vocoder panel, and said: "The information you have just given me is to be regarded as top secret and not to be discussed except over this channel and by my direct order. Absolutely nothing that would give any one a clue to the fact that there is a method of acceleration aboard. Understood?"

"Ye-es, Mah-ike."

"O.K."

Mike switched off the vocoder, flipped his intercom to the temporary galley in the morgue, and ordered two breakfasts readied. Then he set off for the morgue.

Mike Blackhawk located Dr. Y. Chi Tung's hammock, and nudged the scientist unceremoniously. The small physicist awoke and attempted to sit up in one gesture; bumped his head on the hammock above, and laid back down just as suddenly.

"Come on down to engineering will you Ishie?" The request was spoken softly.

"Hokey, dokey," said Ishie and crawled out of the narrow aperture with the agility of a monkey.

Gesturing to the other to follow him, Mike led the way to the galley first, where the two picked up the readied breakfast and took them to Mike's quarters.

The "cups" of coffee were squeeze bottles; the trays were soft plastic packages, similar to the boil-in-the-bag containers of frozen food that had been common on Earth for some time.

Mike hesitated at the entrance to his engineering quarters, considering whether to shut the bulkhead, but discarded the idea as being more of an attention-getter than a seal for secrecy. He gestured Ishie to the bunk, and parked himself at his console.

"We're in trouble," he said. "You and I together are responsible for the first space attack on Earth."

He stopped and waited, owl-eyed, but the small physicist simply tackled his breakfast with no further comment than a raised eyebrow.

"We," said Mike solemnly, "wiped out Thule Base last night."

"As Confusion would say, there's no Thule like a dead Thule. What are you getting at Mike? You sound serious."

"You mean you slept through ... you didn't know we ... you didn't hear the ... yes, I guess you slept! Well... ."

Rapidly Mike sketched the events of the past nine hours, bringing his story completely up to date, including the information he'd gleaned from the Cow, but making no reference to his access to the computer's knowledge. Instead, he attributed the conclusions to himself.

The physicist sat so still when he had finished that Mike became seriously concerned. "Thule... ." he began, but Ishie started to speak.

"Mike, it did? It couldn't ... but ... of course, it must have ... the fields ... six hundred forty pounds of thrust! Only six hundred forty, yet ... yes, it could, if the thrust were exactly aligned ... thrust ... Mike, thrust! *Mike, thrust!* Real thrust! Mike do you know what this means?"

His eyes were alight. His voice was reverent. He sprang from the bunk and knelt before the rack that held the churkling Confusor.

"My pretty," he said. "My delicate pretty. What you have done! Mike, we've got a space drive!"

"Ishie. Don't you realize? We wiped out Thule!"

"Thule, schmule—Mike, we've got a space drive!"

Mike grinned to himself. He needn't have worried. Not about Ishie, any how.

But now Ishie was gesturing him over.

"Mike," he said, "you must show me in detail. In exact detail. What did you do? What was your procedure?"

Mike came over and casually reached towards the churkling device, saying "Why, I—" but Ishie reacted with catlike swiftness, blocking the man before he could even touch the rack.

"No, don't touch it! Just *tell* me what you did!"

Carefully now, Mike began outlining in detail his inspection of the device and each step he had taken as he added to its complexities.

When he had finished, the two sat back on their heels thinking. Finally, Mike spoke.

"Ishie, will you please tell me just how does this thing ... this Confusor ... *get* that thrust? Just exactly what is involved here?"

Ishie took his time answering, and when he did his words came slowly. "Ah, yes. Confusor it is. I was attempting to confound Heisenberg's statement; but instead I think between us we have confused the issue.

"Heisenberg said that there was no certainty in our measurement of the exact orbit of an electron. That the instrument used to measure the position of the electron must inevitably move the electron; and the greater the attempt at precise measurements, the greater the error produced by the measurements.

"It was my hope," he went on, "to provide greater accuracy of measurement, by use of statistics over the vast number of electrons in orbit around the hydrogen atoms within the test mass. But this, apparently, will not be.

"Now to see what it is we have done.

"First, let us make a re-expression of the laws of math-physics. You understand that I am feeling my way here, for what we have done and what I thought I was doing are quite different, and I am looking with hindsight now at math-physics from the point of reality of this thrust.

"As I understand it, there's a mutual exclusiveness of particles, generally expressed by the statement that two particles may not occupy the same space at the same time.

"But as I would put it, this means each particle owns its own place. Now, inertia says that each particle not only owns its own place, but owns its own temporal memory of where it's going to be unless something interferes with it.

"Now let me not confuse you with semantics. When I say 'memory' and 'knowing' I am not implying a sentient condition. I am speaking of the type of memory and knowing that is a strain in the structure of the proton or atom. This is ... well, anyhow, not sentient. You will have to translate for yourself.

"So to continue, inertia, the way I would put it, says that each particle not only owns its own place, but owns its own temporal memory of where it is going unless it is interfered with.

"In other words, the particle arriving here, now, got here by remembering in this other sense that it was going from there to there to there with some inherent sort of memory. This memory can't be classified as being in relation to anything but the particle itself. No matter how you move the things around it, as long as the things around it don't exert an influence on the particle, the particle's memory of where it's been and where it's going form a continuous straight line through space and must, therefore, have spatial co-ordinates against which to form a 'memory' pattern of former and future action.

"Now as I understand gravity, it's simply the statement that all particles in space are covetous, in this same non-sentient sense, of the position in space of all their neighboring particles. In other words, it's a contravention or the attempted contravention of the statement that two particles may not be in the same place at the same time. It seems that all particles have an urge to try to be in each other's space. And this desire is modified by the distance that separates them.

"This adds up to three rules:

"1. No two particles may occupy the same space at the same time.

"2. Even though they can't, they try.

"3. They all know where they're going, and where they've been without relation to anything but the spatial co-ordinates around them.

"That third statement seems to me to knock something of a hole in Einstein's relativity theory. Unless you wish to grant all these particles some method of determining their relationship to particles that are not near them.

"Communication between particles by any means is apparently limited by the speed of light, which is a relationship between space and time, but apparently, from what we know of inertia, if the universe contained only a single particle, and that particle was in motion, it would continue to move regardless of the fact that its motion could not be checked upon in relation to other particles.

"This indicates to me that the particle has an existence in space because it is created out of space, and that space must, therefore, have some very real properties of its own regardless of what is or is not in it. The very fact that there is a limiting speed to light and particle motion introduces the concept that space has physical properties.

"In order to have an electromagnetic wave, one must have a medium in which an electric field or a magnetic field may exist. In order to have matter, which I believe to be a form of electromagnetic field in stasis, one must have special properties which make the existence of matter possible. In order to have inertia, one must also have spatial properties which make the existence of inertia possible.

"People are fond of pointing out that there's nothing to get hold of in free space in order to climb the ladder of gravity, or in order to move between the planets, and that the only possibility of motion of a vehicle in space is to throw something away, or, in other words, lose mass in order to gain speed by reaction. Which is simply a statement that as far as we can tell a force can only be exerted relative to two points—or between two points or masses.

"But this does not account for the continuance of motion once started.

"Inertia says a body will move once started, but it doesn't say why or how. How does that particle once started gain the knowledge to continue without some direct control over its spatial framework? That it will continue, we know. That in the presence of a gravitic field or a magnetic field or other attractive force at right angles to its motion, we can create an acceleration which will maintain it in an exactly circular path called an orbit. But how does it remember, as soon as that field ceases to exist, where it was going before it was last influenced? That it will continue in a straight line indefinitely, without such an influence, we know. That it can be influenced over a distance by various field effects, we also know. But what is the mechanism of influence whereby it influences itself to continue in a straight line? And what handle did we get hold of to convert that influence of self to our own advantage in moving this ship?"

Mike stared at Ishie with vast respect.

"I thought you physics boys did it all with math," he said softly, "and here you've outlined the facts of space that an Indian can feel in his bones—and you've done it in good, solid English that makes some sense.

"In other words," Mike was almost talking to himself as he tried to reword Ishie's theorizing into his own type of thinking, "the particle in motion creates a strain in the fabric—the field—of space; and that fabric must attempt to relieve itself of the strain. A particle in motion makes it possible for the fabric of space to smooth itself out behind the particle; and the fabric attempts to smooth itself on through the area occupied by the particle while it is moving, and so the fabric of space smoothing itself is a constant thrust behind the particle's motion, continuing that motion and making the particle scat to where he wasn't going.

"When that same particle is stopped," Mike was visualizing the process to himself, "the force of the attempt to smooth itself out by the fabric of space exists equally around the particle on all sides; so that the particle will be held stopped by the attempt of the fabric to smooth itself until set into motion again by a force greater than that of inertia—for inertia, then, is the attempt of the fabric of space to smooth itself.

"Quite possibly," Mike was speaking very slowly now as he mocked up and watched the forces of this inertia, "matter itself is created out of the fabric of space, and in its creation, in the stasis condition that keeps it existing as a particle rather than dissolving back into the original fabric, it creates the strain in the fabric—in space—that will then seek to smooth itself so long as the particle shall exist.

"Thus this, then, is inertia—the attempt of the fabric of space to smooth itself; to get rid of the strain of the particle that has been created from itself."

Ishie shook his head. "Not quite," he said, "but you're getting close."

Mike shook himself like a dog coming out of water.

"Oh, well," he said. "Anyway, we've got a space drive—flea sized. Now the question before the board becomes, just what are we going to do with it? Turn it over to the captain?"

"Confusion say," said Ishie, "he who has very little is often most generous. But he who has huge fortune is very cautious about dispersing it. Let's first be sure what we've got," he grinned slyly at Mike, "before we become overgenerous with information."

Mike heaved a huge sigh of relief. He had been afraid he would have to argue Ishie into this point of view.

"Speaking of math, Mike, you're no slouch at it yourself, if you figured out all those orbit co-ordinates in your head, and arrived at an exact

figure on the amount of thrust. It would be very nice for our future investigations if we had some method of putting the Cow to work on this." The little physicist sat back, grinned knowingly, and continued: "Where's your secret panel, Mike? We've got to keep this information from going to anybody else."

"Oh, I already—" Mike stopped. "I mean," he floundered, "uh ... how did you know?" A foolish grin spread over his face. "It's right behind you," he said. "And I've got it by voice," he said. "Just push the switch in the corner and talk to it."

Ishie turned, glanced at the panel, and went over to the switch, pushing it. "I wondered how you were concealing the teletype," he said. "You mean you really talk to it?"

The Sacred Cow's voice came back. "Reference not understood. Please explain."

"Oy!" said Ishie. "It even sounds like a cow!"

"Ye-es, si-ir," said the Cow. "A cow is an herbivorous mammal, usually domesticated, and found in most of the countries of Earth. What specific data did you wish? The milk supply—"

"Hold it," Mike said, forestalling a long dissertation on the dairy industry.

Catching on quickly to the literal-mindedness of the placid computer, Ishie fired a direct question.

"What is our current position in relation to the equatorial orbit that we should be following?" he asked.

There was a sput from the speaker, very much as though someone had been caught off guard and almost said something, and then the placid reply came back.

"That information is top secret. Please identify yourself as Mike and I will answer you."

Ishie groaned, depressed the cutoff switch and turned to Mike.

"You fixed it," he said. "If a simple question like that gets an answer like that, how long do you think it will take the captain to find out something's wrong with the Cow?"

Mike lunged for the switch, but Ishie held him back.

"Hold it, Boy. You've made enough electronic mistakes for one day. This takes some thinking over."

"We better think fast," said Mike. "The captain'll ask that question any second now, or a question like it."

"All right," said Ishie. "First we've got to withdraw your original order—and you'd better not trust your own memory as to what it was. You

ask the Cow to tell you what order you gave her making certain information top secret. Then when she tells you exactly what you said, you tell her to cancel *that* order."

Mike did as he was told.

"Why," said Ishie, "did you give such an order in the first place? Never mind answering that question," he added, "but it's lucky she hasn't been refusing to give people the time of day, and referring them to you. As a matter of fact"—glancing up at the clock on the wall—"it looks like she has. That clock hasn't moved since I got here."

Even as he spoke, the clock whirred, jumped forty-five minutes, and settled down to its steady, second-by-second spin.

"Ishie," said Mike, "we figured out a space drive, and that was great. But if we can figure out how to communicate an idea to a computer, we're *real* geniuses."

Ishie turned on the vocoder. "Please supply us," he told the Cow, "with a complete recording of your latest conversation with Mike."

And as the computer started back over the dialogue that has just occurred between herself and Mike, Ishie interrupted. "Not that," he said, "I mean the last previous conversation."

Then he sat back as the Cow unreeled a fifteen minute monologue which repeated both sides of the conversation including the order to make everything top secret.

Having listened through this, Ishie said: "At the point where Mike asks you about acceleration, you will now erase the rest of the conversation and substitute this comment from yourself: 'The lab is being accelerated by an external magneto-ionic effect.' This will be your only explanation of acceleration applied to the ship. Now please repeat your conversation with Mike."

Then he sat back to listen through the recording again.

This time when it came to the part about acceleration, without hesitation, the Cow referred blithely to the external magneto-ionic effect that was causing acceleration.

When Ishie asked the computer: "How could this effect be canceled?" and listened to a long syllogistic outline which, if condensed to a single, understandable sentence meant simply "by reversing the field in respect to the lab with a magnet on board the lab."

Ishie heaved a great sigh of relief, and said, "Now, Mike, we can go to work. For of course," he added, "we must have authority to install our magnetic coils, and what better authority is there than the Cow?"

"Confusion say it is better to have the voice of authority speak with your words than to be the voice of authority.

"Now," he said, "let us see what we have really got here."

As they worked, time progressed. The empty racks around the Confusor slowly filled with more test instruments both borrowed and devised; and the formerly unoccupied corner of the section of panels took on more and more the look of a complete installation, in the center of which the Confusor still churkled quietly, pitting its strength against the mighty monster to which it was so firmly tied.

Two hours were spent in testing circuits, each one exhaustively. Then Ishie turned to Mike.

"We need still yet another test that we have not provided. A strain gauge to find out how much thrust a mosquito puts out. There's one in the physics lab. I'll run get it."

"You will *not*," said Mike. "Genius you may be, but proton-proof you're not. We can rig that right here."

Walking over to the spare parts locker, Mike brought back a complete readout display panel, a spare from one of the Cow's bridge consoles; and quickly connected it in to the data link on which the vocoder operated. Then, carefully instructing the computer as to the required display, he settled back.

"That'll do it," he said. "The Cow can tell us all we need to know right on that panel—about acceleration, lack of it, or change of it that we may cause by changing the parameters of our experiment. Those racks were checked out to stand up under eighty gees," he added. "Typical overspecification. They never said what would happen to the personnel under those conditions."

Ishie turned the Confusor off and then back on, and watched the display gauge rise to the six hundred forty mark, and then show the fraction above it .12128. Then carefully, ever so infinitesimally, he adjusted a knob on the device. The readout sank back towards zero, coming to rest reading 441.3971.

"We'll have to put a vernier control on this phase circuit," Ishie said to himself. "It jumped thirty per-cent, and I scarcely breathed on it."

After a few more checks on the operation of the phase control, he turned to the power control for the magnetic field. Carefully, Ishie lowered the field strength, eye on the readout panel. As the field strength lowered, the reading increased.

The indication was that by lowering the field strength only ten per cent, he had increased the thrust to sixteen hundred pounds—which, he felt, was close to the tolerance of the machine structure.

Carefully he increased the field strength again. Faithfully the reading followed it down the scale.

Then he had another thought. Running the field strength down and the pressure up, and again arriving at sixteen hundred pounds, he turned off the Confusor, waited a few moments, and turned it back on.

The reading remained zero.

Apparently, then a decrease in field strength would cause an increase in thrust; but the original field strength was necessary in order to initiate the thrust field.

Carefully he nudged the field strength back up, and suddenly there were seven hundred ten pounds indicated thrust.

Thrust could apparently be initiated by a field strength a few per cent lower, but not much lower, than the original operating point.

Captain Naylor Andersen arrived on the bridge with an accusing air, but feeling refreshed. He had slept longer than he intended—and though he had asked Bessie to call him when she came back on duty two hours earlier, he had not been called.

"You needed the sleep, captain," she told him unrepentant. "I checked with the Cow. The flare's predicted to continue for another eight hours. We're simply in standby."

However, various observatories on Earth had not been asleep. Within fifteen minutes of the time he reached the bridge, a message from U.N. Headquarters chattered in over the teletype.

"Tracking stations report your orbital discontinuity too great to have been achieved by jet action of nitrogen escaping from Hot Rod. Hot Rod pressures insufficient to achieve your present apparent acceleration. Please explain discrepancy between these reports and your own summation of ten hours previous. Suggest close and continual observation of Project Hot Rod. Suspect, repeat strongly suspect, possibility of sabotage. End message."

Nails Andersen stared at the sheet that the com officer had placed in his hands. Then he pressed the intercom to the morgue.

"Dr. Kimball. Please report to the bridge. Dr. P.E.R. Kimball. Please report to the bridge immediately."

Then he turned to Bessie. "Ask the Cow for an orbit computation from the time of the ... er ... meteor last night."

Under Bessie's practiced, computer-minded fingers, the answer wanted came quickly—a displayed string of figures, each to three decimal places, accompanied by a second display on the captain's console showing the old equatorial orbit across a grid projection of the Earth's surface to a point of departure over the mid-Atlantic where it began curving ever farther north, up across the tip of South America, very slightly off course.

The captain glanced at the display of Hot Rod and its taut-cable, and realized with a sickening sense of unreality that no jet action on Hot Rod could have caused it to lead the station in this northerly direction; and that instead it was placidly trailing behind. It was now farther south of the Space Lab than its original position; but their orbit had been displaced to the north.

Perk appeared beside the console, but the captain ignored the astronomer for a moment longer, while he leaned back thinking.

What could be the answer? A leak in the Space Lab itself? That would give acceleration; minor, not to have triggered an alarm—it should have triggered an alarm—but acceleration. Sufficient for the off-orbit shown? He did a brief calculation in his head. It wouldn't take much. Very little, for the time that had passed—Very well, then. He put down a leak in his mind as a possibility. Now, water or air? It could be either, if his reasoning this far were correct. He looked up.

"Have the Cow display barometric readings for each section of the rim and for each compartment in the central hub," he said briefly to Bessie; and to the astronomer, "Dr. Kimball, take that side seat at the computer console and check our progress on this orbital deviation," and he gestured at the display on his screen.

Perk moved to the post with only a nod.

The barometric displays held constant, with only fractional deviations that might have been imposed by the spin of the big wheel, or error in the instruments themselves. Balanced against temperature readings, they worked out to possible fractions of gain or loss so small as to be insignificant, indicating only the inaccuracies of measurement that inevitably occur in comparing the readings of a number of instruments.

The captain had hardly digested the readings displayed by the computer when Perk looked up with a puzzled frown.

"The computer records a continuous acceleration over the past eleven hours and forty-three minutes," he said, "and attributes it," he looked

even more puzzled, "to a magneto-ionic effect?" There was a definite question in his voice.

"It's only about six hundred forty pounds," he added. "It must be an external effect caused by the flare."

"Please investigate the effect as thoroughly as possible," the captain told Perk, then dictated a message to the com officer.

"To U.N. Headquarters, Earth, from Captain Naylor Andersen, commanding Space Lab One. Original assumption that disaster was attributable to meteoric impact on Project Hot Rod appears mistaken. Investigation indicates we are under acceleration from an external magneto-ionic effect which is exerting about—" he called to Perk. "Did you say six hundred forty pounds?"

The astronomer nodded, and the captain continued, "Which is exerting about six hundred forty pound pressure against this satellite. We are now working out corrective measures and will inform you immediately they are prepared. If your observatories can give us any advice, please message at once. End."

Then the captain depressed his intercom switch to the morgue. "Dr. Chi. Please report to the bridge. Repeat. Dr. Chi Tung. Please report to the bridge at once."

His own intercom hummed, and a voice came on. "Dr. Chi Tung is not in the morgue. He left with Mr. Blackhawk some time ago."

The captain frowned, but pushed the engineering room intercom. "Is Dr. Chi with you, Mr. Blackhawk?" he asked, and when Mike's voice answered, "Yes, sir," he said, "Will you both report to the bridge at once, please?"

When the two arrived, only a little tardily, on the bridge, the captain addressed Ishie.

"You heard of the disaster last night?" The physicist nodded. "We assumed then," the captain told him, "that a meteor had caused the disturbance. That it had gone through the balloon making a hole through which the balloon's nitrogen was escaping, making a jet action and accelerating the ship.

"It seems, however, that we are under acceleration, and that the acceleration is too great to be such jet action, since Hot Rod does not have sufficient pressure.

"The computer reports that the acceleration is derived from an external magneto-ionic effect. Would such an effect be a result of a flare?" he asked.

"I believe it could, captain. I should have to do a bit of math, but... ."

"We will assume, then, that the computer is correct," the captain told him. "Could such an effect have a sufficiently great effect on this ship to give it as much as six hundred forty pounds of thrust?"

"Again, I should have to check the math, captain, but I would assume so."

"Mr. Blackhawk," the captain turned to his engineer, "could such a thrust throw Hot Rod off her communications beam and cause last night's disaster?"

"I guess I'd have to check by math, too, captain... ." Mike appeared to debate the question. "It would be a very small acceleration at first, of course," he said, "from six hundred forty pounds of thrust. But Hot Rod's cable is slack, and the velocity needn't be great to give it quite a jolt when the slack was taken up. Yes, I feel sure that could happen, captain."

The captain relaxed a little, and a half-smile played near the corner of his mouth as he said to Mike, "I believe, then, we may have found the *real* saboteur, Mr. Blackhawk." Then to Ishie. "Doctor, I believe that your field is the one in which the most experience lies towards finding a means for counteracting the effect that is now influencing our orbit. I am putting you in charge of the problem. The pull, according to the computer, is as I said, six hundred forty pounds. Do you think you can work out a method for counteraction?"

"I think ... possibly, yes, captain. Let me say, probably yes."

"Then please do so, and report the method to me. I will then submit it to the other scientists aboard that may have some selective knowledge in the field, and to Earth. You may, of course, call on any of the personnel of the ship for assistance, and possibly Mr. Blackhawk may be of assistance to you. He is familiar with the equipment aboard.

"You probably recognize the urgency of the problem so I shall not attempt to underline that urgency further, other than to say that it is of the utmost importance," he ended.

Five minutes later the two conspirators were back in the engineering quarters, grinning like Cheshire cats, and mentally rolling up their sleeves to go to work. They had, to all intents and purposes, carte blanche to work out the construction of the device they would need for an enlarged Confusor with a real thrust, even though they would have to appear to co-operate with a multitude of other interested parties. Mike and Ishie were both becoming adept students of the mythical Dr. Confusion, and neither doubted their combined ability to handle that part of the problem.

"Now," said Ishie, "Confusion say he who can fly on wings of mosquito fly better on wings of eagle. How much thrust do we want, Mike?"

"What are our limits?" asked the practical engineer.

"Limits, schlimits. We got *power*. Of course," he added, "*we are* limited by the acceptable stress limits on the wheel, and ... yes ... by the stress limits on our plastic, too."

"The wheel was designed to stand upwards of 1.5 gee maximum spin—but that's only radial strength," Mike began figuring. "Don't think anybody ever calculated the stress of pulling the hub loose, endwise. No reason to, you know, and it wasn't expected to land or anything. And really, nobody expected it to stand in service more than a 1.5 gee spin on the rim. They computed these racks to take all kinds of shock, but the overall structure is rather flimsily built." He paused for thought. "We could maybe put a tenth of a gee on the axis, but I better check some of the stress figures against the structural pattern with the Cow first. We'll have to give some thought to strengthening things later, if we really want to go into the fantastic possibility of landing this monster anywhere."

Consulted, the Sacred Cow computed a potential maximum stress-safety at the hub of something over two-tenths of a gee, and the two finally settled on one-tenth as well within the limits.

"Now the other limit," said Ishie. "This little piece of plastic will only stand a pressure approaching the point at which it begins to distort and run out of the field. This stuff is quoted to have a compression-yield strength of one hundred ten pounds to the square inch. We probably shouldn't exceed ... hm-m-m ... ninety pounds. Let's get the Cow to tell us how big a chunk of surface area that represents."

The answer was discouraging. Mike rapidly converted the figure in centimeters to feet, and came up with nearly an eighty-three foot diameter for a circular surface.

"Looks like we'll have to put it out on the spokes," he muttered in disgust, but Ishie shook his head quickly.

"No need, Mike. Later on we'll need a few thrust points out on the rim for good aiming, but we don't have to have all this surface area in one unit or even in one place. Also, we do not need to consider only the surface of an homogeneous piece of plastic material.

"This plastic can be cast. Very easily. In it, we can insert structures that will absorb the strain from many surfaces within, rather than only on a front surface.

"I expect some of the glass thread with which the hull of the ship was made could be inserted with no trouble. Each thread, then, would take up the strain, and a mass of them distributed through the plastic could deliver a greatly increased amount of thrust from a volume of plastic rather than from a surface area."

Mike started to object. "To get an absolutely parallel magnetic field, the gap between the pole faces can't be very wide."

"Perhaps I wasn't considering pole faces," Ishie answered. "Our investigation has already shown that once initiated the thrust-effect works best in a very low magnetic field."

"Such a low, parallel magnetic field would quite probably be found inside of a simple solenoid coil."

"O.K.," Mike answered, "but you have also found that a very high magnetic field is required to initiate the action. How do you get that inside a solenoid without an iron core?"

"As you say, a strong field must *initiate* the action. Let us try another experiment, Mike."

Ishie turned the Confusor off, selected a piece of wire from Mike's supplies, and wound a ten-turn coil over the large magnetic coils of the experimental device.

The leads from this he ran to a pulse-generator that could be accurately adjusted to supply pulses of anything from a tenth microsecond to a tenth second.

Selecting the shortest possible duration, he then set the magnetic field adjustment on the experimental device to a point just below that point on which it had turned on previously.

"Now we see." Turning on the device, he glanced at the display panel which still showed zero thrust. Then he triggered a single one-microsecond pulse into the additional ten turns of winding. The readout display showed zero thrust. He triggered a ten microsecond pulse. Nothing happened. One hundred microseconds. Nothing. One thousand microseconds—the display changed, dropping so quickly into position that the pulse thrust itself was not recorded—but the figure turned up seven hundred thirty pounds thrust on the display panel.

"So," said Ishie, "we can initiate thrust with a one thousand microsecond pulse. Can you design a power supply that would achieve that field for that time in a solenoid having ... say ... one per cent as high a field strength as the one we are using here?"

"O.K.," said Mike. "I get you. Sounds to me like this thing is going to look like a barrel when we get through with it.

"I wish," he added, "that we could get one point one gee. And land this thing on Earth. And have a big parade, with Space Lab One hovering just overhead to the cheers and the blaring bands and the—"

"Confusion say, he who would poke hole in hornets nest had best be prepared with long legs." Ishie grinned. "You don't think anybody would really appreciate our doing that, do you Mike? Outside of the people themselves, that is, that aren't directly concerned with man's *welfare*? We haven't done this in the proper manner of team research and billions spent in experiments and planned predicted achievements made with the proper Madison Avenue bow to the financier that made it possible. You know what they do to wild-haired individualists down there, don't you?"

Mike shrugged. "Oh, well," he said, "you're right of course. But it was a beautiful dream. How do you suppose we can build these and still keep all the scientists aboard and on Earth happy that they're just innocent magneto-ionic effect cancelers? Boy, that was a beauty, Ishie!"

"Best we have two sets of drawings. The ones for us can be sketchy, and need not have too much exactitude of design. We know what we're doing—at least, I hope we do.

"But let us make a second set of drawings that is somewhat different, though of a simpler shape and design, on which other scientists aboard can speculate, and which can be sent to Earth to confuse the confusion."

The two went to work with a will, and as the two sets of drawings emerged, they were indeed different. The set from which they would actually work was only mildly described as sketchy. The papers looked like the notations a man makes for himself to get the figures he will set into a formalized pattern as it takes shape, before throwing his penciled figurings into the wastebasket.

The second set was exact; created with drawing instruments on Mike's drafting board, and each of the component circuits would have created an effect that would have interlocked in the whole, but it would take the most erudite of persons to figure each into its effect, and its effect into the whole, and the effect of the whole was somewhat that somebody might someday figure out—but would possibly cancel a magneto-ionic effect if such existed. The drawings looked extremely impressive.

As the second set of drawings neared completion, Ishie glanced at the clock, then turned to the Cow's vocoder.

"How soon will Space Lab One reach the northernmost point of her present orbit and begin a swing to the south?" he asked.

Mike looked puzzled, but the Cow answered, "In ten minutes, thirty-seven seconds. At precisely 05:27:53 ship time."

"I think," said Ishie, "we'd best put a switch on our magnetic field so that we can reverse the field and the thrust."

"Why?" asked Mike.

"Because," Ishie explained, "when we reach the top of our course northward, then the thrust of the Confusor and Earth's gravity come into conflict, moving our entire orbit off-center and bringing us closer to the pole. In not too many orbits, that eccentricity in our orbit might pull us into the Van Allen belt. We can't afford that. Now, if we reverse the thrust at the right time, our orbit will be enlarged and we stay out of troubled spaces."

Mike was still puzzled. "I don't see how that works," he said. "Why wouldn't we just go off in a spiral on our present thrust?"

"The acceleration of Earth is a much greater influence," Ishie tried to make it clear, "than our little mosquito here. As long as they work together, things go well. But when Earth dictates that we will now swing south, be it ever so few degrees south, our mosquito is overpowered and can only drag us clear to Earth-center on a closing spiral, which would eventually lead us to crash somewhere in the southern hemisphere, a good many orbits from now.

"I hope," he said, "reversing the magnetic field will indeed reverse our little mosquito's thrust." He moved toward the Confusor.

"Hold it," said Mike. "The displacement in orbit won't be very much, at least on the first few go-arounds, will it? and if we switch it now, somebody'll start getting suspicious of this magneto-ionic effect. The effect that's doing all this. A sudden reversal might not be in its character, if it had a character. And anyhow, we don't want to give another jerk on Hot Rod. We might jerk something loose this time. We've already wiped out Thule Base—and there's no use adding scalps to an already full belt."

"O.K.," said Ishie. "Then now, I think it is time that we presented our formal drawings to the captain; and I think that when we present them we will suggest that we start work immediately on construction, even while he is checking out our drawings through his experts, so that the project will not be delayed."

On the bridge, the captain received the drawings with relief.

"Thank you, gentlemen. If these prove out, you may have saved the satellite by the rapidity of your work. Dr. Kimball calculated that our present acceleration will take us dangerously close to the Van Allen belt in about three orbits, and I need not tell you what that would mean."

Ishie spoke up immediately. "In that case, captain, perhaps Mr. Blackhawk and I had better start construction on this device immediately, without waiting for you to complete the check-out. That may save us invaluable time."

"Of course," said the captain. "What assistance will you need?"

"Of the greatest priority," replied Ishie gravely, "is access to the machine shop. The solar flare should be about wearing itself out."

"Oh ... of course. It may be." The captain's face was slightly red as he realized he had not thought to check this point. "Bessie, ask the computer... ."

"Yes, sir," she answered quickly, and returned shortly. "The computer says the radiation count is down to ten M.R. above normal."

"It's a fairly low reading, even if it is above the Cow's normal-safe mark. That reading could go on for hours, which we may not have," commented Ishie. "Perhaps we could disregard so narrow a differential... ."

"In your opinion, doctor," the captain asked, "would it be safe to return the personnel to the rim? Of course, I would have to return the entire ship to normal conditions in order to give the machine shop or any other part of the rim its normal six-foot shielding," he added, "so please consider your answer carefully."

"I think you would be quite safe to do so, captain. Considering the fact that otherwise we may go into the Van Allen belt, I think it should be done without question."

To himself, Mike chortled gleefully. This grave, pedantic physicist was about as unlike the co-conspirator with whom he had worked for the past nearly ten hours as was possible. "The guy's a genius at a lot of things," he thought to himself. "Puts on the social mock-up expected of him like you'd put on a suit of clothes—and takes it off just as completely," he added as an afterthought.

The return to the rim was slower than had been the evacuation—but it was complete within twenty minutes of the decision to return the satellite to normal.

In the machine shop, Paul and Tombu, with Ishie and Mike, were gathering the materials they'd need for the odd construction—Paul singing to himself as he worked.

*"I got in the shuttle, thought it went to the Base;
I'd learned my trade; there I'd take my place
Safely on Earth; but I found me in space—
I'd went where I wasn't going!"*

"What's that song?" asked Ishie of the spaceman.

"Oh, that's just 'The Spaceman's Lament.' You make it up as you go along." His voice grew louder, taking the minor, wailing key at a volume the others could hear.

*"I got on the wheel, thought I'd stay for the ride—
I'd found a funny suit in which to hide—
But I went through a closet—and I was outside!
I'd went where I wasn't going!"*

Tombu and Mike joined happily in the chorus, bawling it out at the top of their lungs as they began the work that would make the big Confusor.

*"Oh ... there's a sky-trail leading from here to there
And another yonder showing—
But when I get to the end of the run
It'll be where I wasn't going!"*

Meanwhile, facsimile copies of the official drawings had been made for the other interested scientists aboard, and also sent by transfax to U.N. headquarters for distribution among Earth's top-level scientists.

They were innocent enough in concept, and sufficiently complex in design to require a great deal of study by these conservative individuals who would never risk a hasty guess as to the consequences of even so simple an action as sneezing at the wrong time.

Major Steve Elbertson awoke with a start, to see a medic's eyes inches from his own. For a moment, fearing himself under physical attack, he struck out convulsively, and then as the face withdrew he sat up slowly.

He was slightly nauseous; very dizzy; and his instincts told him that he needed a gallon of coffee as soon as he could get it. Then the medic's voice penetrated.

"Please, sir, you must rest. No excitement."

Almost, he was persuaded. It would be so easy to relax; to give someone else the responsibility. But the concept of responsibility brought him struggling up again.

Hot Rod was a dangerous weapon. He could not act irresponsibly.

"How long was I out?" he muttered.

The medic glanced at the clock. "Just over nineteen hours, sir."

"Wha-at? You dared to keep me off duty that long? I must report for duty at once."

"Please, sir. No excitement. You must rest. Just a moment and I'll call Dr. Green." With that the medic turned and fled.

As Dr. Green approached, Steve Elbertson was already on his feet, swaying dizzily, white as a sheet, but perhaps the latter was more from anger than from anything else.

"Major Elbertson. You received a severe dose of radiation. You are under my personal supervision and will return to bed at once."

"Is the flare over?" Elbertson asked the question, although already vaguely aware that the ship was again spinning, that he was standing on the floor fairly firmly, and that, therefore, the emergency must be over.

"Yes."

"In that case, sir, my duty is to my post on Hot Rod."

"Hot Rod's out of commission and so are you. I cannot be responsible for the consequences if you do not follow my orders."

"Explain that, please. About Hot Rod, I mean."

"Why, it was struck by a meteor shortly after the flare last night. I think I heard someone say that it burned out Thule Base before they managed to turn it off."

Without waiting for more, Elbertson brushed past the doctor and headed for the bridge.

The captain was startled by the mad-looking, unshaven scarecrow of an officer that approached him, demanding in a near-scream, "What happened? What have you done? What did you DO to Project Hot Rod? No one should have tampered with it without my direct order! Captain, if that mechanism has been ruined, I'll have them nail your hide to the door!"

"Major!" The captain stood. "This may be a civilian post, but you are still an officer and I am your superior. Return to your quarters and clean up. Then report to me properly!"

For a moment there was seething rebellion on Elbertson's already wild features. Then, automatonlike, he turned and walked stiffly away without saluting.

But the stiffness left him as he passed through the door. Momentarily he sagged against a wall for support, far weaker than he thought possible for a man of his youth and what he thought of as his condition. Making his way almost blindly to Security's quarters in rim-section B-5, he staggered through the door and on towards the latrine, shouting at Chauvenseer to "Get out of that sack and give me a detailed report on events since the flare. Oh, and send somebody for coffee—lots of coffee."

On the bridge the captain flipped the intercom to Dr. Green's station. "Is Major Elbertson under the influence of any unusual drugs, doctor?" he asked when he'd reached the medical staff chief. "Anything that might make his behavior erratic?"

"Only sedatives, captain. And, oh yes, those new sulph-hydral anti-radiation shots. We're not too familiar with what they do, though the reports indicate the worst effect is a mild anoxemia, which generally results in something of a headache. Of course, that's if the quantity of the drug was precisely calibrated. They can be fatal," he added as an afterthought.

"Would anoxemia cause a change in character, doctor?"

"It might. It might make one behave either stupidly or irrationally—temporarily or permanently, depending on the severity of the effect."

"Did Major Elbertson seem normal to you when you discharged him from hospital?"

"I did not discharge him, captain. I ordered him to remain under my care. But he seemed greatly upset, and short of force I could not have kept him from leaving."

"I see." The captain paused, then asked: "Doctor, please consider carefully. Would you consider Major Elbertson's condition serious enough to warrant confining him to bed by force?"

"Probably not. He should come out of it in a few hours. Exercise may possibly be good for him, though I doubt if he's capable of much of it." The doctor chuckled as though at a private joke with himself, then

added, "He's really quite weak physically, you know, even without the after effects of radiation and drugs."

"Thank you, doctor."

Back in his quarters, Elbertson was refusing to admit to himself the fact of his own weakness. He had been quite ill in the shower, had managed to slash himself rather badly with the razor while shaving, but was now smartly attired in a clean pair of the regulation coveralls, with the insignia of his rank properly in place—and so weak he could hardly move.

The coffee hadn't helped much.

The briefing had helped even less. The major knew himself guilty of negligence while on duty. Inadvertently, but as though by his very hand, certainly through the agency of some saboteur he had failed to spot, his weapon had been turned on his own troops at Thule, key post in the plan.

It was possible that the entire plan had been sabotaged, though that seemed quite unlikely. Its ramifications were too great. So long as Hot Rod still existed, was still within their reach, the plan was operational.

The nonsense about a magneto-ionic effect he discarded without hesitation. Obviously it was sabotage, possibly by someone with a plan of his own, more probably by someone in the pay of one of the big power companies that would like to see the operation at least postponed. Obviously—he gave up.

Nothing would be obvious until he knew in exact detail what had occurred, what the plans of the enemy would be, where next they would strike—and who was the enemy.

But that last, at least, was almost obvious. Who else, but the man who had carried the political battle, against all odds, that Hot Rod be created? Who else but Captain Naylor Andersen could possibly have delivered this sneaking, underhanded attack against himself and his comrades?

Who else, he thought, but a man so callous as to order *him*, sick as he was, as though he were a mere cadet, to leave the bridge.

Major Elbertson's mind was made up as to the identity of the enemy.

But he would have to proceed with care, or he would key the plan before the time was ripe. There must be no great shake-up in personnel, or undue attention from Earth to the potentials of Project Hot Rod.

Perhaps the saboteur's cover-story of a magneto-ionic effect would serve his ends as well—at least until his comrades on Earth signaled that the time was ripe.

Yet now that Hot Rod had proved its power, the time was ripe. It was that proof on which the plan had waited. And perhaps this very sabotage would prove to be the "incident" on which the plan hinged... .

Even as he fought to clear his normally organized mind of the weariness of his body that now sapped at its strength, the call came.

Chauvenseer appeared at his side, saluting smartly. "Com Officer Clark, sir, reports a message from Earth. *The* message, sir. 'Begin Operation Ripe Peach.'"

Major Elbertson pulled himself to a military stance, returning his aide's salute with complete precision.

Briefly he considered gathering all his men, all the Security personnel, and storming the bridge.

No, obviously the enemy was organized—an unforeseen circumstance. Obviously the captain was not alone. Obviously *his* men included at least some of these slipstick boys—and he would command the loyalty of them all, since he was somewhat of their ilk himself.

No, an officer must seek the most advantageous position from which to deliver his ultimatum.

He must use Hot Rod itself to control them. If Hot Rod itself were actually sabotaged, then the plan must wait until he could have it repaired. He doubted it was hurt.

The flare had thrown off all original sequences—but perhaps that was to his advantage.

To Chauvenseer he snapped: "This is the detail of our immediate operation. Get four of our best men besides yourself. Have each of them come separately and unobtrusively to the south polar lock, where I will meet them. I will bring Smith with me.

"Have each of the others take his assigned post for Operation Ripe Peach—but order them to take no action other than to prevent anyone on board from doing anything unusual that might be an enemy operation—until I alert them that Operation Ripe Peach is operational.

"Their orders will, of course, come on our personal radios, Security Band 2Z21.

"Execute!" he ended, saluting smartly.

As the Security squad moved, with individual secrecy, towards their various posts, Captain Andersen was considering that Elbertson would probably snap out of it as soon as he had had coffee and a shave. The man had probably been severely affected by the drugs he had been

given. He would make no further reference to the incident of erratic behavior, unless it continued.

Bessie, having at the moment nothing else to do, was busily plying the Sacred Cow not only for her own horoscope for the day, but also those of the several persons of whom she was most fond, while carefully keeping a shielding bunch of paper work in a place to make it appear that she was officially busy. The captain's horoscope, she recognized, didn't look much worse than the rest of them, but was definitely the worst. One of those mathematical jumbles that somehow didn't interpret clearly. None of them looked very good today.

Out on the rim, things were getting back to normal. The labs were functioning again, most of them according to their assigned, routine procedures; but in some, heads were drawn together over the absorbing diagrams supplied by Mike and Ishie.

Mike and Ishie themselves had already put in twelve hours almost without a break. Working under stress, neither of them had remembered to eat.

There was a cough at the entrance to the machine shop, and Dr. Millie Williams' soft voice said "May I come in?"

The two looked up as the slender figure of the dark-skinned biologist entered the lab, balancing "trays" with plastic bottles atop.

"If I know you, Dr. Ishie; and you, too, Mike—you haven't eaten," she said with a smile. "Now, have you?"

"Millie," said Mike, "you've just reminded me that I'm as hollow as a deserted bee-stump after the bears get through with it!"

"Little Millie," said Ishie, looking up at the figure nearly as tiny as his own, "you must be telepathic as well as beautiful. Confusion say 'Gee, I'm hungry!'"

"I'm told that the fate of the satellite depends on you two," Millie smiled. "I thought I'd just give our fate a little extra chance. Now drop what you're doing and light into this.

"After that, if you've got a job for a mere biologist, I've got my lab readied up where it can last till I get back and—I'm not bad with a soldering iron. Meantime, why don't you let Paul and Tombu go eat while you eat?"

"Good idea," said Mike. "You two. You heard the lady. We gotta give our fate the benefit of victuals. Scat."

As soon as the physicist and the engineer were settled to the plastic containers of food and coffee she had brought, wolfing them down hungrily, Millie opened up.

"While we're alone, I'm going to speak my piece," she said. "You two will do me the honor of not taking offense if I say that you have the most brains and the least consciences aboard—and I happen to share the latter characteristic."

The two looked up guiltily and waited.

"Now don't stop eating, for I'm not through talking," she said. "That magneto-ionic effect canceler you dreamed up would probably cancel the six hundred forty pound magneto-ionic effect pull you dreamed up—if such a thing existed.

"What I want to know ... don't stop eating until you've decided whether you're going to let me in on your game or not ... is what really does exist? I might be of some help, you know."

"But—" Mike and Ishie simultaneously choked over their food, looked at each other, and then Mike blurted out, "but how could *she* know?"

"Don't worry," said Millie. "I'm probably the only one. It takes a person with little conscience and much imagination—takes a thief to catch a thief, I mean—yes, I think I mean that quite literally. Besides, I can help with some of that glassware that disappeared out of my supplies several days ago. Oh yes, I knew it was gone and where it went—but I figured any purpose you had was a good one, Ishie.

"But for how I personally canceled the idea of your magneto-ionic effect from the flare—it just happens that last night I was curious while everybody was asleep. When Bessie first came on duty this morning, I offered to relieve her while she had a cup of coffee, and I got a half-hour all by myself with the Cow. The captain wasn't up yet. Her console's so simple anyone with a basic knowledge of computers and cybernetics could figure her out.

"Practically the first question I asked—something about our orbit—the Cow told me that the information was top secret, and to get it I must go to the proper channel and identify myself as Mike. I started to intercom you, Mike, to tell you that your machinations were showing, but Bessie came back about then. I hung around to see what would happen, and pretty soon Bessie asked the Cow about the same question—but instead of getting the same answer, the Cow told her that an external magneto-ionic field was pulling us out of line.

"So I went up to your engineering place. I rather thought you'd like to know what the Cow had told me—but Dr. Ishie was there, and so instead I went about my own business until I could figure things out.

"Now I couldn't figure things out. But I could figure there's a monkey wrench somewhere—and since the two of you have been sticking together like Siamese twins, I know it will be perfectly all right to ask you in front of Ishie.

"Now," she finished, "do I get my girlish curiosity satisfied? You don't have to tell me. I'll just keep on being puzzled quietly and without indicating the slightest magneto-ionic dubiousness, if you'd rather. But I might be helpful; and I *would* like to know."

"Confusion say," Ishie declared through the side of his mouth, "that he who inadvertently puts big foot in mouth is apt to get teeth kicked loose. We are very lucky, Mike, that it was Millie who asked the question of the Cow at that time. Besides, we've got to tell somebody sooner or later. We can't just run off by ourselves.

"Yes, Millie, I think you have a job," he said. "Your help here will be appreciated, of course. But what we really need is a way of bridging the gap between ourselves and the rest of the personnel before it gets too wide. How's your P.R. these days?"

"That's something I learned in a hard school, public relations," she answered nonchalantly. "De-segregation was just beginning when I was a girl back in Georgia. But maybe I'd better know what the gap is."

The two began to talk, interrupting each other, incoherently outlining the Confusor and the various forces it exerted, and the—what Mike kept calling the inertial fish hook.

Finally Mike took over. "To put it simply," he said, "our pet didn't do at all what we expected—it hooked in on inertia and it took us off. A confusing little Confusor—but Millie—it's a space drive! A real, honest-to-gosh space drive!"

Millie gulped. It was far, far more than she had expected. Perhaps this was another form of disguise like the magneto-ionic... .

"Are you sure?" Then she answered her own doubts. "Of course you're telling the truth now. That's not something you two would play games about." Then in awe—"You've really got it!"

"But why, then," she said, uncomprehending, "are you hiding it?" But before they could answer, she answered her own question again. "You'd have to. Of course. Otherwise it'll be strangled in red tape. Otherwise nobody'll let you work on it any more, except as head of a research team

stuck off somewhere. Otherwise, Budget Control would take it over and make a fifteen-year project out of it—and the two of you will probably have it in practical operation... ."

She looked at the molds and wiring taking form all across the machine shop.

"Oh, no! You'll have it in operation—soon!"

"Yes, soon—and we hope soon enough." Ishie sighed, then grinned impudently. "There is," he said, "the little matter of the fact that—in all innocence but nevertheless quite actually—we wiped out Thule Base.

"If we don't get the big Confusor in operation very soon, it may be that we shall spend a good deal of time in Earth's courts proving our innocence while someone else botches most thoroughly the job of creating a Confusor that could take us to the stars. And that," he added mournfully, "neither of us would enjoy. We might not even be able to prove our innocence, for there would be many very anxious to prove us sufficiently guilty to keep us out of the way for many years.

"So you see," he said, "you have a very real P.R. problem. Our assistants here could work better if they knew what they were doing. The people aboard the wheel would be most excited by a space drive, and would give us every aid.

"But what the law says, it says—and the captain would have no choice but to put us in irons if he heard, though I think our captain is such that he would not want to do it.

"We must tell everyone what we have, for where the wheel takes us, they will go. But we can't tell them, for if we tell anyone, it will get back to Earth—and we murdered Thule, according to the law of Earth.

"It is a very neat problem," he said.

Major Steve Elbertson arrived first at Project Hot Rod, and trailing behind him on their scuttlebugs, the other six men.

As he slipped through the lock and out of his spacesuit, he reached down the neck of his coveralls and carefully extracted the Security key in its flat, plastiskin packet, from between his shoulder blades. At least the villainous captain had not gotten his hands on this, he thought, and whatever damage had been done to Hot Rod probably could be quickly repaired.

He had heard of the hunt for the key, and been silently amused, though he had volunteered no information to his briefing officer, Chauvenseer.

Stepping forward as briskly as a sick rag doll, he fitted the key into the Security lock and snapped open the bar that prevented Hot Rod's use.

As the others entered, he turned to them. Supporting himself against the edge of the console and managing to look perfectly erect and capable despite his weakness, he said: "I have instructed each of you to learn as much as you could of the operation of this device. It is now necessary that the civilian scientists," he pronounced the "civilian" as though it were a dirty word, "be relieved of their rule over this weapon, and that the military take its proper place, as the masters of the situation. I trust each of you has learned his lessons carefully, because it is now too late for mistakes—although we have with us assistance far superior to that of the civilians.

"Gentlemen," he said, and his voice took on power as he talked, "it is a pleasure to re-introduce to you a companion whom you have known as Lathe Smith.

"This, gentlemen," he said formally, gesturing one of the men forward, "is the Herr Doktor Heinrich Schmidt, of whom you would have heard were you familiar with the more erudite of the developments of space physics.

"Dr. Schmidt," he added, "it is a pleasure to be able to again accord you the courtesies and respect that are your due.

"Now for myself," he continued, "it may surprise you to know that I, too, have a somewhat more advanced rank than you have suspected." Deliberately he unpinned the major's insignia that he wore, and brought out a sealed packet, opened it, and pinned on four stars.

"Gentlemen," he finished, "may I introduce myself? General Steve Elbertson, commanding officer of all space forces of the United Nations Security Forces.

"Now," he said briskly to his astounded men, his voice crackling with authority, "take stations.

"Dr. Schmidt will key in the number one laser bank only. You will select as your target area that area through which the passenger spokes of the wheel pass. These will each in turn be your targets if it becomes necessary to fire.

"Dr. Schmidt has advised me that, should it become necessary to fire on the hub, the resultant explosion of the shielding water will wreck the big wheel.

"If we should miss and hit the rim, the resultant explosion would inevitably wreck both the big wheel and Project Hot Rod.

"Therefore, gentlemen, I caution the most accurate possible aim.

"And Dr. Schmidt, will you connect the storage power supply you have readied, please?"

Quickly then, he slid into the communications officer's seat, as the Security officers assumed each of the four major posts of the project, while Chauvenseer took up a stance at his general's right hand, ready to respond as directed.

On the bridge, Captain Nails had been annoyed. Too many queries from people who really didn't have authority over his satellite. Too many directives and counter-directives were flooding at him from various officials on Earth.

Some one down there even had the temerity to suggest that Security take over—not officially, just sort of take over.

If that didn't take the cake, he thought. Trying to put that crumb Security officer into command, *real* command, of a scientist? Over HIS people? Never!

And just because somebody had a wild idea about sabotage—after all, the whole thing must be some sort of effect or accident. Why couldn't they leave people alone long enough to find out what was really going on?

And where was Elbertson, anyhow? The man had had plenty of time to freshen up. Possibly he had caved in some place. The medic had said he was sick. But even so, I'd best check, he thought.

Reaching for the intercom switch that would give him a private line to Security quarters in the rim, his gaze happened to fall on the panel that still displayed Hot Rod on its taut cable—

—And seven figures riding the end of the cable to the air lock.

Elbertson, of course, he thought furiously. And taking his men out when the proton level was still too high to go beyond the rim shielding...

Then the captain stopped in mid-thought. This was no idle act of a man feeling the effects of drugs.

He switched the intercom quickly to the Hot Rod crew's quarters on the rim. "Dr. Koblensky!" he almost shouted into the mike.

"Just a minute, sir," came the answer, and seconds that seemed like eternities passed before the doctor's calm voice answered, "Dr. Koblensky speaking."

"Did you know that seven men were going out to Hot Rod?"

"Of course not. They mustn't... ."

The captain switched off and changed to the intercom for the machine shop. "Dr. Ishie. Mr. Blackhawk. To the bridge on the double. *Fast*," he said.

It might not be the saboteur, he thought, but the chances looked grimly real that Earth was right—that the whole thing was sabotage, and those were the seven saboteurs. While he waited, he checked the Security quarters for Elbertson. The major was not there, nor was he in the hospital.

Elbertson, he thought. I've been blind.

He decreased the magnification of Hot Rod so that the entire project showed.

Mike arrived first, almost skidding to a stop at the captain's console, Ishie right behind him.

"The saboteur—seven men that I believe to be saboteurs—are aboard Hot Rod," the captain told him crisply. "Can they activate it?"

"Captain, there's no saboteur... ." Mike began, but the captain interrupted.

"Gentlemen, I'm not asking you to be the judge of that. If they are saboteurs, is there any way that they can activate Hot Rod?"

"Oh, they could have storage batteries aboard, I suppose." Mike didn't even pretend to be excited.

"Then we will assume they have, Mr. Blackhawk." The tone of the captain's voice told Mike he'd better darned well believe in those saboteurs or tell the captain the truth—and that quickly. "Now, assuming Hot Rod can be activated, we will also assume that their first aim will be to control the wheel. They would, therefore, aim at the hub and issue an ultimatum."

"They might aim at a target on Earth, and issue an ultimatum to us." Mike would play the game.

"No. We would refuse such an ultimatum. They would aim at us. Can you prevent that?"

Mike thought hard. He'd better come up with an answer to that one, saboteurs or no.

"If they shot through the hub, they'd hit our shielding water and explode the hub-hull. That would wreck the wheel, and they'd need the wheel. The only place they could safely shoot us would be the passenger spokes, and that would take some pretty fine target shooting—with only one laser bank. They could do it though," he said thoughtfully.

"Assume, Mr. Blackhawk, that if they couldn't hit the passenger spokes, they'd be willing to destroy the wheel in order to gain control. Is there any way to prevent that?"

Mike stood completely silent for almost a minute. Then he grinned. "Sure," he said. "If we turned the rim towards Hot Rod, they couldn't fire into the rim without hitting that shielding—and that would create an explosion, even from their smallest possible shot, that would almost inevitably take Hot Rod with it. If we turn the lab so that only the rim is towards Hot Rod, it's suicide to shoot us."

"You will swing the rim of the wheel into that alignment as rapidly as it can possibly be done." The captain's voice practically lifted the two men off the bridge, and they were on their way to the engineering quarters with every appearance of the urgency they should have felt if they had not known who—or rather what—was the real saboteur.

Then Mike heard Ishie's soft voice from behind him, slightly breathless. "At that, you'd better swing the rim and swing her fast, Mike. The captain sure 'nuff believes in his saboteurs, and it's just possible they're real."

O.K., thought Mike, and really moving now he reached the engineering quarters a good ten strides ahead of his companion.

As he entered the open bulkhead lock he saw a man that he recognized as one of the Security personnel, and brushing on past him said, "If you want to see me, come back later. I'm going to be very busy here for a while."

Mike headed for the panel that controlled the air jets and other devices that spun the wheel.

The Security man didn't hesitate. Seeing the ship's engineer about to make important—and possibly subversive—adjustments, he drew his needle gun and aimed it squarely at Mike's back. "Halt—in the name of Security!" he barked.

Slowly Mike swung around, eying the man coldly, and began a question.

But there was no need. Dr. Chi Tung, having seen what was going on through the lock before he entered, had held back just long enough for the Security man to turn fully towards Mike. Now he launched himself through the lock like a small but well-guided missile, and arriving on the Security guard's back, had his gun-arm down and half broken before the man knew what was happening. Had he been alone, it is possible that

the larger man might have won. But Mike had never been fond of people who pulled guns on him, even if they were only sleepy guns.

Between the two of them, the Security guard was lucky not to lose his life in the first two seconds of battle.

The conflict ended almost before it had begun, with a meaty slap of Mike's fist connecting with the man's jaw, right below the ear. It hadn't been a clean punch, Mike thought, but then he wasn't really used to fighting in this gravity. Anyhow, the man was out.

And now came the question of what to do with him, but Mike left that to Ish.

He turned back to the precession panel a bit more convinced that perhaps the captain had been right—perhaps there were enemies aboard.

The precession controls, though operational, had not to date been required. Carefully, Mike switched the sequence that would put them into active condition but not operate. That was left to the Cow.

Turning to the vocoder panel, he directed the Cow to take over control of the now active precession equipment; to use the sun as a referant for the axis of precession, and to move the pole ninety degrees in a clockwise direction around that axis of precession.

Under these directions, the big wheel began to turn, not as it had been turning, but sideways. The operation would take ten minutes, and the axis of this new turn would be aligned directly on Sol by the computer.

The Cow's help in such a maneuver was required, because the precession could only be accomplished by switching valves between the tanks of the rim in such a manner that water was switched north on one side of the wheel, and south on the opposite side of the wheel, and the points of this switching between the tanks must remain in a stable position relative to the spin of the wheel. The valves that accomplished this, seventy-two of them, were spaced at intervals of five degrees around the rim, but only two out of the seventy-two could be active at any time; and these must be selected by the computer's controls so that always the precessive force was properly aligned to produce the required precession.

When the precession was finished, the rim of the wheel would be aligned, still with the sun, but also with Project Hot Rod which had been to their south.

As a third thought, Mike switched off the Confuser.

Having set up the necessary factors, Mike turned back to the problem of the Security guard, or saboteur, whichever he might be, but found this problem had already been well taken care of. Not satisfied with simply tying the man up, Ishie had bound him with wire to somewhat the

resemblance of an Egyptian mummy, and then for added good measure, given him two sleepy shots with his own needle gun; put electrician tape across his mouth; and taken from him everything he could possibly use either as a method of communication or as a weapon.

At least, Mike thought, Ishie is a thorough workman when he sets his mind to it.

Having parked the Security man in a nearby tool locker, with the feeling that he would keep for a while there, Ishie turned back to Mike with a grin.

"Confusion say those who play with firearms should be cautious! Mike, this convinces me. I've heard snatches of what's going on on Earth, and it looks like somebody is putting over a fast one down there. Seems like maybe our own Security boys are part of it. They would be the ones the captain saw going out to Hot Rod. And that means they've got a purpose out there. Is good to know they can't shoot us now, at least in a few minutes now, without getting themselves shot back. But they can shoot at Earth. Any ideas?"

"Well ... I thought some time ago that there was a little fallacy involved in that project when I saw how they hung the beam-director way out in front on those little old balloon-poles. They've got 'em bent, and if any one or two of 'em should happen to get punctured, the other two would move the mirror complete out of the laser beam focus. Then the only thing they could shoot would be the sun—and I don't think it'd care.

"Ishie, you stay here just to keep the home fires burning and make sure that nobody fiddles with anything we don't want 'em to. All of the bulkheads leading into this section can be locked from the inside—a feature I haven't seen fit to point out to other people who really don't need to know."

Walking around the floor, Mike carefully secured the four bulkheads, two leading back to the morgue; two leading forward to the north pole end of the hub. And then, jumping catlike upward and grasping the access ladder to the central axis tube, he carefully bolted that one, too.

Dropping back to the floor he stepped over to the intercom and switched in Captain Nails' circuit.

"Mission accomplished, sir. And you were quite right. One of our *Security* servos is off balance. I'm attending to the matter."

"Thank you, Mr. Blackhawk." The captain's voice was calm, quite unlike the voice he'd used to them on the bridge. "You would do well to

listen for the ... sound ... of those servos." The captain's voice stopped but the intercom continued to hum, alive from his end.

"Ishie," said Mike, "the captain's in trouble, and he's asking us to listen in on what goes on the bridge. He's left his intercom open.

"Now I've got a mission to accomplish; and you can't leave here, because this post's got to be operational. But you can listen and do whatever the captain tells you.

"And, Ishie—if anybody takes the bridge away from the captain, you tell the Cow not to obey any orders or answer any questions unless they come from here."

With that, Mike leaned over, loosened an inspection plate in the floor, and climbed down a ladder through the inspection tube that led through the six feet of normal-shield water directly beneath the floor into the seventeen-foot flare-shielding chamber beyond. This was the tank which surrounded the hub and held all of the waters of the rim during flare conditions; but was now holding only the air supply which, during a flare, was pumped to the rim.

Making his way back towards the center of the hub, Mike considered his luck in being one of the people most familiar with the entire structure of the ship. It would be unlikely that enemies operating aboard would think to cut off the air and water passages, or even keep them under surveillance. Nevertheless, he would be cautious.

He must now get to the machine shop, and enter it without triggering any more of those—he laughed quietly to himself—Security servos.

The particular tank he was in he had selected carefully. Of the twenty-one possible combinations, this one he knew would bring him into the water under the north hall that circled the outer rim.

In a few strides he reached the three-foot-diameter spoke tube through which the flood of water would pour during a draw-in action such as that they had had during the flare; let himself over the side head first, let go and began falling down the seventy-nine foot length of the tube, accelerated by the light pseudo-gravity of the spin. Even so, he spread his legs and arms against the walls of the tube to act as a brake, so as not to arrive with too much impact at the bottom of the tube.

As he hit the water at the bottom, the tube swung around the circumference of the rim to the point at its far side at which it entered its particular river.

The course of his dive carried Mike to the bottom of the curve, and he started crawling up its far side to where the tunnel entered the rim-river. There the motion of the fluorescent-lighted water caught him, and he

was swirled quickly to his target, twenty-five feet along, inspection plate B-36. He grabbed the hand-hold by the plate before he swirled past, loosened the plate, lifted it only enough to be sure that the room was empty, and then pushed it off, pulled himself through, and emerged into the whining dimness of Compressor Room 9, next to the machine shop. The low whine assaulting his ears was that created by the air compressors that fed the jets that drove the waters through the rim.

Stepping over to the wall locker, Mike took out a dry pair of shorts, a T-shirt, and moccasins, kept there for the purpose of making changes after such swimming inspections of the rim tanks.

Before entering the machine shop, Mike spotted the Security man through the open bulkhead—just standing there while Paul and Tombu grimly worked on; and Millie sat idle, watching.

Mike entered the machine shop casually, as though intent on business, brushed past the Security man, and stepped over to the tape-controlled, laser-activated milling machine as though to inspect its progress.

Then, as though finding an error, he halted its operation and swung the laser-head back away from the work piece.

The head swung free in his hand, attached to the machine but nevertheless free. Casually, without even looking at the Security man, he had somehow centered the laser directly on him. Just as casually, he stepped to one side.

"The beam from this machine is quite capable of milling the hardest materials," he said, still casually, as though to himself. "Even a diamond can't withstand it."

Now he looked directly at the Security guard. "It's capable," he said in an even tone, "of milling a hole right through your guts if you even to much as breathe too deep."

Then to Chernov, "Move around behind him, out of range of this beam, and secure the man please. Millie, is there any thing in your department that will make sure he won't talk for while?"

"Yes, Mike, but I don't think I'd better go there right now. There aren't many of them, but these boys seem to be spread out all over."

Chernov had the gun now; and the personal communicator from the Security man as well.

"O.K.," said Mike. "I don't think he can give us much trouble in there," pointing at the air-lock bulkhead through which he had just entered. "We can go in and out through the physics lab," he said. "Best we shut that off now before some more of these boys wander along."

When both the lab and the Security man were under control, Paul Chernov turned to Mike. "That milling-laser," he said. "It's got a focus of about six inches maximum. How did you fix it so it could burn the guard at that distance?"

"I didn't," said Mike briefly. "He already knows that lasers can reach from here to Earth. Why should I bother to tell him any different?" Turning to Tombu he handed him the Security man's radio. "See if you can rig this," he said, "to broadcast everything they say over the general intercom channel. It's about time we let people know what's happening."

It took Tombu only minutes to hook in the radio. As he turned it on, Elbertson's voice came over the loud-speaker system. A roll call of Security men was apparently being completed. The last three men responded as called.

The Elbertson's voice, crisp but somewhat labored, came over the Security beam, booming throughout the ship. "It is obvious that the renegade scientists and engineer of the wheel have replaced the men guarding their sectors.

"As we were informed, the captain had put them in charge. Since they struck the first blow, it is now up to Security to converge on them and eliminate them.

"Jones, Nackolai and Stanziale are detailed to the Dr. Chi mission. Nilson, Bernard and Cossairt are detailed to get the Indian. The rest of you will take over where you are posted, and secure all personnel to their quarters.

"Clark. Drop your cover and take over control of the bridge.

"I expect to have Hot Rod operational within five minutes. And Clark. Instruct the computer to discontinue precession operations that have been initiated.

"Take whatever measures are necessary to carry out these instructions.

"This is no longer an undercover operation, gentlemen. Security is taking control.

"This is war."

As the last sentence came over the loud-speaker, Mike sprang to the intercom. He quickly keyed the direct line to engineering.

"Ishie," he said, "I gather you're safe?"

"Yes, Mike. Situation here very secure. I heard announcement of conflict. You need not tell me to put the Cow under our control. It is done. She will obey no one else until further instructed from here. I didn't

instruct her to obey only instructions by me, Mike, because we are all expendable now."

As he finished speaking, the intercom went dead. Obviously the communications officer, as his first act, had turned off the central intercom power system under his control.

On the bridge, from the time that Mike and Ishie had left, the picture of what was occurring had grown more ominous by the minute.

More than the vague, official messages had been flooding in from Earth.

At the captain's command, the communications officer had opened up a channel for news broadcasts, and put it on the speaker so they could all hear.

The news round-ups indicated that various elements and factions in the world below had had their say—each more vicious than the last.

From an original rumor of a minor space disaster, it had become a tremendous accident that had wiped out Thule Base and left a smoking ruins of Greenland.

From this it had become—possible sabotage.

From this, a direct, unprovoked attack by the scientists on Earth itself.

Suddenly statesmen were standing forth in the U.N., condemning the actions of country after country that had made possible the great wheel; and just as suddenly, word had been announced:

Earth would be protected. The U.N. would act.

The U.N., it suddenly was found, controlled the majority of all weapons on Earth; controlled the majority of all armies, navies, and all stockpiles of ships and planes and ammunition that it had so boastfully told everyone that it had scrapped.

The honeyed phrases of a few years before that there would always be peace on Earth, and that the U.N. had taken the bite out of war, changed; and the individual nations were now forgotten.

Now the U.N. itself was the military power; and now it would be U.N. telling others what to do.

Mobilization would be declared. A war footing for the economy. Everyone must fight back against the insane scientists above with their inhuman weapon.

With appalling swiftness, where apparently nothing had been before, a military force stepped forth in full armor to grind man's hopes for freedom under an iron heel while waving its fist at the stars.

At first there had been voices crying out against this monstrous action, this unbelievable birth, in the U.N. Assembly. But the voices had become fewer and fewer, weaker and weaker, and in a matter of hours had been drowned out.

Amazingly, even now, there were one or two who stood up in an attempt to stem the tide; but they were ignored, and a ninety-eight per cent favorable vote was cast.

The U.N. Security Forces had been granted dictatorial powers.

For the "duration of the emergency."

The die was cast, and the yoke fitted, ever so snugly but firmly, across mankind's back, while he cheered the fitting.

Captain Nails Andersen sat stunned at his console.

The communications officer sat back, paying little attention to the board before him, a light smirk on his face.

But the smirk dropped from his face suddenly. Rising over the background chatter of the radio announcements from U.N. Headquarters, came loudly over the ship general intercom the voice of Major Steve Elbertson, counting down through the list of Security personnel.

He, too, sat stunned until, as the voice ended "This is war," he came to, stood up needle gun in hand, pointed at the captain.

"I don't know how your slipstick boys cracked our code and picked that message up," he said, "and I don't really care. As you heard, the major has ordered me to take command of the bridge. I hereby do so."

Coming through the bulkhead were two more Security men, each with a needle gun. His gun unwaveringly pointed at the captain, Com Officer Clark reached down and flipped the red switch that turned off the power to all of the ship intercoms.

On board Hot Rod, the Security crew was working against an accelerated time-schedule now. The aiming controls of Hot Rod's big mirror were infinitely precise—and correspondingly slow. As soon as the storage power supply had been wired into the big weapon—a precise operation, requiring both skill and time—the factors had been keyed in that would bring the mirror in an arc, turning it to bear precisely on that area of space through which the passenger spokes of the wheel turned; but the motion of the mirror was infinitesimally slow.

As the crew of Hot Rod strove to get it into position to fire; and the computer on the wheel strove to precess the wheel to a position where firing would be fatal to the firer, it became a race between giant snails.

But already the rim of the big wheel had inched slightly ahead in the race; and the main part of the hub was disappearing behind it. In spite of Elbertson's orders, the big wheel continued to turn its rim directly towards the giant balloon with its bulbous nose.

It was a curious sensation, seeing the big wheel from this angle. Much the same sensation as that of an ant, staring at the oncoming wheel of a huge truck.

In the machine shop, Mike was rummaging around in one of the tool lockers. "Any sort of a small telescope," he muttered, almost to himself. Then "Paul, is there a theodolite or anything like that left lying around in here?"

"Yes," said Paul, moving off to a cabinet in another part of the room. "We needed them when we were putting the wheel together."

"O.K." Mike turned back to the laser milling machine. "Now can we take the focusing lens off of this, and rig something to give me a focus at about 4.5 miles? Or would it need focusing at all? Shooting at that distance?"

"Depends on what you shoot, Mike. The unfocused beam can make a black surface very hot very quick. But from a mirror surface, it would just bounce, unless it's carefully focused."

"It ought to take care of the plastic at least, then."

"Go right through it. You gonna laser Hot Rod?"

"No. Just the anchor tubes that hold the mirror; and maybe a slash through the nitrogen tank at the back. Here, make me a bracket to fit these two things together, so I can see what I'm aiming at." He handed the theodolite telescope and the laser milling-head to Paul.

"How much of the machine do I have to take to power that milling-head?" he asked Tombu.

"Oh, most of it's just control circuits. This box on the back is the power supply. Plugs right in to ship's power."

"Hey!" Mike called over to Paul now busy constructing a bracket. "Make that bracket to hold this power supply, too. Oh, and round me up about sixty feet of extension cord, Tombu."

"But, Mike, how are you going to get out there?" Millie's voice was concerned. "They've probably got men all over the place out here on the rim. If you try to go through the corridor towards an emergency lock, they'll have you sure with their needle guns. You heard Elbertson delegate three men to kill you!"

"I expect I can find a place where they aren't." And picking up the Security radio from the intercom bench, he turned it on and spoke into it.

"Elbertson, this is Mike Blackhawk. You now have twenty minutes to surrender," and he cut off.

Mike turned to Tombu. "Get me some plastic wrapping material. Preferably a plastic bag. I've got to make this stuff waterproof."

When the power supply, telescope, milling head and extension cord were rigged and carefully wrapped in plastic to make a waterproof package, he attached them with a shoulder rope.

"Too bad we didn't make a lock in the wall right here," he muttered. "But I don't suppose the Security guards will be guarding those empty labs over in the R-12 sector. Guess I'm going for a swim now." And with that, Mike reached down and carefully removed the inspection plate from one of the floor tanks, and lowered himself over the edge into the racing waters.

Hanging there with one hand, he carefully pulled his plastic bag into position beside and slightly behind his body, and let go. Instantly he was sucked away into the subdued blue fluorescent-lighted glow of the waters of the rim.

"Glad they figured these planktons need light," he thought to himself. "I'd have a time finding where I'm going in the dark."

Forty-five seconds later, he reached up and snatched at a passing hand-hold, next to a plate marked with the numbers of the lab he sought.

Wrenching the handle of the inspection plate and pushing it free, he climbed out into the deserted lab; made his way out into the corridor, his unwieldy package hanging to his shoulder and runlets of water making a trail behind him—and stepped into the nearby emergency lock.

In the lock he quickly donned one of the emergency spacesuits that hung there, gathered up his bundle again, and stepped out on the catwalk of the inner part of the rim, under the brilliant night sky at the moment, but turning towards its "sunrise." He opened his plastic package.

"Major Elbertson," he said, turning on the Security radio, "you now have five minutes to surrender."

Attaching his suit to the guideline nearby, part of the rim's "hairnet," he crept out over the inside edge of the rim. From this position he had a full view of the glowing bubble that was Hot Rod for the few seconds until the movement of the rim took him past the "sunrise" point and turned him sunwards.

Last time Mike had been out on the rim, the wheel had not been turning. There'd been no reference of up and down, other than the rim itself

as an oddly curved floor. Now he felt disoriented. The wheel was spinning, the hub, therefore, seemed "up." And from the edge of the rim where he clung to its hairnet, all directions were down.

The stars seemed to sweep beneath his feet and over his head; and though it was a slow pattern, only twice as fast as the crawl of a second hand around the face of a clock, it was, nevertheless, disorienting.

Bracing himself carefully into the net, with his back wedged firmly against the rim, he adjusted his bizarre "gun" to rest on his knees so that he could sight in the direction that was, to his body's senses, straight down.

Not at all, he thought, like trying to shoot fish in a barrel. More like being the fish and trying to shoot the people outside the barrel.

Back in the shadow again. Not really shadow where he sat, but the rim around him, below him, and curving away from him, had disappeared in its brief night-side, and there came Hot Rod again. Carefully he tracked it; then putting his eye to the scope he focused briefly on one of the high-pressure supporting tubes that formed the rigid structure from which the aiming mirror was held in place.

And fired.

The tube burst, noiselessly but quite spectacularly. And the mirror itself shuddered shook, as the tube's gases escaped.

Now he was in bright sunlight again, quickly closing his eyes as the sun itself looked full into his vision, and slowly passed to be following by Earth, to be followed by a blank stretch of starry space, and here again was Hot Rod.

Carefully he tracked another of the supporting tubes.

And fired.

And again a spectacular, writhing collapse—and this time, the mirror fell free, supported by only two tubes, and permanently out of focus, incapable of aiming the monster beam.

This time, Hot Rod was definitely secure from the misapplication of Security.

"Three minutes," he spoke into the radio. "Your weapon is dead. My next shot will be through the nitrogen tank at your air-lock. I wouldn't advise you to be there."

The wheel turned once more, as the radio came alive from the other end.

"Mr. Blackhawk, do you realize that what you are doing constitutes mutiny in space and will be dealt with accordingly on Earth? I have

officially taken control of Hot Rod at the command of my superiors in the new U.N. Security Control Command."

Mike didn't bother to answer. As the wheel turned him towards Hot Rod again, he said into the radio, "Two minutes."

Elbertson's voice came again. "With this new weapon we control Earth. Don't you realize that you can't stand up against the new people's government of Earth?"

The wheel came around. Mike replied: "One minute."

The lock on the Hot Rod control room opened. Frantic tiny figures burst forth, activated scuttlebugs, and started on the five-mile trek back towards the big wheel.

Mike worked his way back through the clinging net to the catwalk, failing completely to see the tiny figure that dodged beneath the rim as he approached.

Glancing around he carefully scanned over the entire inner rim before stepping out into the sunlight of the catwalk itself. Nothing.

Then a blink caught his eye, and he glanced up toward the observatory. There. In the observatory.

He thought for a minute it was someone signaling, but it was only a touch of sunlight on the shiny surface of the automatic tracking telescope, which was poked out of the open shutters of the airless observatory, still doing its automatic job of recording solar phenomena in the absence of the astronomers.

Instead of re-entering the lock as he had intended, Mike linked his safety line to one of the service lines that lay along the nearest spoke, and kicked up it.

On Earth, he could have jumped maybe four feet with that motion. But here, it carried him the full distance to the outer wall of the hub-shielding tank, where he grasped another line, quickly transferred his safety line, and began working his way toward the observatory.

As the intersection of the rim where Mike had been passed into darkness, another figure moved and jumped up the same line he had taken. But this Mike did not notice.

Reaching the bulge at the end of the shielding tank and crawling up over it, Mike made his way up, at an odd reversed angle, through the netting; and into the observatory dome through its open shutter.

Making his way about in the open vacuum in free-fall conditions of the observatory, Mike carefully checked the lock at the main axis to make

sure that he could get into it without arousing an alarm for any guards that might be nearby.

The lock showed vacant, and empty. Just as he was about to enter it, he saw another figure in a spacesuit come drifting through the open shutter where he had entered.

Mike stepped into the lock, closed the door behind him as though he had not noticed, and cycled the lock. But he did not remove his suit and did not leave.

As the lock showed clear, the observatory door opened again, and the two spacesuited figures stood face to face. Mike with needle gun raised checked himself in surprise. Then he motioned the other figure into the lock.

"And just what are you doing here?" he inquired as the air around them became sufficient to carry his voice.

"You might have needed help," answered Dr. Millie Williams in a small, scared voice as she took off her helmet and shook out her long hair.

"And just *what*," Mike inquired, "were you planning to do about it besides having me shoot you by mistake?"

Millie held up an oversize pair of calipers. "The Security people," she said, "are not the only ones with weapons. I borrowed this from the machine shop."

Mike stared down at the odd-looking "weapon."

"It's hard," Millie continued, "to look at more than one thing at a time through a spacesuit helmet. I could've got 'em in the air hose while you held their attention."

Mike's chuckle was just a trifle ragged, and his mutter about blood-thirsty panthers didn't really go unheard as he began shucking his spacesuit.

This was the most dangerous point, Mike knew. The axis tube went from the observatory straight through to the south polar lock, with nothing to block sight or sound from traveling its length. They'd have to simply chance it. The spacesuits shucked, he opened the lock.

Their luck held. No Security man was stationed opposite the mouth of the axis tube at the south polar lock.

Halfway to the engineering quarters, Mike stopped, used a special key to open an inspection plate, and they dropped lightly into the huge shielding tank that now held only air. From there the pair back-tracked Mike's original path to the inspection plate in the engineering quarters,

and so into his own bailiwick, where they found Ishie standing on catlike guard, a wrench in one hand, waiting for whatever might come up.

"Confusion say," the grinning Chinese physicist declared, "two for one is good luck."

General Steve Elbertson made his way wearily in through the south lock and on to the bridge where he found the communications officer in complete charge with two Security men for assistants. The captain and Bessie were effectively bound, and placed in spare console seats.

General Elbertson made his way to the captain's console and seated himself.

Hot Rod was dead, but their control was by no means lessened.

That he himself had not been shot dead on the way from Hot Rod was, to him, a confirmation of the weakness of his enemies.

The satellite was under his control. The scientists would repair Hot Rod—and well he knew how to see to it that they did so.

U.N. Security Forces were in complete, dictatorial command of Earth.

He had only to eliminate the renegade Indian, and long before the Security scuttlebug, now on its way from Earth loaded with crack troops, should arrive, Security would be in complete command not only of the Space Lab, but of the weapon, which would by then be in repair.

As a final test of its operation, it would be amusing to use the Indian, Blackhawk, as a target; and perhaps the captain as well, though he might have to use them as examples sooner—the captain and some others.

The fortuitous accident that had put Hot Rod in operation ahead of schedule had also stepped many plans months ahead. No violence had actually been planned until the weapon had been thoroughly tested; but now things looked to be working in orderly fashion; working with the well-oiled precision of a master-plan, properly designed and properly executed in the proper military manner.

Only one small difficulty marred the current smoothness of the operation. The Security men were attempting to instruct the computer to precess the wheel back to its original position.

In reply, for every figure of any type sent over the keyboard, the Cow sent back a half-yard of confused, rambling figures and would do nothing else.

General Elbertson snapped a single command. "Turn the thing off. We'll get to that later."

Busily the men switched the keys to the "off" position. Just as busily the Cow continued to pour out figures, interspersed with rambling pages

of physics covering such odd subjects as the yak population of the Andes, the number of buffalo that were purported to be able to dance on the rim of the Grand Canyon—a fantastic figure—some confused statement about the birth rate in Indo-China, and an equally confused statement about the learning rate in schools in Haddock.

Eventually, if one cared to sort it out, the Cow might produce the entire Encyclopedia Britannica for the year 1911; and then again, possibly for the year 33,310. Actually, it only depended on what you wished to select. It was a vast mass of material that was being happily upchucked into the lap of the confused communications officer and his two, unhelpful assistants.

Not a single one of the view panels, either those at the computer's console or the ones at the captain's console, were presenting a readable picture. Hodgepodes and flickerings, yes. Scraps of star-lit sky—perhaps. Or vaguely wavy electronic patterns that would have been familiar to anyone who ever looked at a broken TV set.

The Cow was really wild.

Leaning back in the captain's chair, watching the screen casually, General Elbertson chuckled.

He didn't, he noticed, feel nearly so weary.

The position actually was good, even if those idiots didn't know what they were doing with the computer. That could be straightened out.

Somewhere, he was sure, there was cause for great pride in his actions.

The peaceful glow of victory seemed to settle about him.

He HAD won. He was in the captain's chair of the only space station that man had ever put in orbit.

His worst enemy was tied to a chair only a few feet away.

At times like this a man could glow, could feel expansive even towards his enemies.

Naylor wasn't such a bad chap. If he hadn't thrown in with the scientists he might even now be a fellow officer, entitled to full respect and honor.

General Elbertson did not consider it odd that his face was suddenly flushed with triumph. There was a glow of energy. Why, he could even get up and dance a jig—and this he proceeded to do.

Around him, the two Security men joined in, followed by the communications officer—and then, realizing that their friends couldn't dance with them, they undid the ropes and invited the captain and Bessie to join them.

Soon they were all whirling giddily, though there was hardly the space for it. Maybe they should go next door, into the large clear area that was the ship's gymnasium when not being used as a morgue.

Surprisingly, amidst these dancing figures, a head emerged from the floor. All of them leaned over to laugh at it; and even the needle gun failed to frighten them.

Bessie had a hangover. She groaned and stretched. There certainly must have been lots of vodka at that party last night.

Party? What party?

It was difficult to separate various concepts and orient herself to a present where and when.

Slowly the soft susurrus background song of the big wheel penetrated consciousness, and another, closer roar. Millie taking a shower, she realized.

Suddenly she came out of the vagueness wide awake, the hangover cleared magically, evaporating much too quickly to have been caused by alcohol.

But she had been tied up to a chair on the bridge beside Nails, prisoner of the Security men, only minutes ago.

WHAT was going on?

Millie stepped out of the shower into the compartment the two girls occupied, and smiled.

"How're you doing? About to come out of it?"

"Da, Da eta—" with an effort Bessie switched to English. "Explosion? What happened?"

"Oh, Mike just had to get the Security men off guard. Something to do with the air supply. He asked me to apologize to you if you don't feel so good. But after all, we got the Lab back and that's the main thing."

"Security. Oh! I've got to get to Nails right away. They've taken over Earth, too, you know. We've got to make sure they don't get control of the projects. We'll be shot of course. But their ambitions rest on having control of Hot Rod and the wheel. Probably secret control—"

"But—"

"Nails has got to figure out how to destroy the project without too many casualties. Maybe he can get some of our men back to Earth, though of course we're all expendable. We can't let these monsters have the wheel and Hot Rod! That's what they need for power—"

"Bessie—"

"Of course, we can stand and fight for as long as possible, but we're sitting ducks, and even with Hot Rod there's not much we can do—we can't fire on Earth, we'd hit friend as well as enemy. So I think we've just got to stand and fight a bit, and then destroy both Hot Rod and the wheel. Anyhow, that's Nails' decision, and I've got to get to Nails—"

"Whoa!" Millie finally managed to stem the flow. "We're not stuck—not just stuck here in orbit any longer, waiting to see what's going on on Earth," she said softly, "or what they're going to do about us 'mad scientists.' Mike and Ishie started this whole thing when one of their experiments turned out to be a space drive, and the boys are working real hard on getting a drive unit set up capable of taking our whole complex out into space. But they need somebody to tell the captain ... uh ... properly ... as soon as he's awake that is ... uh ... you know what I mean."

"Whoa, yourself, girl. What's this—space drive?"

"Well, they didn't find out themselves until after it had wiped out Thule Base—nearly ten hours after that, in fact. That magneto-ionic thing the Sacred Cow's been talking about—they invented that real quick to cover up. You see ... oh, it's too complicated.

"Look, we've got a real *space* drive. We can go to the moon or Mars—or Pluto if we want to. And we've got to let Nails know real quick that he can get us out of here—and without making him mad that we wrecked Thule Base. But really, after the way those Security goons acted, maybe he won't be mad if you handle it right. How about it?"

The hangover was disappearing magically. But this flow of information was nearly as bad.

A space drive? Bessie knew she couldn't evaluate one way or the other on that. That would be Nails' problem.

But they were in a pickle, and it would be up to her to see that Nails didn't waste too much time evaluating things. Those Security men had been prepared to play real rough, and more of them were on their way up.

"Where is Nails?"

"The boys put him to bed. In his quarters. He got a dose of the same stuff that put you out. He ought to be coming to almost any time now. And probably mad about the whole thing."

Instantly, Bessie was on her feet, flinging on clothes, and out down the corridor toward Nails' private stateroom.

It had been thirty-two hours since Major—General—whatever it was Elbertson—had been defeated on the bridge for the final time.

He and his men were now securely locked in one of the empty labs. The paralysis effect of the needle gun had probably worn off. Mike hadn't checked to find out.

Bessie and her relief operators were watching the prisoners through a video display on the Sacred Cow's console, and would report anything unusual that went on to Captain Andersen.

Mike, Ishie, Millie, Paul and Tombu had completed the new Confusor drive units, and they were nearly installed.

More time would be taken arranging the engineering quarters so that the installation of her control panel and the units themselves would be completed.

This part, Mike didn't like too well. It meant re-arranging his already carefully arranged units, and considerable re-wiring without interfering with any of the basic functions of the wheel.

The new units had turned out to look very little like the original. Fourteen feet long by eighteen inches outside diameter, they looked very much like a group of stove-pipes arranged in a circular pattern around the engineering quarters, braced from wall to wall.

The control console itself, even though made rapidly, had the look of a carefully planned and well-made unit; something that might have turned up in one of Earth's better R&D labs, as part of a multi-million dollar project.

All together, the drive rods would provide something better than a tenth of a gee thrust for the combined mass of the wheel, Hot Rod, the pile and the other subsidiary units around them.

A tenth of a gee. Not enough to land on Earth; but with things down there the way they were now, who wanted to?

With these units, the whole storehouse of the solar system was at their disposal.

With these units they could reach the asteroids.

With these units, they could range as far out as Pluto without fear of consequences—without, Mike added to himself, even the fear of radiation that was a constant threat to them here, for the farther from the sun they went, the less radiation they would have to endure. The three months would be extended. For those who needed it, better shielding could be found.

The system was theirs.

Possibly, also the stars beyond.

That, he reminded himself, if they could get these units installed before the scuttlebug arrived.

Undoubtedly, Earth Security had sent arms as well as men.

Where they were, not strictly on course, but still in a satellite-type orbit, they remained sitting ducks for any number of countermeasures that Earth might throw against them.

Once gone from this orbit, there was not sufficient rocket-power on Earth to track them down.

If they took Hot Rod with them, there was no single weapon at man's command that could stop them. And take Hot Rod with them they would.

In his address to the ship's personnel this morning, Captain Nails had made it quite clear that they wanted no part of the plots and counterplots of Earth; that theirs was the job of scientists, not soldiers; that a path was open to them that they would follow.

Later, they could return. Later, with the supplies that were free to be taken from space, they could build strength.

They could return quietly, one by one, two by two, at times and places of their own choosing.

Then, and only then, they could lend aid to those on Earth who would always fight for freedom.

But not now.

They were yet weak; the path of escape and the path of promise lay before them.

The only help they could be would be to follow that path.

It might not be that the path led where they wanted to go—or where they thought they were going—but nevertheless the path was there, and follow it they must.

Quite a speech, Mike thought. There had been much more, but that, and the Declaration of the Freedom of Space, were the parts that had stayed with him.

That last they had broadcast back to Earth, thrown, as it were, into the screaming teeth of the new dictatorial leaders.

Mike leaned back from what he was doing and caught Ishie's eye.

He chuckled, and said "That was quite a mass of stuff that the Cow upchucked on your command. Why didn't you just freeze her like I thought you were going to do?"

"Confusion say," quoth Ishie blandly, "he who would play poker with dishonest men should never put all cards on table too soon. Or in other

words, Confusion is the better part of valor. The garbage made them think that the Cow had sprung a cog somewhere, without ever guessing that we had control.

"And by the way, Mike, that was quite a trick you pulled with the air supply. Having the Cow boost up the oxygen on the bridge until those idiots got so drunk they were climbing the walls."

"You don't happen to have any education as a psychologist, do you Ishie? Or perhaps a brain surgeon?" Mike inquired. "It seems a shame to drag those Security apes along with us. We can't just dump them overboard, but it would be nice if we could just confuse them or something."

"Sorry, Mike. Techniques of brainwashing are a bit out of my line. Beside, Confusion say those who run from wolf pack have better chance if they leave some meat behind for the wolves to fight over. I've already spoken to Captain Nails about it. We *intend* to dump them overboard—just twenty minutes before the scuttlebug arrives. In suits, of course," he added. "Then we'll take off and see whether Security takes care of its own."

There was a possibility, Mike felt grimly, that perhaps Security wouldn't take care of its own. But then, he asked himself, did he really care? And found it very difficult to come up with an answer. But he realized with vast respect that the master of Confusion was not himself confused as to the issues involved before them.

"It's lucky for us," Mike said, "that you happened to pick this time to be aboard. Your work would have gone more smoothly if you'd waited until the next go-round."

Ishie grinned, for once slightly embarrassed. "Confusion say," he said, "luck is for those who make it. I expected that with Hot Rod coming into operation, some such play would be attempted. I've met Security before."

Millie laid down her soldering iron, and disappeared through the bulkhead, returning shortly with a tray of sandwiches and coffee.

Coffee in real cups, for there was spin on the satellite, things were working well, and those bottles—ugh.

"Relax, boys, we've still got three hours," she told them. "Radar hasn't spotted the scuttlebug yet. But our new communications officer, Lal, has them on the line. He's apparently convinced them of his honorable intentions and gotten an exact prediction of arrival time. They think Major ... uh, General Elbertson has the situation well in hand. They even think Hot Rod's operational!"

The crew relaxed around the circular room, squatting wherever convenient, and sipping luxuriously at the cups of coffee, munching sandwiches, and for the moment content.

Hot Rod had been secured to the ship with extra acceleration cables, and as soon as practicable a remote-controlled Confusor would be placed aboard to assist in any fast maneuvers that they might have to make; but for now there was no acceleration, and the group composed of the wheel, the big laser, the dump and the pile moved peacefully in orbit under free-fall conditions.

Millie began to hum a soft tune. Someone else brought forth a harmonica that had been smuggled aboard, and suddenly Paul Chernov burst into song, his deep baritone, perhaps inspired by the captain's speech earlier in the day, lending the wailing "The Spaceman's Lament," an extra folk beat:

*"The captain spoke of stars and bars
Of far-off places like maybe Mars
But the slipsticks slip on this ship of ours—
And we'll get where I wasn't going!"*

Mike looked over at Millie as she drank her coffee, a slender, dark figure—able with a soldering iron; able as a defending panther; able as a spaceman's mate. He was glad the captain of the ship was a proper marrying officer, for he had an idea the feeling he felt was mutual, as he joined with the crew in the chorus:

*"There's a sky-trail leading from here to there
And another yonder showing—
But when we get to the end of the run
It'll be where I wasn't going... ."*

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